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MODELLING THE IMPACT OF FOOD SAFETY INFORMATION ON MEAT DEMAND IN SPAIN

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I dedicate this thesis to my mother

and the memory of my father

for their love, patience and sacrifice that

makes me what I am today

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Resumen

La enorme difusión de los escándalos alimenticios en los medios de comunicación ha aumentado notablemente la preocupación de los consumidores sobre los aspectos relacionados con la seguridad alimentaria en todo el mundo. En España, la denominada crisis de las “vacas locas” generó una reducción significativa del consumo de carne de vacuno, lo que indica que la renta y los precios han dejado de ser los únicos determinantes de la demanda de carne y que otros aspectos, como la seguridad alimentaria, están jugando un papel cada vez más relevante. El objetivo de esta tesis consiste en evaluar la reacción de los consumidores ante la creciente publicación en los medios de comunuicación de información sobre aspectos relacionados con la seguridad alimentaria. En concreto, este trabajo se ha centrado en el efecto de la información publicada sobre la Encefalopatía Espongiforme Bovina sobre la demanda de carne y pescado en España. Un mejor conocimiento sobre la reacción de los consumidores ante este tipo de información puede ser de gran utilidad tanto para los decisores políticos como para los agentes que trabajan en el sector cárnico.

Para alcanzar este objetivo, partimos de la especificación de un modelo teórico que incorpora la información relativa a la seguridad alimentaria en la función de utilidad del consumidor, a partir del cual se obtienen las correspondientes ecuaciones de demanda. Dos formas funcionales alternativas se han considerado para dichas funciones: el Sistema Casi Ideal de Demanda (AIDS) y el Sistema Casi Ideal de Demanda Generalizado (GAIDS). Este último permite eliminar unos de los inconvenientes del primero cuando se incorporan variables que desplazan las curvas de demanda. La información sobre seguridad alimentaria se ha medido a través de un índice construido a partir de los artículos publicados sobre el mal de las “vacas locas” en el principal diario español (El País).

Los resultados obtenidos sugieren lo siguiente. En primer lugar, y consistente con la literatura existente, en el caso de España el pescado fresco debe considerarse como parte integrante del sistema formados por las carnes frescas. En segundo lugar, los hábitos juegan un papel relevante, de ahí que se han especificado modelos de demanda dinámicos, así como el componente estacional. En tercer lugar, las elasticidades obtenidas a partir de los modelos AIDS y GAIDS difieren entre sí. En el caso de considerar el índice de información, los resultados obtenidos a partir del modelo GAIDS son más coherentes con lo previsto, teniendo en cuenta el patrón de consumo de las distintas carnes en España. Sin embargo cuando no incluimos el índice de información, el modelo AIDS genera mejores resultados. En este caso, al no introducir ninguna variable que desplace la función de demanda, los parámetros estimados son invariantes respecto a las unidades de medida de las variables explicativas y el modelo GAIDS carece de sentido. Desde el punto de vista económico, la información sobre la EEB tiene un efecto significativo sobre la demanda de carne y pescado en España. Tal como se esperaba, el efecto es negativo en el caso de la carne afectada por el escándalo (vacuno) y positivo en el resto de carnes, especialmente en el caso de la carne de cordero, su principal sustitutivo.

Abstract

The amplification of food scares by mass media has increased consumers' concerns about food safety worldwide. In Spain, the BSE crisis provoked a significant reduction in beef consumption indicating that food safety concerns may have a potentially impact on meat consumers' preferences in addition to the traditional economic factors of income level and prices. The objective of this thesis has been to assess consumers' reactions to food safety information provided by mass media. Specifically, this thesis has focused on the effect of BSE information on the demand for fresh meat and fish in Spain. A better understanding of the consumers' responses to such type of information could be important to both policy analysts and the meat industry.

To achieve the above mentioned objective, we start by specifying the theoretical model incorporating the food safety information in the consumer's 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 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".

Obtained results suggest a number of points. First and consistent with previous literature, fresh fish should be incorporated in a meat demand system. Second, dynamic models have to be specified in order to overcome misspecification problems. 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. In our case, results obtained from the GAIDS model are more consistent, in the case of introducing the food safety information index, with expectations taking into account the evolution of meat consumption in Spain during the last decade. However, when only seasonal or other types of dummy variables are considered the estimated parameters of the AIDS are invariant with the units of measurement of the explanatory variables and, in this case, the AIDS system performs relatively well. From an economic point of view, information on BSE 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 by the food scare (beef), while the effect is positive in other cases, mainly for lamb, the principal substitute of beef meat in term of prices.

Résumé

La grande diffusion des crises alimentaires par les Mass-médias a augmenté la préoccupation des consommateurs pour la sécurité alimentaire dans le monde entier. En Espagne, la crise de « la vache folle » a provoqué une réduction significative de la consommation de la viande bovine en indiquant que le revenu et les prix ont cessé d'être les seuls déterminants de la demande du viande et que autres aspects, comme la sécurité alimentaire, jouent un rôle de plus en plus important. L'objectif de cette thèse est d'évaluer les réactions des consommateurs aux informations fournies par les Mass-médias sur la sécurité alimentaire. En particulier, dans ce travail on s'intéresse á étudier l'effet de l'information publié sur l'Encéphalopathie Spongiforme Bovine « ESB » sur la demande de la viandes fraîches et de poissons en Espagne. Une meilleure compréhension des réactions des consommateurs face à ce type d'informations pourrait être important, à la fois, pour les décideurs politiques et les agents travaillant dans ce secteur.

Pour atteindre l'objectif décrit ci-dessus, on commence par la spécification d'un modèle théorique qui intègre l'information sur la sécurité alimentaire dans la fonction d'utilité du consommateur, a partir du quelle sont obtenus les équations de la demande. Deux formes fonctionnelles ont été considérées, le Système Quasi Idéal de la Demande AIDS et le Système Quasi Idéal de la Demande Généralisé (GAIDS), ce dernier nous permet de surmonter le problème généré par le premier quand à l'intégration de variables qui déplacent la courbe de demande. L'effet de l'information est mesuré par un indice construit à partir des articles publiés sur la maladie de « la vache folle » dans le principal quotidien espagnol "El País".

Les résultats obtenus suggèrent un certain nombre de conclusions. En premier lieu, conformément avec la littérature, le poisson frais doit être considéré comme une partie intégrante du système de demande de la viande fraiche. En deuxième lieu, les modèles dynamiques doivent être spécifiées en vue de surmonter les problèmes de mal spécification. En outre, le caractère saisonnier doit être pris en compte ainsi que l'indice d'information l'ESB. Troisièmement, les résultats des modèles AIDS et GAIDS sont un peu différents. Dans notre cas, les résultats du modèle GAIDS sont plus cohérents, en tenant compte l'évolution de la consommation des différents types de viande en Espagne au cours de la dernière décennie. Toutefois, lorsqu'on introduit seulement des variables saisonnières ou autres types de variables dummy les paramètres estimés par AIDS sont invariants avec les unités de mesure des variables explicatives et, dans ce cas, le modèle AIDS fonctionne relativement bien. D'un point de vue économique, l'information sur l'ESB exerce un effet important sur la demande de la viande fraîche et du poisson. Comme prévu, l'effet est négatif dans le cas de la viande touchés par la crise alimentaire (viande bovine), alors que l'effet est positif dans d'autres cas, principalement pour l'agneau, le principal substitut de la viande de bœuf en termes de prix.

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Chapter 1:
Introduction

In this chapter the motivation and objectives of this study will be discussed; then a brief review of the related literature and the previous work will be presented.

1.1. Motivation and objectives

During the last two decades, both the supply and the demand of food have experienced important changes. Many of them have been positive and have allowed expanding the buyer's possibilities of election, but also they have generated uncertainties with respect to the consequences, among others, on the health and/or the environment.

On the supply side, technological changes have been enormous allowing to the development and the massive diffusion of a great variety of products using more and more complex processes but their long term effects on the health and the safety of the consumers, in some cases, still are unknown with exactitude (e.g. Genetic Modified Organisms - GMOs). The generated excess of supply in developed countries has originated, on the other hand, an increasing process of globalization of agro-food markets, which has led to increasing price competitiveness. As a consequence, the agro food sector has been forced to continuously modify their cost structure in order to survive in the market.

On the demand side, changes have been also spectacular. In the more developed societies, food expenditure represents a smaller percentage of total household expenditure as a result of increasing both the families' disposable income and well-being. Second, the reduction of population growth rates in most developed countries has resulted in more saturated agro-food markets with the obvious consequences on food prices. Although differentiation policies have become a strategic necessity for survival, still price competition plays a key role in the agro-food sector. Vertical integration and horizontal concentration have significantly grown during the 21st century in order to benefit from economies of scale and cost reductions (Connor, 2007).

In any case, changes in food demand in the last years can only be partially explained by changes in productive efficiency or the behavior of the traditional economic factors that have been considered to determine consumer behavior (income and prices). Interestingly, those changes have to be attributed to the increasing amount of information about food and food characteristics that has been made available to consumer (quality, way of elaboration, nutritional content, impact of agriculture on the environment, consequences on health, food safety, etc).

In this thesis we will focus on the potential impact of food safety issues on food demand. Recent food scares (dioxins, Bovine Spongiform Encephalopathy (BSE), foot and mouth disease, avian influenza …) have increased consumers' concerns on food safety, with significant reductions in the consumption of affected products. 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 exerted a high influence in their shopping and consumption habits. Therefore, understanding the consumers' responses to food safety information is important to policy analysts and the food industry.

Among the most recent food scares, the discovery of Bovine Spongiform Encephalopathy (BSE) had a widespread influence around the world, affecting not only beef consumption but the consumption of other competing products (especially fish and other meats). In the case of Spain, beef consumption slightly decreased since 1994, having recovered in 1999 and 2000 (MARM, 2006). However, this recovering process ended with the first case of BSE, in Spain, in October 2000. Between 2000 and 2001, beef consumption decreased by 12%, taking annual figures. 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 results suggest that food safety issues should be taken into consideration when analyzing food demand. In spite of the importance that the experts and the researchers have given to food scares as determinants of the changing habits of the Spanish consumers, until now and up to our knowledge, apart from some merely descriptive studies based strictly on consumption data, (CIS, 2001) and the MARM (2004), no study exist in Spain that has tried to quantify the effects of the food crisis on the demand for food.

This is precisely the main objective of this Master Thesis. Taking as an example the food scare that has had the widest effect on the demand for meat in the European Union, the BSE. This study tries to quantify the impact that this crisis has had on the demand for meat in Spain. In order to achieve this general aim, the following intermediate objectives are considered:

1- To describe the evolution of the BSE scare in Spain as well as to compare it with the situation at other European countries and worldwide.

2- To describe the evolution of meat consumption habits in Spain.

3- To analyze the impact of the BSE on the public opinion by considering the articles published in mass media on the disease and its impact on the beef sector.

4- To specify and estimate a model that allows quantifying, in the short and long term, the impact of food safety information on the demand for the different types of meat in Spain.

5- To compare results obtained from the inclusion or not of available BSE information in mass media on estimated meat demand elasticities.

To achieve the above mentioned objectives, this thesis is organized as follows. We finish this introduction with a literature review mainly focused on three directions. We start by considering a number of studies that have incorporate additional explanatory variables, apart from prices and income, in food demand models. Second, we report how food safety issues have been considered. Finally, we specifically focus on the literature dealing with BSE and meat demand, the main aim of this study.

Chapter 2 presents some descriptive analysis about the evolution of BSE cases and meat and fish consumption, in Spain and Europe. In the case of Spain also the main socioeconomic factors affecting meat and fish consumption are characterized. In chapter 3 the theoretical and the econometric frameworks are explained. The theoretical framework will concentrate on the concept of information and its effect (especially food safety information) on consumers' decisions and how this information can be incorporated into demand analysis. The second part is devoted to the econometric frame work. We will focus our discussion on the model that we are going to specify and estimate, the so called Generalized Almost Ideal Demand System (GAIDS). Chapter 4 deals with the description of data used in this thesis. Specific attention is devoted to the construction of a BSE information index depending upon newspaper articles related to the mad-cow disease. Main results are presented in Chapter 5. As a first step, weak separability between fish and meat products is analyzed. Second, misspecification tests are carried out in order to find the best model. Finally, food demand elasticities are obtained. Results from AIDS and GAIDS models with and without including the food safety information index are compared. The thesis ends with some concluding remarks and some suggestions for further research.

1.2. Literature review.

This thesis is based on the neoclassical consumer theory and the estimation of demand functions. From the seminal work by Stone (1954a), there has been a vast literature addressed to apply microeconomic theory consistently to specify demand equations. In his earlier work, Stone estimated price and income elasticities for 48 food categories in the United Kingdom. Further attempts were made by Stone (1954b), who developed the linear expenditure system (LES), and by Theil (1965) and Barten (1966), who developed the Rotterdam model, which could be used to test the theory. In the 1970s and 1980s, more emphasis was placed on flexible functional forms originated from utility maximization or cost minimization functions. The translog model (Christensen et al., 1975) and the almost ideal demand system (AIDS) (Deaton and Muellbauer, 1980) have been widely used in the literature of food demand analysis.

During the 80s and the 90s, having recognized that other factors different from income and prices affect food demand, the emphasis was placed on how to incorporate such variables in the traditional demand analysis framework. In particular, three issues were mainly considered: 1) advertising; 2) information about consequences on health and nutrition; and 3) information about food scares.

While advertising can be easily measured as total expenditure on promotion in different time periods, the measurement of information on consequences of diets on human health is not so straightforward. Traditionally, health information was measured by the number of articles published in scientific medical journals that linked food ingredients such as fat and cholesterol with cardiovascular diseases. The latter approach was first used by Brown and Schrader (1990) to build a cholesterol index. The hypothesis underlying their index was that consumers' attitude towards cholesterol changed slowly as scientific information was accumulated. Consumers received health information from different sources, including newspapers, television, friends, etc., so that the number of articles in scientific journals was just a simplification of the diffusion of health information. The Brown and Schrader's index has been updated, modified and used in several studies, such as Chern et al. (1995), Kinnucan et al. (1997) and Alfnes and Rickertsen et al. (2003), among others. Moreover, some methodological refinements on how to construct the index have been developed in the literature, being the most relevant those suggested by Chern and Zuo (1995) and Kim and Chern (1997), which are those that are going to be considered in this study.

Previous studies have followed different approaches to measure the effects of food safety information on demand. It is assumed that preferences for a commodity are influenced by the consumer's perception of its attributes such as quality and safety (Bausmann, 1956). Application of this framework has been prevalent in food advertising and health and food scare studies (Chiang and Kinnucan, 1991; Brester and Schroeder, 1995; Swartz and Strand, 1981; Van Ravenswaay and Hoehn, 1991; Dahlgran and Fairchild, 1987). The standard approach to account for food scares requires the construction of a media coverage index, which is interpreted as a proxy of risk perception, as in Smith et al. (1988) and Liu et al. (1998). Recently, more emphasis has been placed on systemwise approaches, to account for cross-product effects (Burton and Young, 1996; Verbeke and Ward, 2001; Piggott and Marsh, 2004; and Marsh et al., 2004; among others).

As the BSE food scare was originated in Europe, the larger number of studies analyzes its impact on specific European countries. Burton and Young (1996) and Burton et al. (1999), focused on the effects of BSE information available to the public opinion on meat demand in the UK using a simple information index based on the number of newspaper articles generated about BSE. In Belgium, Verbeke et al. (2000) found that television coverage on meat safety had a negative effect on the demand for red meat after the Belgium BSE-outbreak and this effect was more prominent among the younger population. Verbeke and Ward (2001) extended the previous work by introducing advertising expenditures to recover consumers' trust on beef. They found that advertising had only a minor impact on meat demand compared to the negative media coverage. In the Netherlands, Mangen and Burrell (2001) used a switching almost ideal demand system (AIDS) to investigate the preference shifts among Dutch consumers. They found that preference shifts due to the BSE crises reduced beef expenditures with offsetting gains in the shares of pork, prepared meat and fish. In Italy, Mazzocchi (2004) and Mazzocchi (2006) investigated the effect of the BSE crisis on the meat demand in Italy. The main methodological novelty was how to introduce the food scare information. He found that the use of structural time series analysis by including dummy variables to capture the structural change or using a time varying parameters approach reported similar results to those obtained using a media coverage index.

Apart from Europe, several studies have investigated the effects of BSE on meat demand. The most relevant in the USA are those by Marsh et al. (2004) and Piggott and Marsh (2004), among others. Finally, Erikson et al. (1998) compared the behavior in Australia, Japan and the USA, prior to the main incidence of the BSE. He concluded that consumers in those countries were concerned about food-borne illnesses in meat prior to the BSE outbreak. They found that the most important product attributes for consumers purchasing beef in these countries were the cleanliness of the display case and production/expiration date. They also found that the geographical origin of the beef was more important to Japanese consumers than to consumers from Australia and the United States.

Most of the studies dealing with the issue of the effect of food safety information have included the food safety information index ad hoc, as an additional shifter in the demand system (Burton and Young, 1996; Verbeke and Ward, 2001; among others) This type of modeling does not account for the fact that modifying the intercept of the AIDS model makes estimates sensitive to the units by which quantities and prices are measured. Regarding this issue, Alston et al. (2001) shows that the use of Generalized Almost Ideal (GAIDS) model is a manner for flexibly and parsimoniously incorporating demand shifters in the Almost Ideal Demand System (AIDS) model and even though obtaining invariant estimates to changes in the units of measurement of quantities and prices. Few studies dealing with the issue of the food safety information effect on meat demand have used this (GAIDS) model (Piggott and Marsh, 2004; and Marsh et al., 2004; among others). Piggott and Marsh (2004) used the GAIDS model that incorporates pre-committed quantities and varying intercepts for the expenditure share equations accounting for food safety events' impact on the demand for each meat commodity over time. This will be the methodological approach used in this study.

Chapter 2:
The mad cow crisis and meat consumption in Spain

In this Chapter we will analyze the history and the evolution of the BSE disease in the world, in Europe, and in Spain. At the same time, we will explore the evolution of meat and fish consumption both in Spain and Europe. The analysis will be carried out in terms of quantities and expenditure levels. In the case of Spain we will characterize the main socioeconomic factors affecting meat and fish consumption. Finally, we will anticipate, in a very descriptive way, the effect of the mad cow crisis on meat and fish consumption in both areas.

2.1. The BSE outbreak in the world, Europe and Spain.

2.1.1. Definition and description.

Bovine spongiform encephalopathy "BSE", widely known as mad cow disease, is a lethal, central nervous system disease, which specifically targets cattle. The disease is characterized by the appearance of vacuoles, or clear holes, in neurons in the brains of affected cattle. The brain then gets the appearance of a sponge. BSE-affected animals may display changes in temperament, such as nervousness, aggression, or abnormal posture; changes in coordination and difficulties in rising; decreased milk production; and, finally, loss of body condition despite continued appetite. It is a degenerative disease with a 100% mortality rate, and no treatment. Since the disease has a long incubation period, it does not normally occur in cows that are under thirty months aged. The incubation period ranges from 2 to 8 years. Following the onset of clinical signs, the animal's condition deteriorates until it dies or is destroyed. This usually takes from 2 weeks to 6 months (Hyun et. al., 2004)

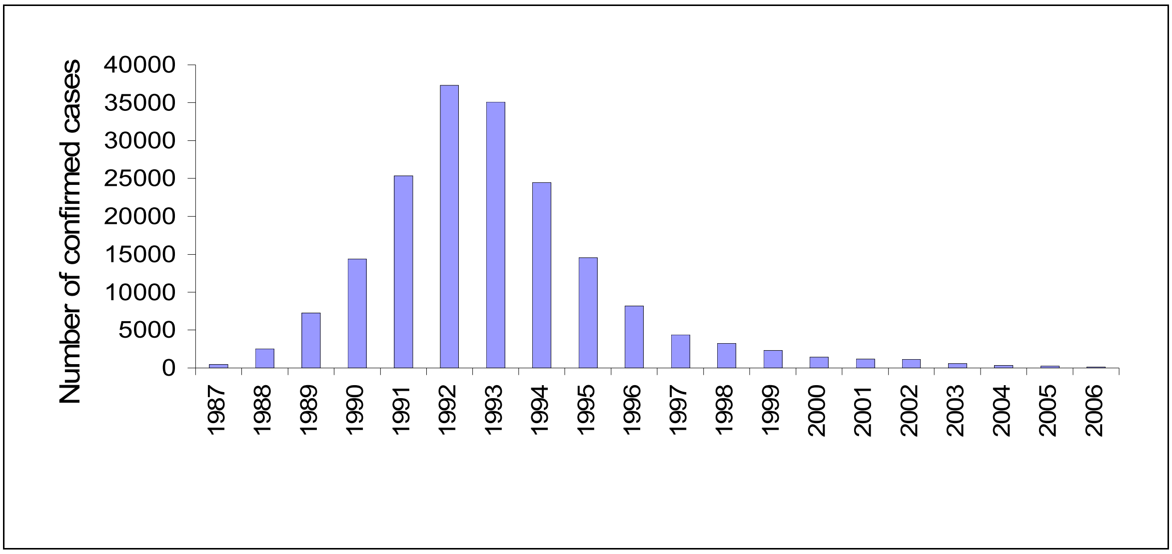
As mentioned by Buzby (2003), BSE is a major food safety concern for several reasons, including: (1) the uncertainty of exactly how the disease is transferred to humans (generating the Creutzfeldt-Jakob disease - vCJD), which means that we have limited knowledge about how to prevent it, (2) the uncertainty of the total number of BSE and vCJD cases, partly due to the long incubation periods in both cattle and humans, (3) the inability to destroy the "prion" the agent believed to cause BSE and vCJD, (4) the lack of a cure for BSE and vCJD, and (5) the ability to confirm the presence of the disease only through postmortem testing.

The primary means of transmission of BSE to cattle is by eating feed contaminated with rendered material from BSE-infected cattle. There is also a possibility that, in rare cases, mother to offspring transmission may occur, but this is unconfirmed. There is no evidence that BSE is transmitted directly from animal to animal.

BSE was first confirmed in cattle in 1986 in the UK. It is unclear how the BSE disease started in cattle, but it is believed to have been spread through the common European practice in those days of feeding cattle with cheap meat and bone meal (MBM), which contained remnants of slaughtered animals, including cows and sheep. Extensive use of MBM in cattle feed in the UK meant the disease became widespread there.

Figure 2.1 shows the evolution of the confirmed BSE cases in the United Kingdom from 1987 to 2006. As can be observed, the peak is reached in 1992 with more than 37 thousand cases, declining from then to only 114 reported cases in 2006.

Figure 2.1.The evolution of confirmed BSE cases in United Kingdom from 1987 to 2006.



Source: the world organization for animal health (OIE)

A dramatically dividing point in the BSE history took place on March 1996 when the U.K. Government announced that there is a possible link between the consumption of BSE-infected meat and the development of the Creutzfeldt-Jacob disease (vCJD), a rare but fatal degenerative disease in human brain. Up to now the exact transmission mechanism of BSE to human population has not been identified, but consumption of BSE-contaminated meat is the most likely hypothesis. By June 2007, 193 people has acquired and died as a consequence of this disease, from which 161 occurred in the United Kingdom. The number of definite or probable vCJD cases still alive is 9 (The UK Creutzfeldt-Jakob Disease Surveillance Unit, 2007).To prevent the transmission of the disease to humans in the form of vCJD, the parts of cattle and sheep most likely to carry BSE must be removed by law in the UK. These parts are known as Specified Risk Material (SRM) and include the brain and the spinal cord. The announcement of this relationship generated considerable media attention and resulted in an immediate and significant decline in beef consumption in Europe. Consumers' concerns over the disease grew around the world. Authorities in European countries banned suspect animal feed and launched offensives against fears of BSE-infected meat. But it was difficult to assuage consumer panic. Beef sales in Europe plummeted after the news. Moreover, some governments outside Europe banned importing beef from European countries.

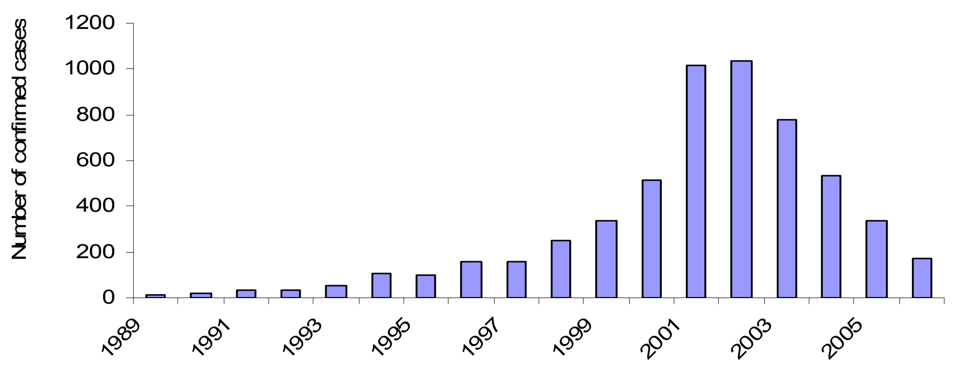
2.1.2. The situation in EU and the world.

While over 95 percent of all BSE cases have occurred in the United Kingdom, where the disease was first discovered in 1986, many other cases have been confirmed in most European countries (Table 2.1). By 2001 every EU member country had reported at least one case of BSE. The European Union banned the feeding of ruminant derived meat and bone meal in the United Kingdom in July 1988 but not the export of this risky material. Actually, exports significantly increased. Ten months later, Germany stopped the imports for meat and bone meal. Only in 1996, the European Union stopped the BSE contaminated meat and bone meal exports from United Kingdom and 14 months later feeding was forbidden in the European Union. The Court of Auditors (2001) reported that the costs of the BSE crisis in the EU were about 4.7 billion Euros. The largest recipient was the United Kingdom with 2 billion Euro followed by France and Germany with 0.74 and 0.72 billion Euro, respectively. Main costs sources were direct income support payments, public interventions and the so called "over thirty months scheme (UK)". The last one was introduced in 1996 to eliminate cattle aged more than 30 months from the human food and animal feed chains.

Outside Europe, in 1993, the first case of BSE in Canada was found in Alberta (Table 2.1). The cow had been imported from the United Kingdom. Japan discovered its first case in September 2001, followed by the first, and the only one, case in Israel in May 2002. On May 20, 2003, the “mad cow disease” once again showed itself in a full color in Canada. The United States was clear of BSE until the discovery of its first case in December 2003.

Figure 2.2 shows the evolution of the confirmed BSE cases in the world, excluded the United Kingdom, from 1989 until 2006. Worldwide, BSE has been found by 2006 in about 190,161 animals, 184,514 of them in the United Kingdom. From the remaining, the main share took place elsewhere in Europe.

Figure 2.2.The evolution of confirmed BSE cases in the world excluded United Kingdom from 1989 to 2006.



Source: OIE (2007)

Table 2.1 Confirmed BSE cases in the world, by countries during the period 1987-2006.

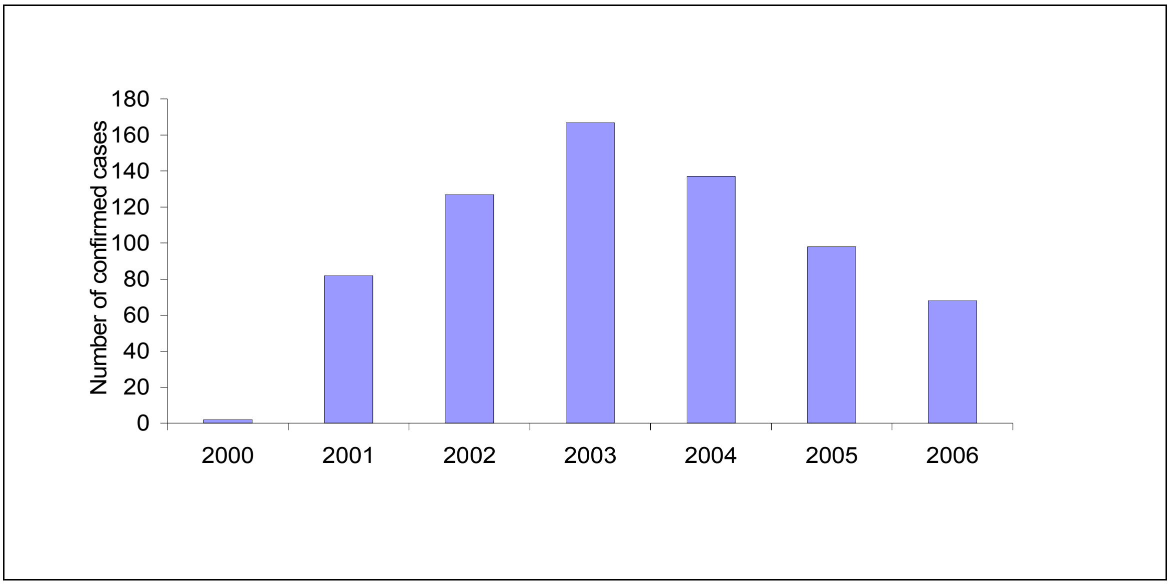
Countries	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	cumulative
Austria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2	5
Belgium	0	0	0	0	0	0	0	0	0	0	1	6	3	9	46	38	15	11	2	2	133
Canada	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	1	1	5	10
Czech Republic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	4	7	8	3	26
Denmark	0	0	0	0	0	1	0	0	0	0	0	0	0	1	6	3	2	1	1		15
Finland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
France	0	0	0	0	5	0	1	4	3	12	6	18	31	161	274	239	137	54	31	8	984
Germany	0	0	0	0	0	1	0	3	0	0	2	0	0	7	125	106	54	65	32	9	404
Grece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Ireland	0	0	15	14	17	18	16	19	16	73	80	83	91	149	246	333	183	126	69	41	1589
Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Italy	0	0	0	0	0	0	0	2	0	0	0	0	0	0	48	38	29	7	8	7	139
Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	4	5	7	10	31
Liechtenstein	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0		2
Luxembourg	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	3
Netherlands	0	0	0	0	0	0	0	0	0	0	2	2	2	2	20	24	19	6	3		80
Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	11	19	10	49
Portugal	0	0	0	1	1	1	3	12	15	31	30	127	159	149	110	86	133	92	46		996
Slovakia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	2	7	3	0	23
Slovenia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	1	1	7
Spain	0	0	0	0	0	0	0	0	0	0	0	0	0	2	82	127	167	137	98	68	681
Sweden	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Switzerland	0	0	0	2	8	15	29	64	68	45	38	14	50	33	42	24	21	3	3	5	464
United Kingdom	446	2514	7228	14407	25359	37280	35090	24438	14562	8149	4393	3235	2301	1443	1202	1144	611	343	255	114	184514
United States	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2
the world	446	2514	7243	14424	25390	37316	35140	24542	14664	8310	4553	3487	2637	1956	2215	2179	1389	878	591	287	190161

Source: World Organization for Animal Health (OIE)

2.1.3. The situation in Spain.

On November 22, 2000, the first Spanish BSE case was diagnosed and two weeks later the second one. Both cases took place in Galicia. Since then the number of confirmed cases increased notably reaching its peak in 2003 with 167 cases (Figure 2.3).The total number of confirmed cases in Spain from November 2000 to the end of 2006 was 681 cases, being the fifth European country more affected by the BSE after U.K., Ireland, France, and Portugal.

Figure 2.3 Evolution of confirmed BSE cases in Spain from 2000 to 2006.



Source: información EEB, administración general del estado (http://www.eeb.es)

Up to now, the incidence in humans has been very limited. More precisely three cases have been confirmed. The first case of vCJD was reported in Spain in 2005 in a woman, born in 1978, who developed symptoms in 2004 and died in 2005.The second case was a woman, born in 1957, who developed progressive cognitive deterioration in February and died in December 2007. The third case was a man, born in 1967, who had onset in May 2007 with psychiatric symptoms, and after several months developed progressive cognitive decline with dementia and died in February 2008.

2.2. The evolution of meat and fish consumption.

2.2.1. Meat and fish consumption in Europe.

Meat consumption in the EU-15, in 2005, accounted for 28.9 million tons (around 73.12 Kg/capita). Five countries: Germany, France, Spain, Italy and United Kingdom, which account for around 80% of the population in the EU-15, represent the same percentage in terms of total meat consumption. Pork meat is the most consumed meat (29.15 Kg/capita) followed by chicken (17.13 Kg) and beef (16.52 Kg). Within the EU Netherlands ranks first in terms of per capita meat consumption (90.52) followed by Spain, Ireland and France with: 85.49, 82.51and 82.33 Kg respectively. The lowest per capita consumption has been observed in Greece, Belgium and Sweden with 56.52, 53.5 and 53.27 Kg, respectively.

Fish and sea food constitute the main substitutes of meat. The total consumption of fish and sea food was about 9.8 million tones, in 2005, with fish representing around 70 %(7 million tons).

Table 2.2 shows the evolution and the annual growth rates of meat and fish consumption during the period 1995 – 2005 in the EU 15 countries. As can be observed, in general terms, meat consumption has slightly increased during the last ten years (annual growth rate of 0.63%). However, some differences have been found for the different types of meat. For instance, although beef consumption was affected by the mad cow disease crisis in 1996, it has recovered until the second crisis in 2000-2001.During the whole period, beef consumption has increased with an annual growth rate of 1.13%. In relation to other meats, pork consumption has remained quite stable during the analyzed period (annual growth rate of 0.19%), while more relevant changes have taken place in lamb (annual growth rate of –1.42) and chicken (1.69%). Fish consumption has remained also quite stable while sea food has substantially increased.

Table 2.2 Evolution of per capita consumption (Kg/year) of the different types of meat, fish and sea food in the EU- 15.

Country	Year	Beef	Chicken	Pork	Lamb	Total meat	Total Fish	Total sea food	Total fish and sea food	Total meat and fish and sea food
Austria	**1995**	10.67	11.32	39.54	1.17	67.53	8.38	0.95	9.33	76.87
	2000	9.62	12.39	41.53	1.18	70.70	8.86	1.23	10.09	80.79
	2005	21.15	11.87	37.85	1.17	77.70	10.34	1.41	11.75	89.45
	A.G.R.	7.08	0.48	-0.44	-0.01	1.41	2.13	4.01	2.33	1.53
Belgium	**1995**	11.32	18.62	30.32	2.04	71.20	17.00	7.08	24.08	95.28
	2000	15.98	20.70	23.81	1.93	67.58	16.85	6.17	23.02	90.60
	2005	5.62	17.79	25.28	1.64	55.98	16.50	7.31	23.81	79.79
	A.G.R.	-6.76	-0.46	-1.80	-2.19	-2.38	-0.30	0.33	-0.11	-1.76
Denmark	**1995**	9.12	12.12	40.83	1.09	67.80	15.59	8.10	23.69	91.48
	2000	20.28	15.66	27.01	1.09	67.49	11.70	10.50	22.20	89.69
	2005	16.88	15.14	28.46	1.14	66.12	13.28	9.46	22.74	88.86
	A.G.R.	6.35	2.25	-3.55	0.48	-0.25	-1.59	1.56	-0.41	-0.29
Finland	**1995**	16.48	8.53	30.86	0.40	57.19	31.68	1.68	33.36	90.56
	2000	15.91	12.92	32.61	0.33	62.71	28.82	2.04	30.85	93.57
	2005	15.88	15.77	32.52	0.31	65.56	30.21	2.18	32.39	97.96
	A.G.R.	-0.37	6.34	0.52	-2.64	1.38	-0.47	2.65	-0.29	0.79
France	**1995**	17.21	14.51	31.07	4.38	82.77	19.41	10.42	29.82	112.59
	2000	15.22	15.50	31.32	4.05	83.20	19.97	10.75	30.71	113.91
	2005	19.73	14.23	29.47	3.51	82.51	22.04	11.25	33.29	115.80
	A.G.R.	1.38	-0.19	-0.53	-2.20	-0.03	1.28	0.77	1.11	0.28
Germany	**1995**	9.20	7.95	39.53	0.98	63.70	12.65	1.63	14.28	77.98
	2000	7.57	7.26	40.34	0.98	64.42	12.08	1.53	13.61	78.04
	2005	12.23	7.39	41.82	0.89	69.81	12.97	1.34	14.31	84.12
	A.G.R.	2.88	-0.73	0.57	-1.01	0.92	0.25	-1.95	0.02	0.76
Greece	**1995**	12.42	15.10	10.95	14.26	54.62	17.20	4.59	21.79	76.41
	2000	19.73	15.88	11.52	13.19	63.37	17.20	4.67	21.87	85.24
	2005	16.31	14.19	11.34	12.01	56.52	14.74	6.91	21.65	78.17
	A.G.R.	2.76	-0.62	0.35	-1.70	0.34	-1.53	4.17	-0.06	0.23
Ireland	**1995**	15.46	19.80	15.84	9.67	67.37	15.16	4.35	19.51	86.88
	2000	20.41	25.69	20.70	7.63	80.16	19.97	5.09	25.05	105.21
	2005	24.77	23.48	20.84	5.73	82.33	11.59	4.33	15.92	98.25
	A.G.R.	4.82	1.72	2.78	-5.10	2.03	-2.65	-0.04	-2.01	1.24
Italy	**1995**	26.42	13.97	22.87	1.65	75.05	13.56	7.80	21.36	96.41
	2000	24.68	13.17	26.32	1.53	76.78	13.37	9.11	22.48	99.26
	2005	24.71	11.54	28.75	1.43	75.69	14.84	9.93	24.76	100.45
	A.G.R.	-0.67	-1.89	2.31	-1.40	0.08	0.90	2.44	1.49	0.41
Netherlands	**1995**	23.02	18.66	36.98	1.28	82.73	13.98	3.73	17.71	100.44
	2000	19.75	14.04	39.93	1.11	77.59	21.00	1.07	22.07	99.66
	2005	20.37	41.47	24.61	1.18	90.52	19.06	3.33	22.40	112.92
	A.G.R.	-1.22	8.31	-3.99	-0.87	0.90	3.15	-1.13	2.38	1.18
Portugal	**1995**	14.94	19.47	21.23	3.58	63.09	51.53	6.12	57.65	120.73
	2000	14.34	22.49	25.91	3.47	72.40	46.46	7.79	54.25	126.65
	2005	16.74	17.90	23.78	2.81	67.11	46.18	8.29	54.47	121.58

Country	Year	Beef	Chicken	Pork	Lamb	Total meat	Total Fish	Total sea food	Total fish and sea food	Total meat and fish and sea food
	A.G.R.	1.15	-0.84	1.14	-2.37	0.62	-1.09	3.08	-0.56	0.07
Spain	1995	12.11	22.74	26.53	6.21	72.16	29.02	13.06	42.09	114.25
	2000	14.58	25.01	32.77	5.92	82.64	26.63	16.61	43.24	125.89
	2005	13.55	31.32	31.17	5.52	85.49	27.08	15.47	42.55	128.04
	A.G.R.	1.13	3.25	1.62	-1.18	1.71	-0.69	1.70	0.11	1.15
Sweden	1995	10.97	8.34	28.64	0.67	51.61	20.65	5.71	26.36	77.97
	2000	11.25	10.79	26.35	0.86	52.11	20.44	7.25	27.69	79.80
	2005	12.72	12.73	24.29	0.90	53.27	21.26	8.12	29.39	82.66
	A.G.R.	1.49	4.32	-1.63	3.02	0.32	0.29	3.59	1.09	0.59
United Kingdom	1995	13.44	20.11	22.91	6.67	68.61	15.09	3.76	18.84	87.45
	2000	11.89	23.78	21.74	6.38	69.10	15.84	4.45	20.30	89.40
	2005	16.65	26.76	21.64	5.92	75.50	15.32	4.53	19.85	95.35
	A.G.R.	2.17	2.90	-0.57	-1.19	0.96	0.15	1.89	0.52	0.87
EU 15	1995	14.77	14.49	28.59	3.53	68.67	17.27	5.98	23.25	91.93
	2000	14.24	15.40	29.73	3.34	70.79	17.20	6.69	23.89	94.68
	2005	16.52	17.13	29.15	3.06	73.12	17.80	6.99	24.79	97.91
	A.G.R.	1.13	1.69	0.19	-1.42	0.63	0.30	1.57	0.64	0.63

Note: AGR= Annual Growth Rate from 1995 to 2005.
Source: FAOSTAT database

The situation is also differs among countries. Total meat consumption has slightly increased in most EU countries (annual growth rates under 1%) with the exception of Belgium (-2.32%), Ireland (2.03%), Spain (1.71%), Austria (1.41%) and Finland (1.32%).

However, we cannot find a very clear relationship between consumption levels and annual growth rates. Moreover, in each country the evolution of the consumption of the different meat products is totally different. For instance the consumption of beef has substantially increased in Austria, Denmark and Ireland (and to a lesser extent in UK in which consumption has recovered after the mad cow crisis). On the opposite side we found Belgium, in which the consumption of all meats has decreased (particularly in the case of beef). Chicken consumption has increased in the Netherlands (at an annual growth rate of 8.31%), Finland (6.34%), Sweden (4.32%), Spain (3.21%) and United Kingdom (2.9%), while has decreased significantly only in Italy (-1.89%). As mentioned, pork consumption has remained quite stable , with the exception of significant increases in Ireland(at an annual growth rate of 2.78% during 1995-2005) and Italy (2.31%) and decreasing in the Netherlands (-3.99%)and Denmark (-3.55). Lamb consumption has decreased in most countries being more significant in Finland (-2.64%), while only Sweden has experienced a significant increase along the analyzed period. Finally, fish consumption has significantly increased in the Netherlands, Austria and Spain (with annual growth rates of 3.15, 2.13 and 1.71% respectively) and decreased in Ireland (-2.65%)

Table 2.3 shows the evolution of meat, fish and sea food price indices for the different EU-15 countries as well as their respective annual growth rates during the period 1996 –2006. As can be observed, in all countries meat prices increases have been lower than inflation rates, which has not been the case for fish products. However, there is no clear relationship between the evolution of prices and consumption. In global terms, meat prices annual growth rate ranged between only 0.44%, for Finland, and 2.87%, for Greece, with an average value of 1.64% for the EU-15. In the case of fish and sea food the situation is quite different with annual growth rates ranged from 2.08%, for Austria, and 4.45%, for Greece, with an average value of 3.27% for the EU-15.

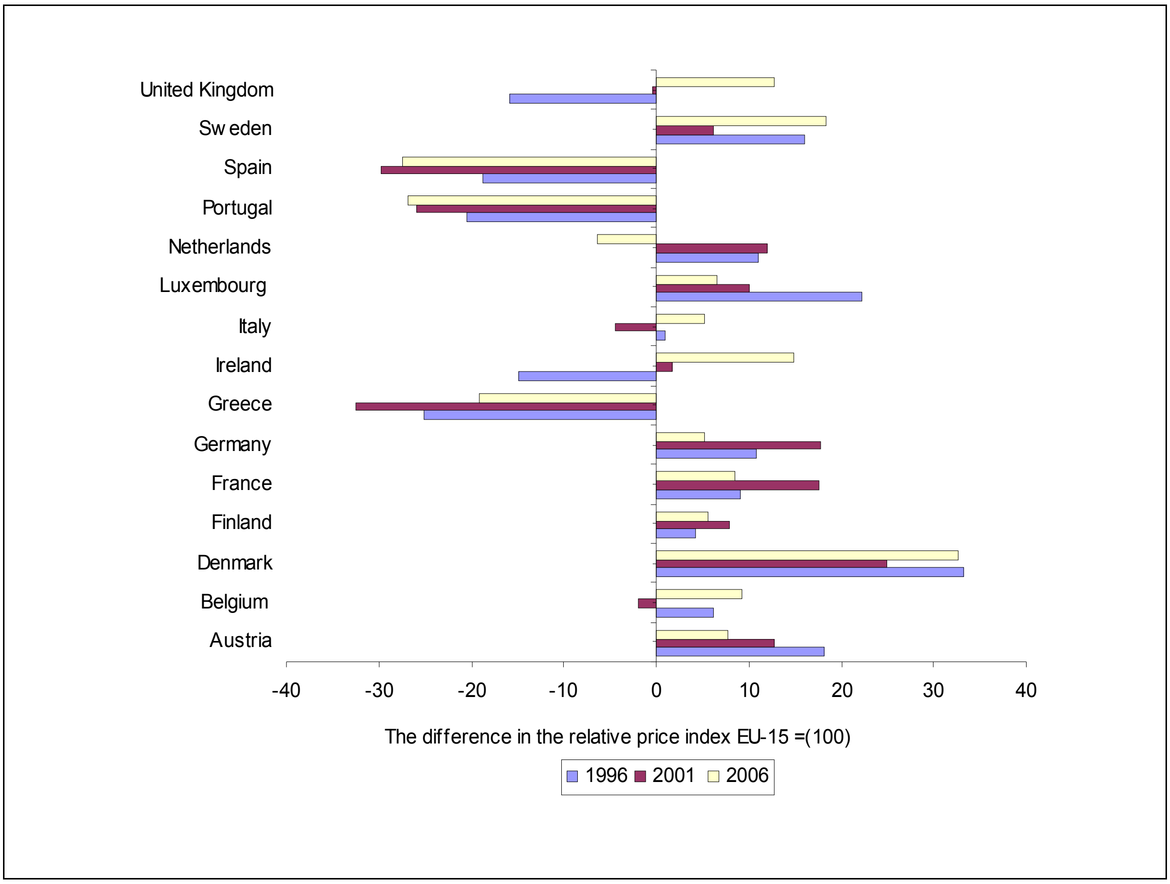
Table 2.3 Evolution of the meat and fish price indices in EU-15 countries (2005=100).

country	1996		2001		2006		A.G.R. (1996-2006)	
	Total meat	Fish and sea food	Total meat	Fish and sea food	Total meat	Fish and sea food	Total meat	Fish and sea food
Austria	88.24	82.08	94.15	94.67	100.59	100.89	1.32	2.08
Belgium	84.25	76.68	91.86	95.97	101.46	103.57	1.88	3.05
Denmark	89.3	81.9	99.8	97.1	100.8	108.8	1.22	2.88
Finland	96.71	82.25	102.45	92.95	101.1	105.28	0.44	2.50
France	82.47	81.27	93.99	95.44	102.13	102.68	2.16	2.37
Germany	93.6	77.8	101.2	91.7	101.1	104.8	0.77	3.02
Greece	78.39	65.59	92.36	87.18	104	101.4	2.87	4.45
Ireland	85.3	74.5	98.8	98	101.4	104.7	1.74	3.46
Italy	87	78.6	93.5	89.3	102.5	103.8	1.65	2.82
Luxembourg	83.79	74.45	93	94.88	102.28	103.47	2.01	3.35
Netherlands	86.04	70.73	99.28	94.43	101	103.16	1.62	3.85
Portugal	89.43	69.67	98.29	101.14	102.76	102.98	1.40	3.99
Spain	79.03	70.18	90.12	86.67	104.69	104.59	2.85	4.07
Sweden	93.19	75.72	98.08	88.66	101.57	104.31	0.86	3.26
United Kingdom	96	79.1	97.2	98.7	101.9	107.9	0.60	3.15
EU 15	86.98	75.47	95.41	91.71	102.3	104.09	1.64	3.27

Source: EUROSTAT data base.

Figure 2.4 shows differences in meat relative price indices (EU-15 =100) in 1996, 2000 and 2006. In Mediterranean countries prices are significantly lower than the average in the three years, while in Denmark prices are substantially higher. Differences are not due to the different costs of living as all prices are measured in Purchasing Power Parity (PPP) terms. The most significant case is UK where prices were lower than the EU average, in 1996, almost the average, in 2001, and clearly above average, in 2006, reflecting a clear strategy of reducing prices to recover past consumption levels. Moreover in Italy and Belgium meat prices were below the EU average only in 2001 indicating also a strategy of lowering prices to overcome the second wave of the BSE crisis. Netherlands is the unique country with prices above average in 1996 and2001, and below average, in 2006.

Figure 2.4 The difference in meat relative price index EU-15 = (100).



Source: EUROSTAT data base.

2.2.2. Meat and fish consumption in Spain

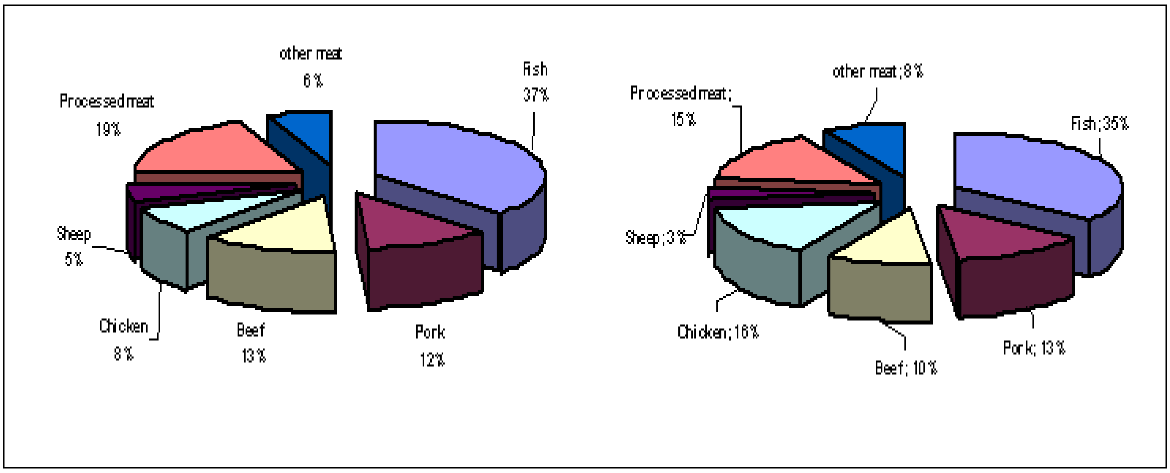
a) Relative position of meat and fish consumption.

Total food expenditure in Spain was about 77,810 million Euros, in 2005. (1818.39 Euros per capita) (MARM, 2006). A significant part is allocated to food away-from home consumption (27.8%); a percentage which has increased in the last years due to changes in life styles and rising income.

Meat and fish is the most important food category for Spanish households. In 2005 it represented around 35% of total food expenditure, being one of the countries in which this percentage has increased more rapidly among European countries (Kaabia et al, 2001). Total meat expenditure accounted for 16,688 million Euros representing 21.4% of total food expenditure. Consumption at home represents 79.5% of meat expenditure, a higher percentage than that mentioned for total food. Fish expenditure represents 13.3% of food expenditure showing a similar distribution as meat between consumption at home and away-from-home.

Figure 2.5 shows the distribution of meat and fish expenditure in both value and volume terms. As can be observed, fish (including sea food) represents the most significant share (37%) of total meat and fish expenditure. Around half of this percentage is allocated to fresh fish. Among meat types, processed meat represents 19% of total meat and fish expenditure followed by beef (13%), pork (12%), poultry (8%), and lamb (5%). In value terms, percentages are very similar, although clearly showing relative prices differences. In general terms, fish and pork prices represent average meat prices as their percentages in volume and expenditure are similar. Poultry is the cheapest meat as it represents 16% of total meat and fish in volume but only 8% in expenditure terms. Lamb meat, on the other hand, is the most expensive meat type followed by beef and processed meat.

Figure 2.5 Distribution of meat and fish expenditure both in value and volume terms (%).



Source: MARM (2006). La alimentación en España.

b. Evolution of meat and fish consumption

Having shown the relative importance of meat and fish consumption on total food consumption and its distribution among the different meat and fish products, in this section we will analyze the evolution of the consumption of the most relevant meat and fish products.[1]

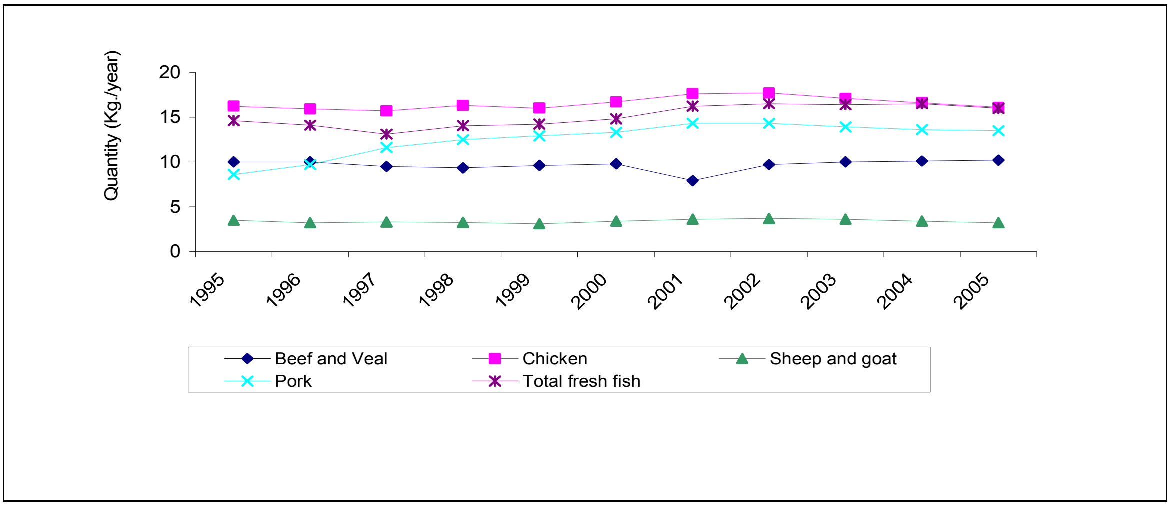
Figure 2.6 shows the evolution of the consumption of the most important fresh meat types and fish (in per capita terms). As clearly indicated, since 1995 all meat products have experienced a slight increase except in the case of lamb in which consumption has slightly decreased. The outbreak of the BSE generated a significant decrease of beef consumption partially covered by an increase in the consumption of other meats and fish. Once beef consumption recovered, the consumption of lamb, pork, and poultry is reduced. Only fish consumption still shows an upward trend.

As mentioned above, a significant share of meat and fish consumption is at-home. However, some differences exist among the different meat types (Figure 2.7). In fact, the importance of away-from-home consumption is higher in beef than in other meat types, even showing an upward trend in the last

[1] We will focus only on fresh meat and fish. We have not considered processed meat and sea food as they are only partial substitutes of fresh products.

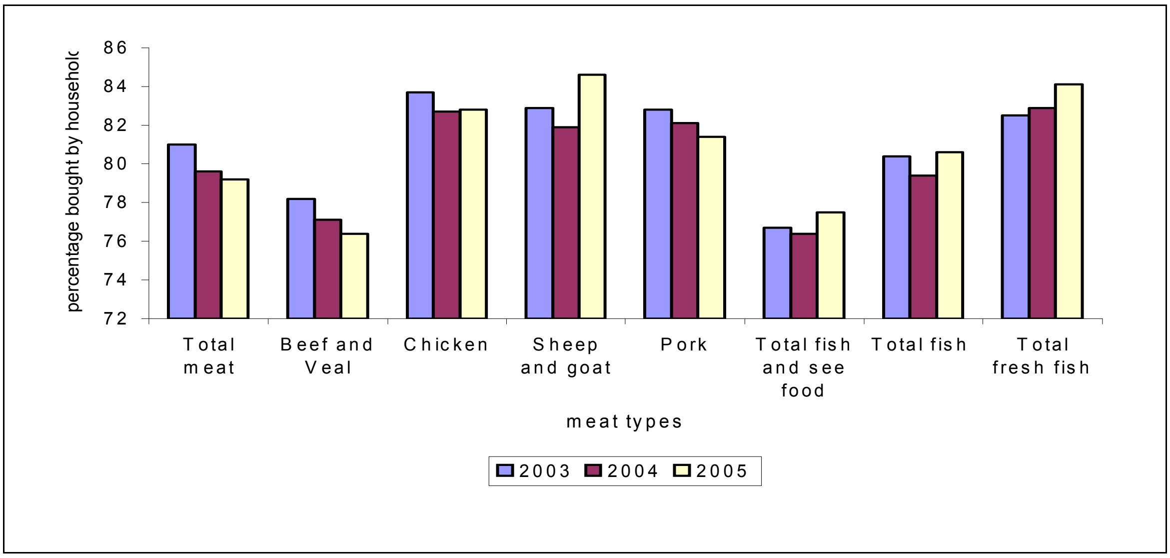
years. On the other hand, at home consumption is relatively more important in lamb and fish. In the first case this can be explained by the fact that this type of meat is usually associated to special occasion's meals and gastronomic traditions in a significant share of the Spanish geography.

Figure 2.6 Evolution of the per capita consumption of major fresh meat types and fish in Spain during the period 1995-2005 (Kg).



Source: MARM (2006). La alimentación en España.

Figure 2.7 Percentage of meat consumption bought by the household in Spain (%).

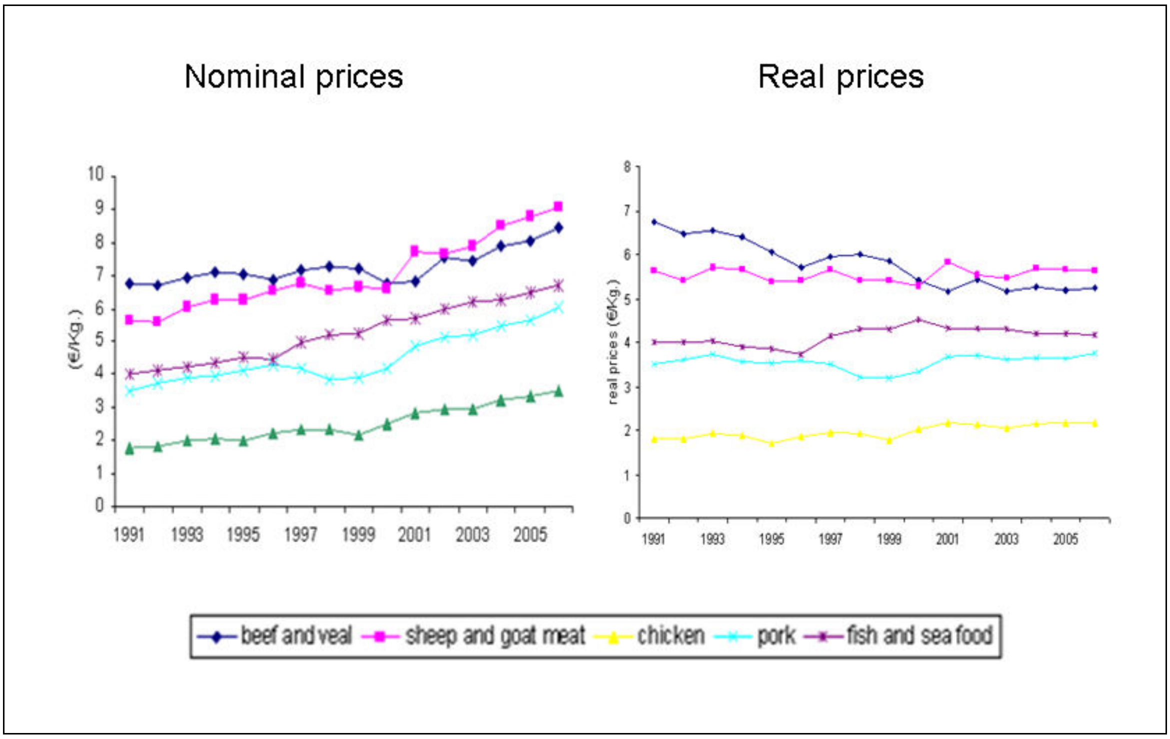


Source: MARM (2006). La alimentación en España.

C. Evolution of meat and fish prices.

Figure 2.8 shows the evolution of the major meat types and fish prices in Spain during the period 1995-2005, both in nominal and real terms. In the first case, all prices exhibit an upward trend along the whole period. Beef prices sharply decreased in 2001 due to the BSE crisis, but rapidly recovered in 2002. Moreover, pork prices show the traditional cyclical behavior with a decreasing phase from 1997 to 2001.In real terms two main broad trends are observed. In general, for the two most expensive meat (beef and lamb), real prices have slightly decreased along the analyzed period while a smooth positive trend is observed for the rest.

Figure 2.8 Evolution of the major fresh meat types and fish prices in Spain during the period 1995-2005 (€/Kg).



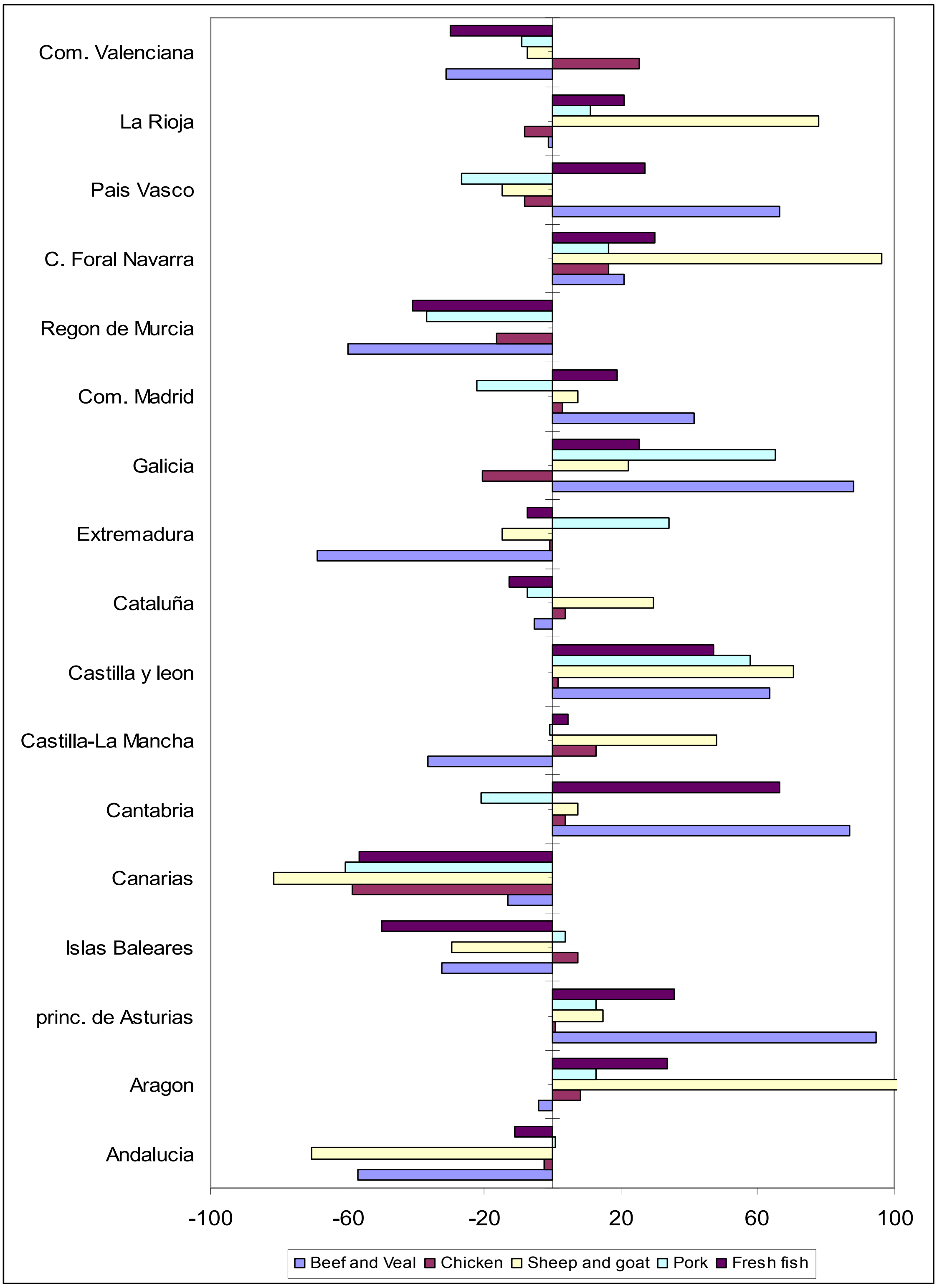
Source: MARM (2006). La alimentación en España.

d. Sociodemographic factors affecting meat and fish consumption.

Once we have analyzed the evolution of fresh meat and fish consumption, we will concentrate here on analyzing differences related to some socioeconomic characteristics of households. More precisely, we will focus on analyzing differences by region, housewife activity, housewife age, household type, family size, and socioeconomic status.

Figure 2.9 shows per capita consumption regional differences relative to the national level for fresh meats and fish. In general terms, consumption patterns are highly correlated with production patterns and gastronomic heritage. Beef consumption is relatively more important in the northern regions (Galicia, Asturias, Cantabria, País Vasco, and Navarra). A similar pattern is found in the case of lamb where higher consumption levels are associated to the main producing regions as Aragon, Castila- La Mancha and Castilla-Leon. The situation is somewhat different in the case of poultry and pork. Poultry, as mentioned, is the cheapest meat type and it is produced in a highly industrialized way in almost all regions. Differences in relation to the national average hardly exceed 2 Kg/capita with the exception of Canary Islands, in which consumption of all meat types is significantly lower than any other region. In the case of pork the situation is, to some extent, similar. However, in this case differences are more relevant in specific regions. Consumption is relatively higher in Castilla-Leon, Galicia and Extremadura (in those cases associated to gastronomic traditions and heritage) while it is lower in Pais Vasco, Comunidad Valenciana, Cantabria and the above-mentioned Canary islands. Finally, in the case of fish, no clear conclusion can be obtained as we are including in a single group different sea and river species. In northern regions as well as in Madrid and Rioja fish consumption is relatively higher.

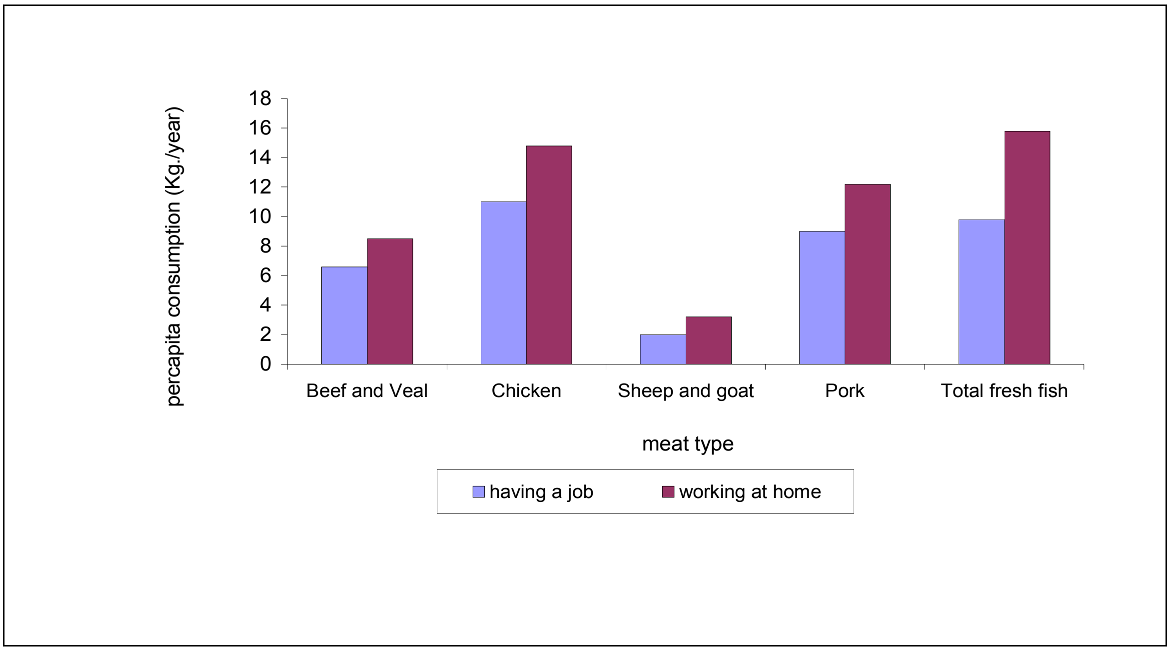
Figure 2.9 Per capita consumption of major meat types and fish in the different Spanish communities (differences relative to national average) (Kg/year).



Source: MARM (2006). La alimentación en España.

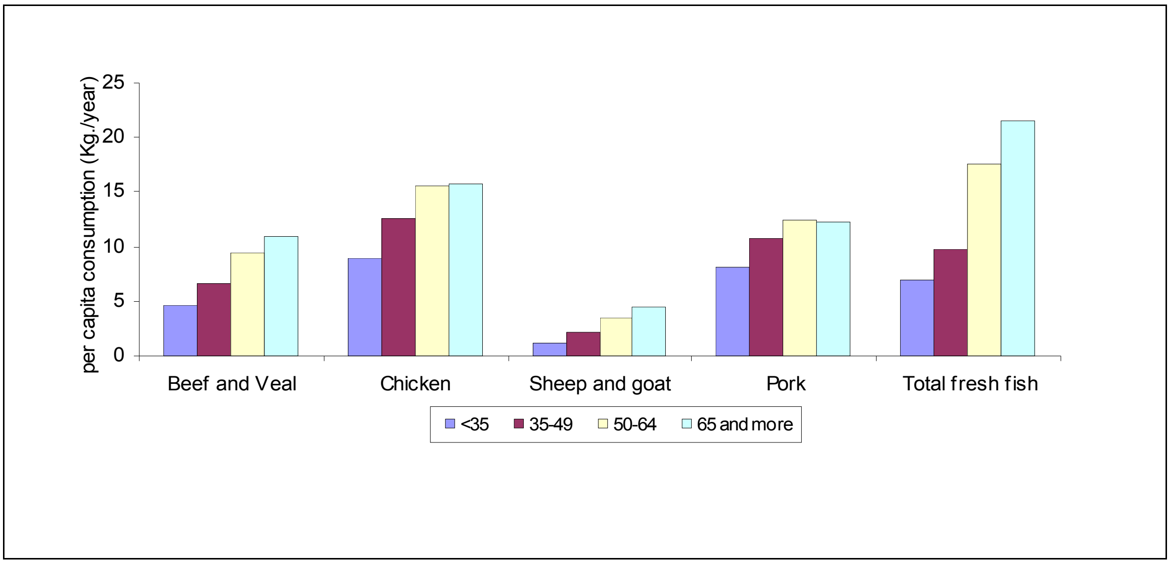
Figure 2.10 Shows fresh meat and fish consumption patterns differences taking into account housewife activity (working at-home or out-of-home). As expected, in all cases at-home per capita consumption in households with a housewife having a job is lower than in households where the housewife works at home as usually housewives working out of home have less time to prepare meals. Moreover, as shown in Figure 2.11 there seems to exist a positive correlation between housewife age and per capita consumption of fresh meat and fish at home. This result is related to the previous one as the employment rate of women is significantly higher in younger groups.

Figure 2.10 Per capita meat consumption in Spain by housewife activity (Kg/year).



Source: MARM (2006). La alimentación en España.

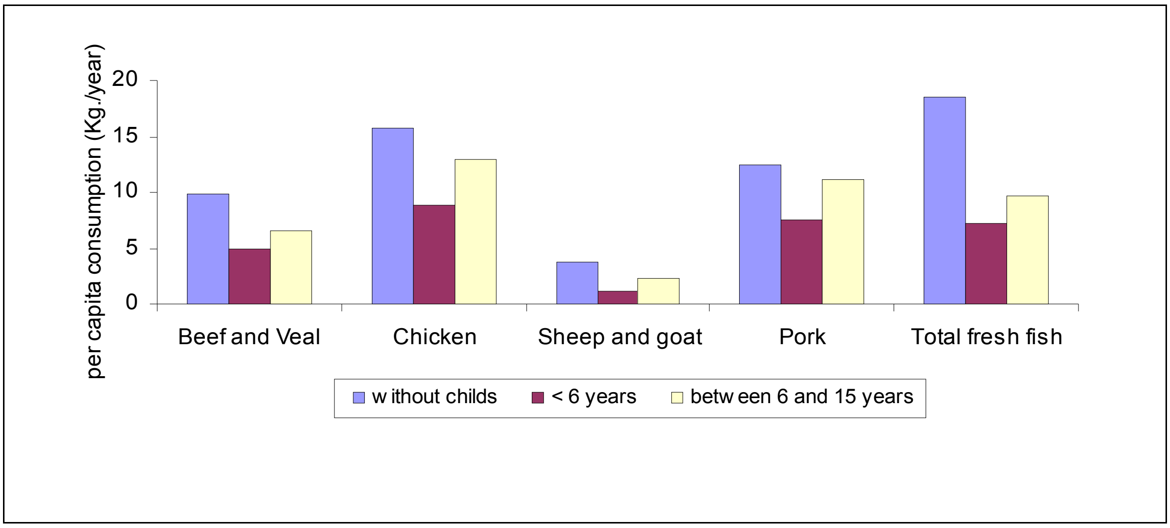
Figure 2.11 Per capita meat consumption in Spain by housewife age (Kg/year).



Source: MARM (2006). La alimentación en España.

Family size and composition also play an important role in fresh meat and fish consumption. Figure 2.12 shows that the highest per capita (adult equivalent) consumption for the different fresh meats and fish is observed in households without children. On the other hand the lowest level is shown in households with small children. This result is also consistent with those shown in the previous two figures as usually younger housewives are those with small children.

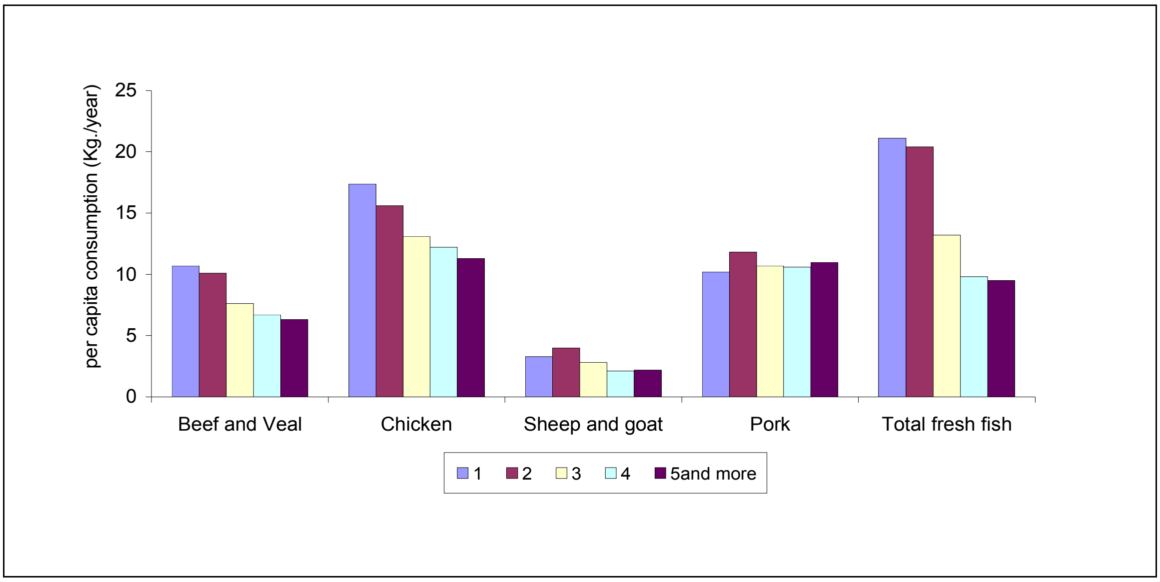
Figure 2.12 Per capita meat consumption in Spain by household type (Kg/year).



Source: MARM (2006). La alimentación en España.

In relation to the household size it is interesting to note, as it was expected, that per capita consumption of food products used to decrease as the family size increases. Fresh meat and fish are not an exception. As shown in Figure 2.13, in relation to family size, households can be divided in two main groups:1) 1 and 2 members households, and 2) more than two members. Differences within the group are not very significant. However, differences between groups are relevant, mainly in the case of fresh fish. Only in the case of pork the average consumption is very close.

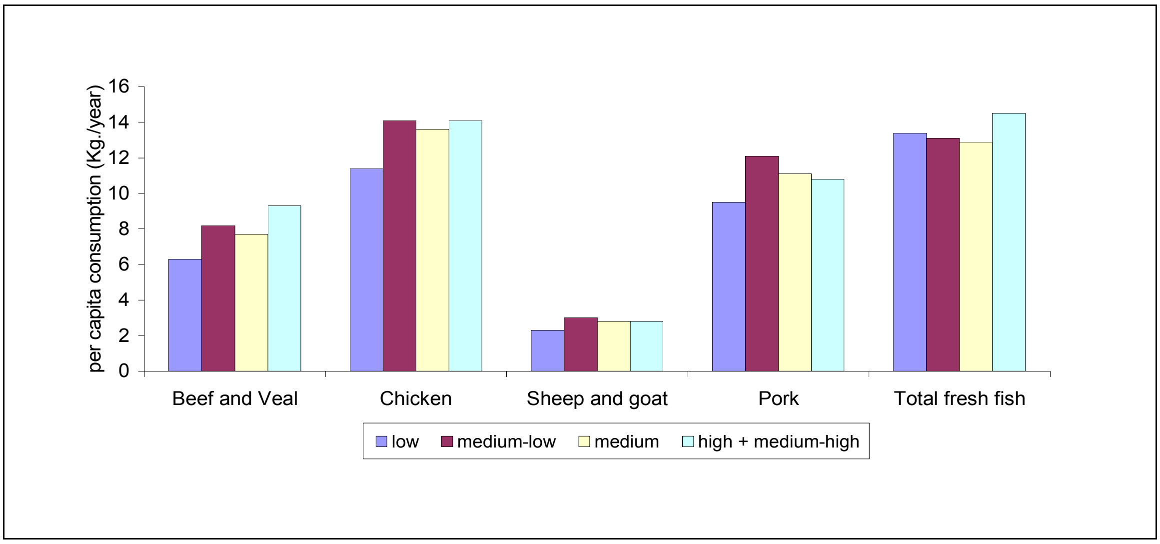
Figure 2.13 Per capita meat consumption in Spain by family size (Kg/year).



Source: MARM (2006). La alimentación en España.

Figure 2.14 shows the per capita consumption of the different meat types and fish by the socioeconomic status of the household. As can be observed, we can not appreciate significant differences. The common pattern is a slightly lower consumption level in the lower socioeconomic status with no significant differences among the other groups. That is the Engle's law holds. Rising income in Spain has generated stagnation in the consumption of food products and an allocation of an increasing share of household's budget to non-food goods.

Figure 2.14 Per capita meat consumption in Spain by the socioeconomic status (Kg/year).



Source: MARM (2006). La alimentación en España.

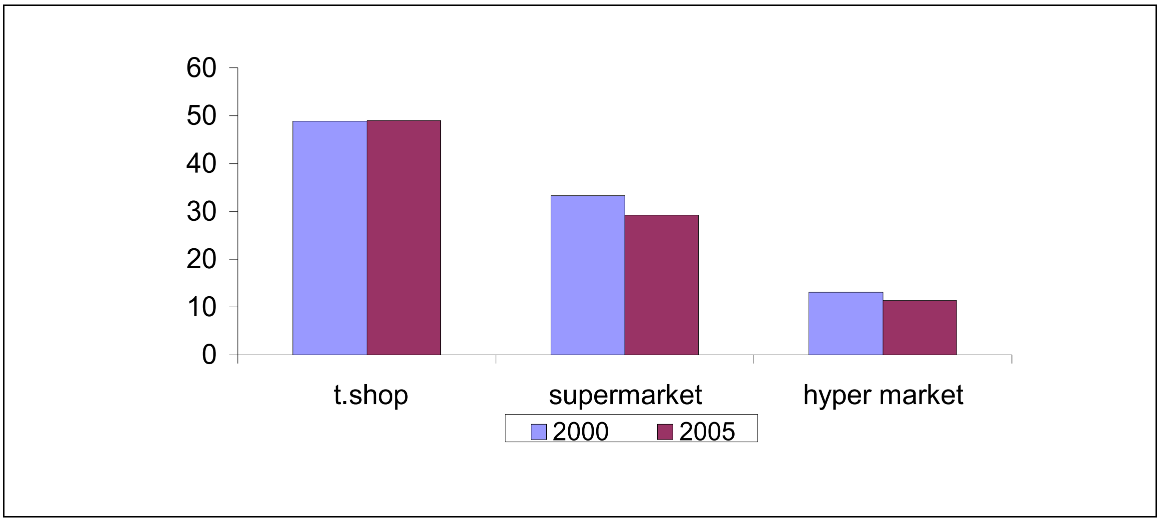
e) Place of purchasing meat.

To finish with this descriptive chapter we will focus on the importance of different retailing formats when buying fresh meat and fish. In Figures 2.15 to 2.19 we show the situation for beef, poultry, lamb, pork, and fresh fish comparing years 2000 and 2005. Two main comments can be outlined. The first one is the relatively high importance of traditional shops. While the market share of traditional shops is around 27% of total food sales in Spain (MARM, 2006), in meat products this share lies between 40 to 50% depending on the meat type. The relative importance of traditional shops is higher in more expensive meats, as lamb and beef, in which convenience is not so important while asking the retailer for advice still plays an important role for a significant group of Spanish buyers (even with the cost of waiting for attendance) .

The second important result is the increasing importance of self-consumption in meat products. As MARM (2006) pointed out this has become a global trend in Spain. In 2005, self-consumption represented 3.6% of total food expenditure. In the case of fresh meat (in fish the percentage is negligible), percentages ranges from 6% up to 10% in the case of pork. Traditionally in Spain, in rural areas some pork producers used to slaughter one or two animals for self-consumption. This practice was regulated by law to guarantee safety. It is noticeable that this tradition has been recovered (following sanitary regulations) after the BSE crisis.

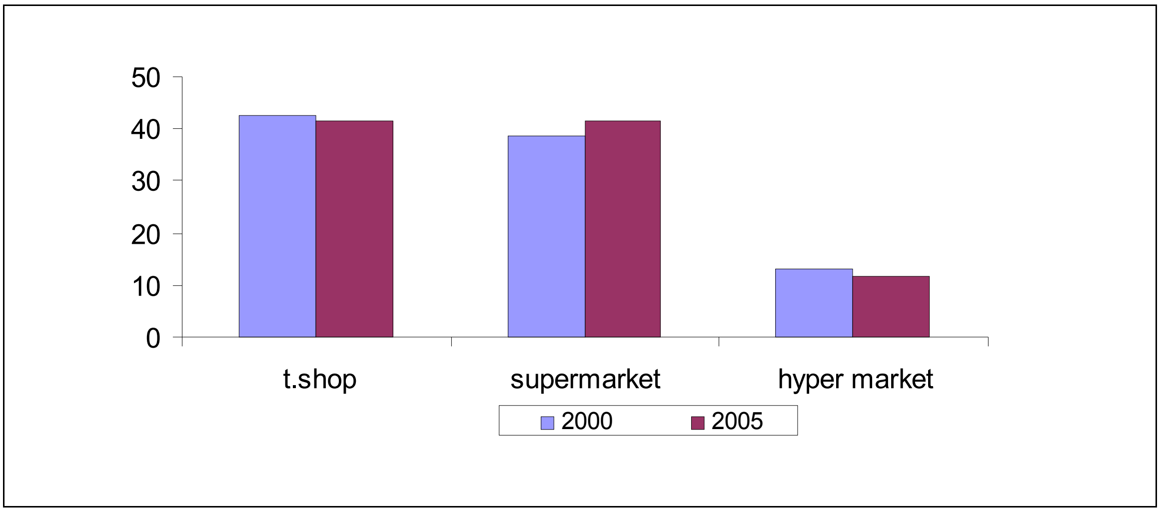
Linked to the previous result, the market share of supermarkets and hypermarkets has diminished in almost all cases with the exception of the supermarkets' share for chicken and fish.

Figure 2.15 Relative importance of retailing formats when purchasing beef (%).



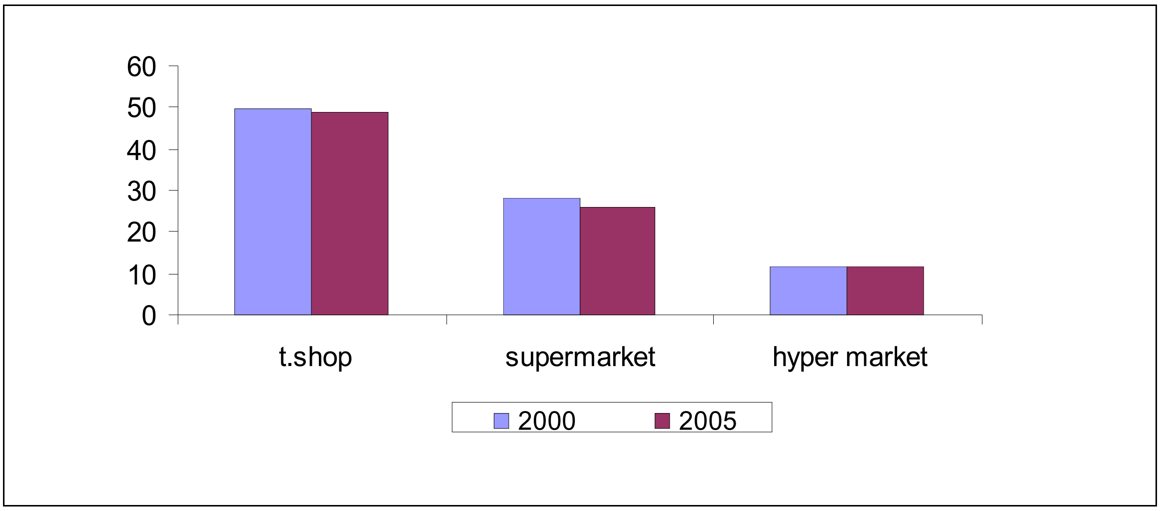
Source: MARM (2006). La alimentación en España.

Figure 2.16 Relative importance of retailing formats when purchasing chicken (%).



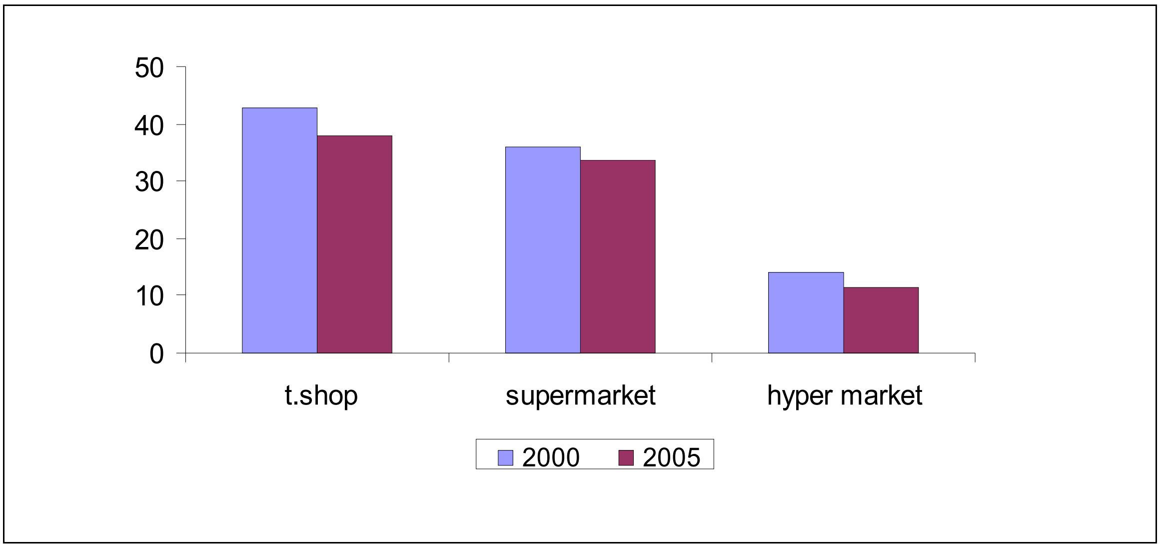
Source: MARM (2006). La alimentación en España.

Figure 2.17 Relative importance of retailing formats when purchasing lamb and goat meat (%).



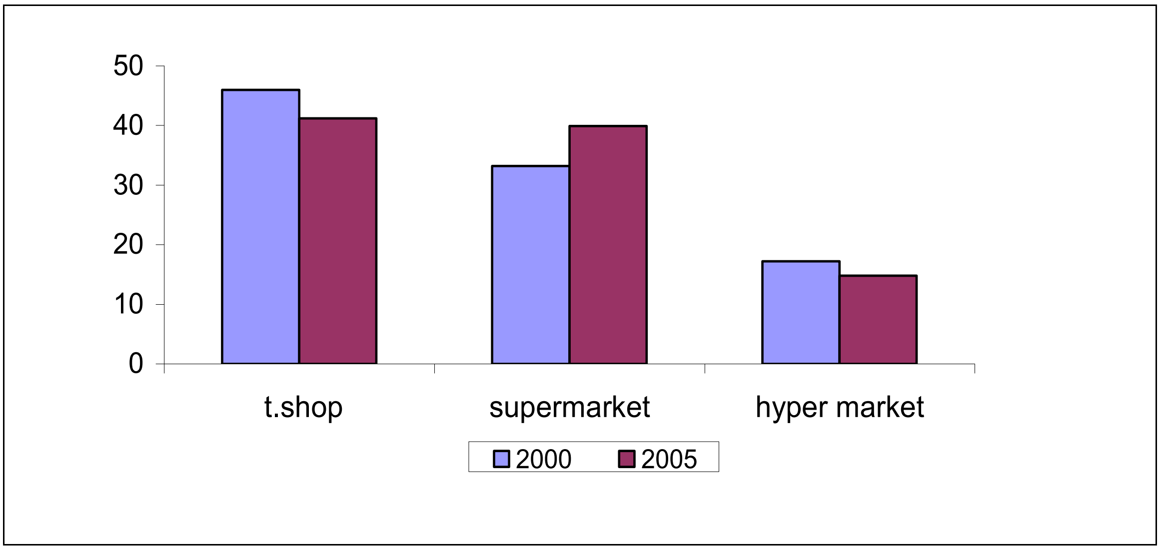
Source: MARM (2006). La alimentación en España.

Figure 2.18 Relative importance of retailing formats when purchasing Pork (%).



Source: MARM (2006). La alimentación en España.

Figure 2.19 Relative importance of retailing formats when purchasing fish (%).



Source: MARM (2006). La alimentación en España.

Chapter 3
Theoretical and econometric frameworks

This chapter will discuss the theoretical and econometric frameworks of this thesis. The theoretical framework will concentrate on the concept of information, its effects (especially food safety information) on consumers' decisions and how we can incorporate this information into demand analysis. The second part is devoted to the econometric framework. We will focus our discussion on the econometric model that we are going to specify and estimate, the so called Generalized Almost Ideal Demand System (GAIDS).

3-1- The theoretical framework

It is evident that consumers today are increasingly responsive to new information about food safety. In certain cases information can influence long-term trends in food consumption together with other factors such as income, changes in relative prices, changes in lifestyles, etc. In other cases, new information can result in "food scares", a sudden heightened level of concern about the safety of a particular product, which can stimulate rapid and significant reductions in demand that may or may not recover in the medium or long term (Spencer et al. 2002). In this context, it is important to incorporate the health and food safety information in demand models. However before doing this let us introduce to the reader the definition of information and the main sources of health and food safety information available to consumers.

Information can be defined in many ways. Without aiming to be very exhaustive, there are a number of definitions in the literature. In earlier studies, information is associated to everything addressed to reduce random uncertainty (Shannon, 1949). However, more recent literature associate information as anything that can alter behavior (Hirschleifer, 1992) or, as Losee (1997) states, "one or more statements or facts that are received by a human and that have some form of worth to the recipient".

Dealing with food, among the relevant pieces of information consumer can receive, with no doubt, that related to health and food safety information is especially relevant. In this context, health and food safety information about food products comes from numerous sources, including: health professionals such as doctors, nurses or nutritionists; mass media such as television and newspapers; advertising and many other sources.

Information can be classified from different points of view, biased versus unbiased, accurate versus inaccurate, or favorable versus unfavorable. It is argued that unfavorable product information may weight more in decision making than similar amounts of favorable information (Weinberger and Dillon, 1980). A related hypothesis suggests that the source and type of information have different impacts on consumers. In general, personal and neutral information are more influential than non personal and market-oriented information.

Finally, it is useful to distinguish between two categories of information: information with temporary impact and information with permanent implications for consumption. While in the latest case information may impose structural breaks in consumption behavior, "temporary" news have short-run behavioral impacts and can be captured within the model structure.

The important question, however, is how to incorporate health and food safety information in demand models. 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 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 to be constant. Only in the case that the effect is temporary, we could accept introducing safety information as a demand shifter.

However, if we accept that the effect can be more permanent we should modify the consumer's maximization problem. Following Piggott and Marsh (2004), consumer's utility is assumed to depend on both the quantity of goods consumed (x_i), as well as on product's 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 (i.e. BSE). A negative relationship between public information and perceived quality is also assumed.

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

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

$$\text{S.t. } \text{p}'\text{X} + \text{I C} \leq y \tag{3.1}$$

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, $\frac{\partial \text{q}_\text{i}}{\partial \text{I}_\text{i}} \prec 0$ and $\frac{\partial \text{q}_\text{i}}{\partial \text{I}_\text{j}} = 0 \quad \forall j \neq i$.

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 (3.1) can rewrite as

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

$$\text{S.t. } \text{p}'\text{X} \leq y \tag{3.2}$$

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

$$\text{L=U}\left[\text{x, q(I)}\right] + \lambda(\text{y-p}'\text{x}) \tag{3.3}$$

where λ is the Lagrange multiplier.

By deriving (3.3) with respect to x and λ, we get the first order condition from which the Marshalian demand functions are obtained.

$$X^m = f(p,y,q(i)) \quad (3.4)$$

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

The dual cost minimization problem is:

$$\min p'x + \mu(u - U(x,q)) \quad (3.5)$$

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

$$x^h = f(p,u,q) \quad (3.6)$$

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

$$\frac{\partial x_i^m}{\partial q_k} = -\left(\frac{1}{\lambda}\right)\sum_{j=1}^{n}\left(\frac{\partial x_i^h}{\partial p_j}\right)U_{x_j q_k} \quad (3.7)$$

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 $\frac{\partial q_i}{\partial I_i} \prec 0$ and $\frac{\partial q_i}{\partial I_j} = 0$, the Marshalian demand function can be re written as

$$X^m = f(p,y,q(I)) \Rightarrow X^m = f(p,y,I) \quad (3.8)$$

with the opposite signs for the comparative statics for I

3-2- The functional form

To capture own and cross - commodity impacts on demand from safety concerns requires the specification of the demand system shown in (3.8). The Deaton and Muellbauer's (1980) Almost Ideal Demand System (AIDS) has been widely used due to its desirable characteristics. It is a plausible demand system, easy to estimate and the imposition of theoretical restrictions is straightforward.

The AIDS model is derived by specifying an expenditure function representing a PIGLOG "price independent generalized linearity logarithm" class of preferences. This PIGLOG class of preference leads to the following cost function, which is the minimum expenditure necessary to achieve a certain level of utility at any given price:

$$\log c\,(u, p) = (1\text{-}u) \log a(p) + u \log b\,(p) \quad (3.9)$$

were u is the level of utility, a (p) and b (p) represent functions of a price vector p that can be regarded as the costs of subsistence and bliss, respectively. For the resulting cost function to be a flexible functional form, the following functional forms are assumed for log a (p) and log b (p):

$$\log a(p) = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2}\sum_i \sum_j k_{ij} \log p_i \log p_j \qquad (3.10)$$

$$\log b(p) = \log a(p) + \beta_0 \prod_i p_i^{\beta_i} \qquad (3.11)$$

Substituting (3.10) and (3.11) in (3.9) we get the AIDS cost function:

$$\log c\,(u, p) = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2}\sum_i \sum_j k_{ij} \log p_i \log p_j + \beta_0 \prod_i p_i^{\beta_i} \qquad (3.12)$$

Following Shephard (1970), a fundamental property of the cost function is given by:

$$\frac{\partial c(u,p)}{\partial p_i} = q_i$$

Multiplying both sides by $\frac{p_i}{c(u,p)}$, we find: $\frac{\partial \log c(u,p)}{\partial \log p_i} = \frac{p_i q_i}{c(u,p)} = w_i$

where w_i is the budget share of the i-th good , Thus the logarithmic differentiation of (3.12) gives the budget shares as a function of prices and utility

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i u \beta_0 \prod p_k^{B_k} \qquad (3.13)$$

where $\gamma_{ij} = \frac{1}{2}\left(k_{ij} + k_{ji}\right)$

As y = c (u,p), this equation can be inverted to set u as a function of p and x. If we do this for (3.13) we get the static AIDS model in expenditure share terms:

$$w_{it} = \alpha_i + \beta_i \ln\left(\frac{y_t}{P_t}\right) + \sum_i^n \gamma_{ij} \ln\ p_{jt} + u_t \qquad (3.14)$$

Subscript t indicates time, P_t is a price index defined as:

$$\log p_t = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj} \log p_k \log p_j\,;$$

α_i, B_i and γ_{ij} are parameters to be estimated and u_{it} is the error term.

The theoretical restrictions of adding-up, homogeneity and symmetry can be expressed as:

Adding-up: $\sum_{i=1}^{n} \alpha_{i0} = 1$, $\sum_{i=1}^{n} \beta_i = 0$ and $\sum_{i=1}^{n} \gamma_{ij} = 0$

Homogeneity : $\sum_{j=1}^{n} \gamma_{ij} = 0$

Symmetry: $\gamma_{ij} = \gamma_{ji}$

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 elasticities) 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 generalised version of the AIDS model (GAIDS), first developed by Bollino (1987), preserve the desirable theoretical property of being “closed under unit scaling” (CUUS).

Bollino (1987) generalizes the AIDS model by incorporating the so called pre-committed quantities (those quantities that are not sensitive to income or price effects). The starting point (Piggott and Marsh, 2004) is the following generalised expenditure function:

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

where p is a n-vector of prices, C is 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:

$$x_i = c_i + x_i^*\left[p, y^*\right] = c_i + x_i^*\left[p, y - \sum_{i=1}^{N} c_i p_i\right] \tag{3.15}$$

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

Under model (3.15) 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. This translating approach is plausible in the context of this study as we are indeed considering the possibility that consumers might decide to change consumption decisions irrespective of prices and income. As noted by Piggott and Marsh (2004) augmenting the pre-committed quantities does not imply any restrictions on parameters of demand shifters. The only required restriction is that the changes in expenditure on pre-committed quantities must be equal and opposite to changes in supernumerary expenditure, leaving total expenditure unchanged. 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 (3.15) the GAIDS model in share form can be expressed as:

$$w_i = \left(\frac{p_i c_i}{y}\right) + \left(\frac{y^*}{y}\right)\left(\alpha_i + \sum_{j=1}^{N} \gamma_{ij} \ln p_j + B_i \ln\left(\frac{y^*}{p}\right)\right) + e_i \tag{3.16}$$

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

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

Adding-up: $\sum_{i=1}^{n} \alpha_{i0} = 1$, $\sum_{i=1}^{n} \beta_i = 0$ Homogeneity: $\sum_{j=1}^{n} \gamma_{ij} = 0$ Symmetry: $\gamma ij = \gamma ji$.

Elasticities

The most important economic information in demand systems is provided by elasticities. In the following paragraphs we will derive the corresponding formulas for both the AIDS and the GAIDS model.

Expenditure elasticity

From (3.16) we get

$$w_i = \frac{\mathrm{p_i} c_i}{y} + \left(\frac{\mathrm{y}^*}{\mathrm{y}}\right)\left(\alpha_i + \sum_{i=1}^{n} \gamma_{ij} \ln(p_j) - B_i \ln(\mathrm{p}) + B_i \ln(y^*)\right) \tag{3.17}$$

The derivative of (3.17) with respect to the logarithm of total expenditure(y) has the following expression:

$$\frac{\partial w_i}{\partial \ln y} = -\frac{p_i c_i}{y} + \frac{(y - y^*)}{y} * w_i^* + \frac{y^*}{y}(B_i \frac{y}{y^*}) = -\frac{p_i c_i}{y} + \frac{1}{y}(y - y^*) * w_i^* + B_i$$

Taking $\frac{1}{\mathrm{y}}$ as a common factor we have

$$\frac{\partial w_i}{\partial \ln y} = \frac{1}{y}(-p_i c_i + w_i^*(y - y^*) + B_i)$$

Thus, the expenditure elasticity is given by

$$\eta_{iy} = 1 + \frac{\partial \ln w_i}{\partial \ln y} = 1 + \frac{\partial w_i / w_i}{\partial \ln y} = 1 + \left[\frac{1}{\mathrm{y}}(\text{-}\mathrm{p_i c_i} + \mathrm{w_i}^*(\mathrm{y}\text{-}\mathrm{y}^*) + \mathrm{B_i})\right] / \mathrm{w_i}$$

while in the AIDS model, the expenditure elasticity is given by(Green and Alston, 1991):

$$\frac{\partial w_i}{\partial \ln y} = B_i$$

$$\eta_{iy} = 1 + \frac{B_i}{w_i}$$

Marshalian price elasticity

From (3.16) we get

$$w_i = \frac{p_i c_i}{y} + \left(\frac{y^*}{y}\right)\left(\alpha_i + \sum_{i=1}^{n} \gamma_{ij} \ln(p_j) - B_i \ln(p) + B_i \ln(y^*)\right)$$

Rearranging terms:

$$\left(\alpha_i + \sum_{i=1}^{n} \gamma_{ij} \ln(p_j) - B_i \ln(p) + B_i \ln(y^*)\right) = \left(w_i - \frac{p_i c_i}{y}\right) * \frac{y}{y^*} = w^* \qquad (3.18)$$

where w^* represents the supernumerary expenditure share.
On the other hand, the derivative of (3.18) with respect to $\ln p_i$ equals:

$$\frac{\partial w_i}{\partial \ln p_i} = \frac{p_i c_i}{y} + \frac{- p_i c_i}{y} * w^* + \frac{y^*}{y}(\gamma_{ij} - B_i(\alpha_i + \sum \gamma_{ij} \ln p_j) + \frac{B_i}{y^*}(-c_i p_i))$$

$$= \frac{p_i c_i}{y} - \frac{p_i c_i w^*}{y} + \frac{y^*}{y}(\gamma_{ij} - B_i(\alpha_i + \sum \gamma_{ij} \ln p_j) + \frac{B_i}{y} * (-c_i p_i) \qquad (3.19)$$

Then, the uncompensated price elasticity is given by:

$$\eta_{ij} = -d_{ij} + \frac{\partial \ln w_i}{\partial \ln p} = -d_{ij} + \frac{\partial w_i / w_i}{\partial \ln p}$$

where d_{ij}=1 for $i = j$ and d_{ij} = 0 for $i \neq j$.
And using (3.19), we get:

$$\eta_{ij} = -d_{ij} + \frac{1}{yw_i}\left\{c_i p_i (1 - w_i^*) + y^*(\gamma_{ij} - B_i(\frac{c_i p_i}{y^*}) + \alpha_i + \sum \gamma_{ij} \ln p_j)\right\} \qquad (3.20)$$

while in the case of the AIDS model, the price elasticity is given by (Green and Alston, 1991):

$$\eta_{IJ} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{B_i \alpha_i}{w_i} - \frac{B_i}{w_i} \sum \gamma_{ij} \ln p_i \tag{3.21}$$

As can be observed equation (3.21) is also obtained by resetting $c_i = 0$ in (3.20) (Green and Alston, 1991).

Hicksian price elasticity

Using the Slutsky equation, Hicksian price elasticities have the following expression:

$\varepsilon_{ij} = \eta_{ij} + w_j \eta_{iy}$

Chapter 4
Data sources, description and specification

As concluded by Clarke (1976) models´ estimation using monthly, bimonthly or quarterly data is most likely to be free of data interval bias. Moreover econometric literature indicates that the impact of communication on demand is generally a matter of months rather than of quarters or years (Verbeke and Ward, 2001). Thus, monthly data have been used in this study to analyse the impact of information related to BSE on fresh meat demand in Spain. Four fresh meat groups are included: beef, pork, lamb and chicken. Additionally fish consumption is included also. The sample period extends from January 1997 to September 2006.

The data set consists of monthly per capita expenditure (€/capita) and retail level prices (€/Kg.) for the five products during the above mentioned period. Data came from the former Spanish Ministry of Agriculture, Fisheries and Food (MAPA)[1]. 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.

4.1. The Information index

Several types of indices have previously been introduced for use in econometric demand analyses, ranging from dummy variables (Tansel, 1993), actual message numbers (Smith et al., 1998) or cumulative message numbers (Brown and Schrader, 1990; Chang and Kinnucan, 1991; Van Ravenswaay and Hoehn, 1991), sometimes with discrimination between negative and positive messages and/or including some message or time weighting factor.

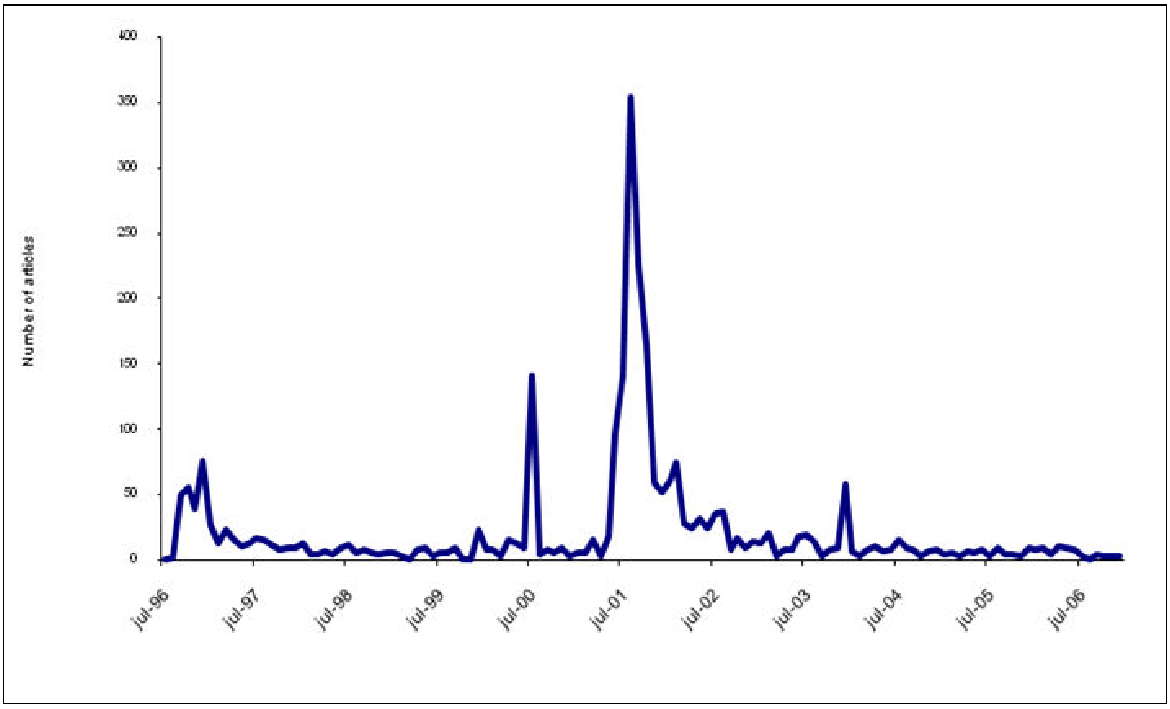
In this study we have developed an information index based on the published news related to the mad-cow disease in the most popular Spanish newspaper “El País”. Actually, this newspaper is considered, following the Asociación para la Investigación de Medios de Comunicación (AIMC)

[1] Now, Ministry of Environmental, Rural and Marine Affairs (MARM).

(Association for Mass Media Research) as the first Spanish newspaper taking into account the number of readers (Estudio General de Medios “EGM” 2006).

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 Spongiforme Enzephalopathie, and Creutzfeldt-Jakob disease “CJD” (vacas locas, Crisis bovina, Encefalopatía espongiforme bovina”EEB”, Enfermedad de Creutzfeldt-Jakob). Results are shown in Figure 4.1.

Figure 4.1 Number of newspaper articles published in “El Pais” newspaper that mentioned “mad- cow disease”.



The average number of published 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, and the minimum number of news was zero in January 1996.

No discrimination between positive or negative messages (as in Smith et al., 1988; Liu et al., 1998; and Verbeke and Ward, 2001, among others) was carried out because, as indicated by Mazzocchi (2006), such discrimination can be highly subjective. For example, news about the incubation period of the

Creutzfeldt-Jakob disease, which was linked to BSE, suggests a possible latency period of up to twenty years. While this could be a source of anxiety for a younger consumer, the same information could lead to a lower hazard perception for an older one. Furthermore, Smith et al. (1988) noted an extremely high correlation between news classified as positive and negative. This is due to the fact that media interest drives the volume of news, and when coverage increases, both positive and negative news reports rise. A change in the balance between positive and negative news could only be triggered by the disclosure of novel scientific evidence, which rarely happens in the short term. 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. For example, a very short article invoking the relationship between the BSE and the human disease “CJD” will affect consumer behavior more than another longer one just speaking about the spread of the disease among cows.

Once we have counted the number of news, the second step has been to build the index. In doing so, Burton and Young (1996) indicated that this index should be defined in such way to incorporate some mechanism to permit the effects of BSE publicity to dissipate over time. Also, Mazzocchi et al. (2004) mentioned that it is inappropriate to assume that the marginal impact of a single piece of news is constant over time, which is the case when a single media index is devised. To overcome this problem, and taking in account the lagged and diminishing effect of information over time, we have adopted in our study the weighted information indices introduced by Chern and Zuo (1995) and Kim and Chern (1997).

Chern and Zuo (1995) in their study about the impacts of fat and cholesterol information on consumer demand extended the cholesterol information index introduced by Brown and Schrader (1990); more precisely they used a cubic or third degree polynomial weight function defined as follows:

$$v_i = \gamma_0 + \gamma_1 i + \gamma_2 i^2 + \gamma_3 i^3$$

where i is the number of the i-th lagged period. To determine the value of γ_j parameters (j = 0, 1, 2, 3) the following criteria should be taken into consideration: (1) the maximum weight lies somewhere between the current period (j=0) and the longest period (j =n); (2) the minimum weight occurs at j =n+1 and is set to be zero; and (3) the sum of weights over the current and lagged period is equal to one.

Let n be the number of total lag periods and m the lag period with the maximum weight. Based on the above mentioned criteria we can impose the following restrictions:

$dv_i / di = 0$ at i=m for defining the maximum

$dv_i / di = 0$ at i=n+1 for defining the minimum

$v_{n+1} = 0$, and

$\sum v_i = 1$

From these four restrictions we can find the solutions to γ_j's in terms of m and n. By substitutions, the cubic function can be rewritten as:

v_i = 2a/ ((n+1)b) + (12m/b)i - (6(n+1+m)/((n+1)b)i^2 +(4/((n+1)b)i^3

where:

$a = (n+1)^2(n+1-3m)$ and

$b = (n+2)\left[(n+1)^2 - m(2n+3)\right]$

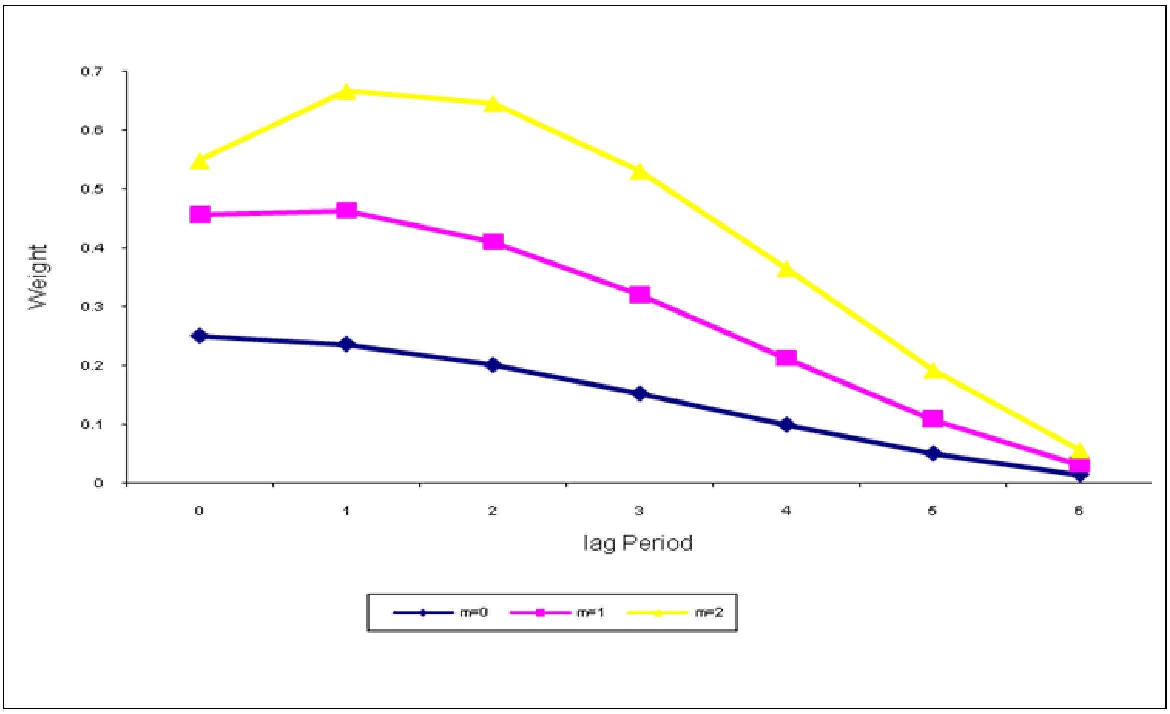
The monthly information index is then given by:

$$I_t = \sum_{i=0}^{n} v_i Np_{t-i}$$

where I_t is the weighted information index and Np_t is the number of news published in month t.

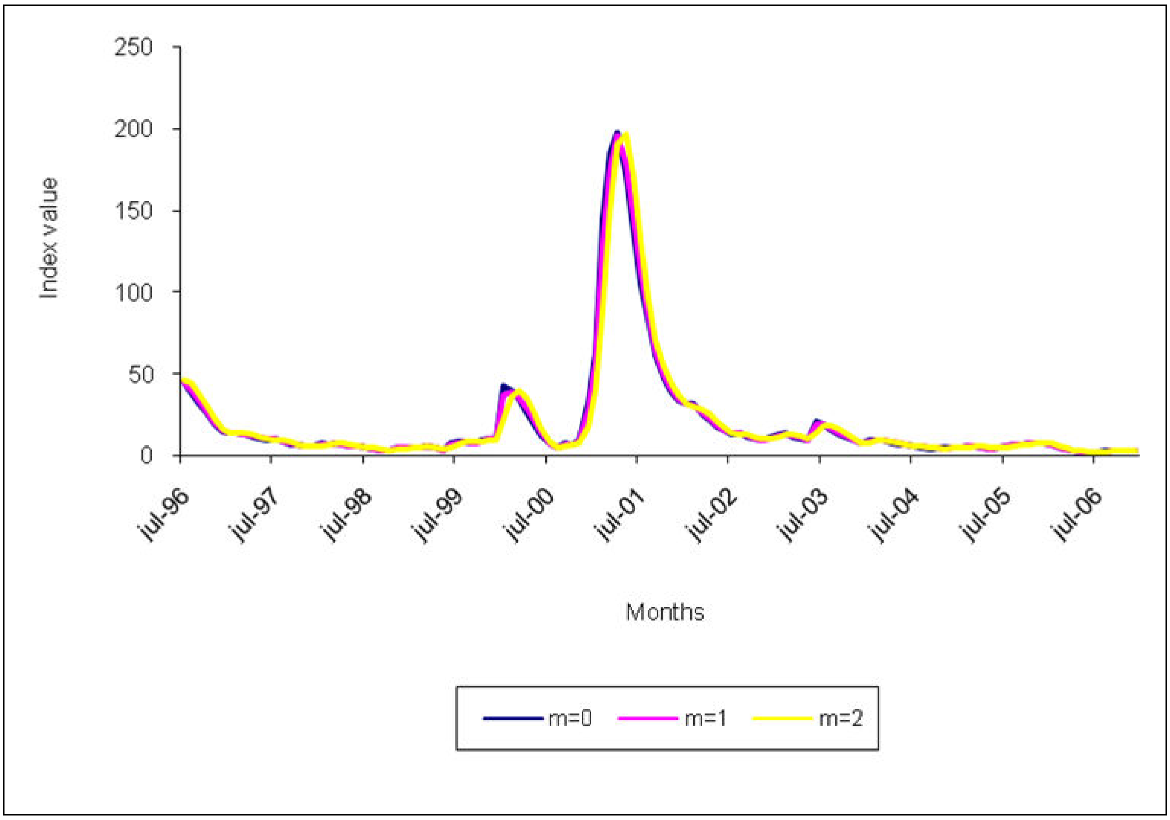
There is no an easy way to determine n and m. In this study we have simulated the resulting index for a set of combinations of m and n (m = 0,1,2,3,4. and n = 3,6,12).[2] Results indicate that, in principle, the resulting index was not very sensitive to values of m and n. As a result, we have set n to be 6. Figure 4.2 shows the obtained weights for n = 6 and m = 0,1 and 2. Moreover Figure 4.3 shows how the information index looks like for m =0,1 and 2. As can be observed, results are almost identical. Moreover correlation among them is always over 0.9. As a result, we have decided to build the information index by choosing n = 6 and m =2. In any case, the validity of this index can only be tested by their explanatory power in a demand system which is one of the objectives of this thesis.

Figure 4.2 Weights from cubic function with n=6 and different peak times (m).



2 Chern and Zuo pointed out that the expression $(n+1-3m)$ in the equation should be positive. This requires m $\leq (n+1)/3$. Failure of this condition will result in a negative weight (v_i) which is not acceptable.

Figure 4.3 Weighted information index with n=6 and different peak times (m).



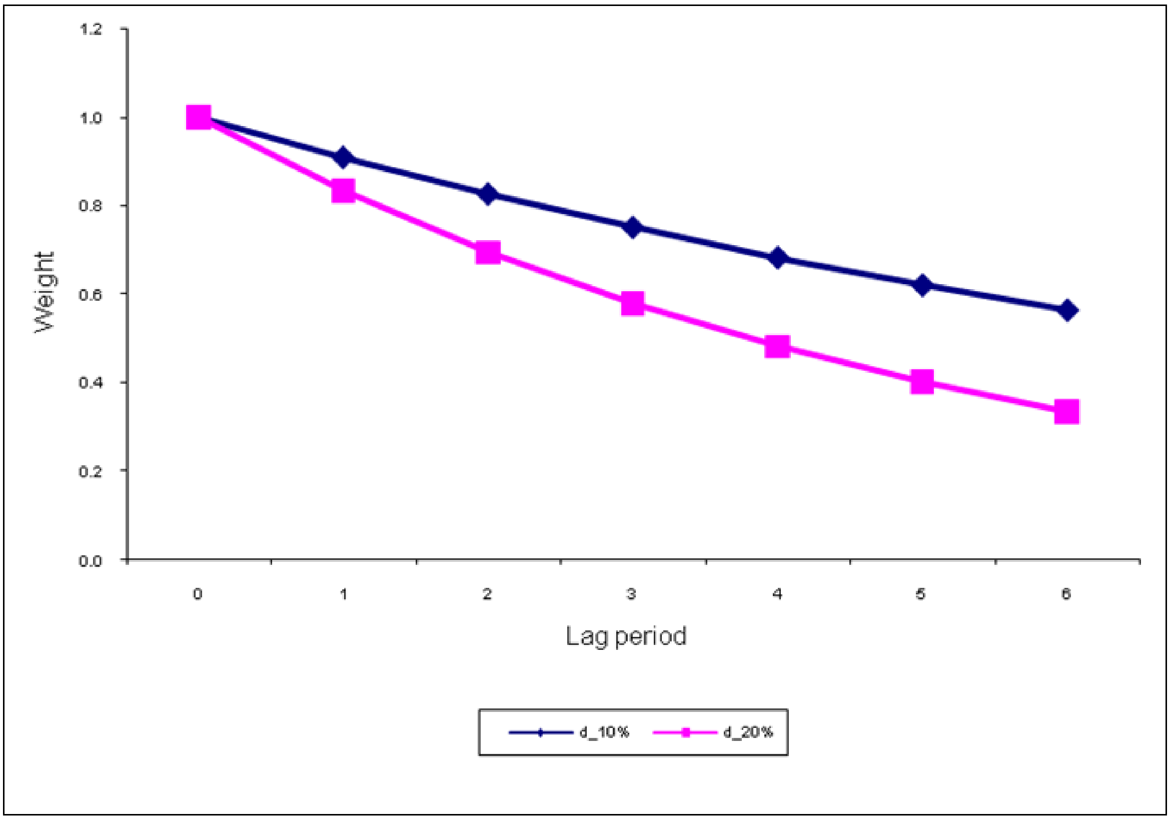
Kim and Chern (1997) mentioned that the restrictions Chern and Zuo (1995) used in determining the coefficients of the cubic weight function may be problematic because a newspaper article published several years ago (e.g. ten years) may be still affect the current health knowledge of the consumers. Therefore they proposed to construct a new information index using a geometrically declining weight function as follows:

$$v_i = \alpha \left(\frac{1}{1+d} \right)^i$$

where d is the decaying rate and i is the carryover period.

Kim and Chern did not offer a specific criterion to determine the value of d but they indicated that for a larger d the effectiveness of a published article as a source of information decreased faster over time. In our study, we have calculated the resulting index by allowing n to take up the following values 3, 6 and 12 and d between 10 and 20%. Figure 4.4 shows how the weights look like for n = 6 (to be consistent with the cubic function) and for the two values of d. Moreover Figure 4.5 shows the weighted information index for both values of d. Finally Figure 4.6 shows the comparison between the weighted information indices calculated using the cubic function (n=6, m=2) and the geometrically declining weight function (n=6, d=10%).[3]

Figure 4.4 Weights from a geometrically declining function for different values of d.



As observed, the obtained weighted information indices from both the cubic weight function and the geometrically declining weight function seem to be identical. In this study we have chosen the cubic weight function to be included in the estimation of our demand system as it is slightly smoother than the other one.

[3] A 10% value for “d” finally has been choosen as it is thought to represent in a more realistic way the impact of the information period, in spite of that results using d=20% were almost identical.

Figure 4.5 Weighted information index using a geometrically declining weight (n=6) for different values of d.

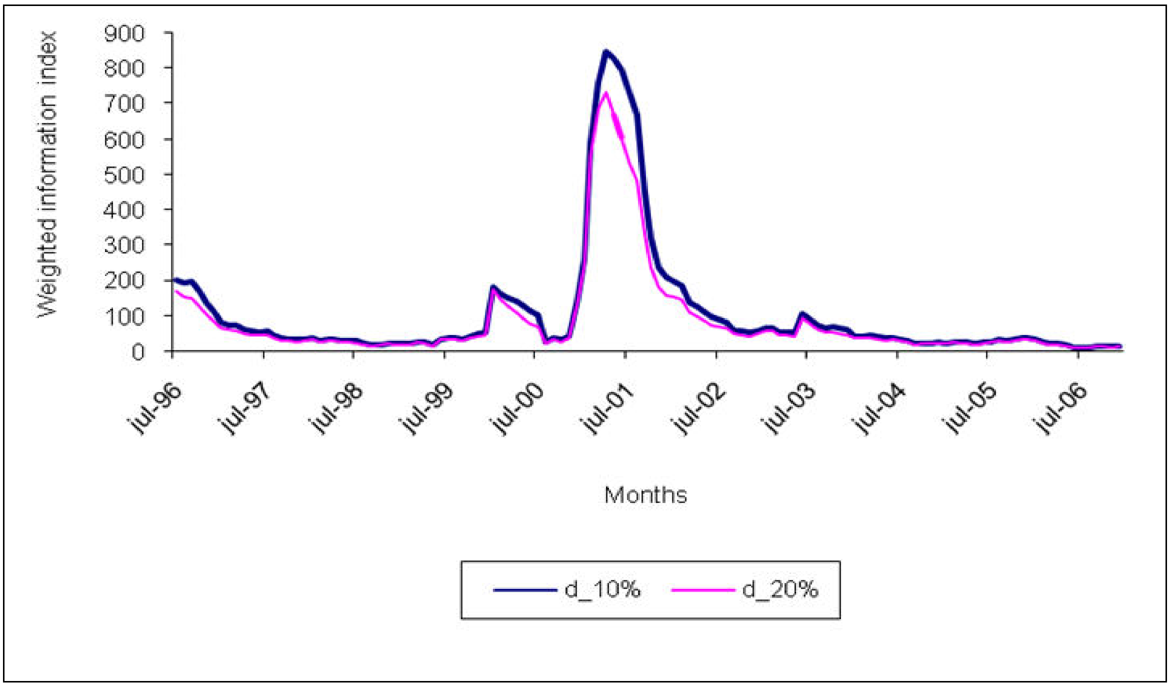
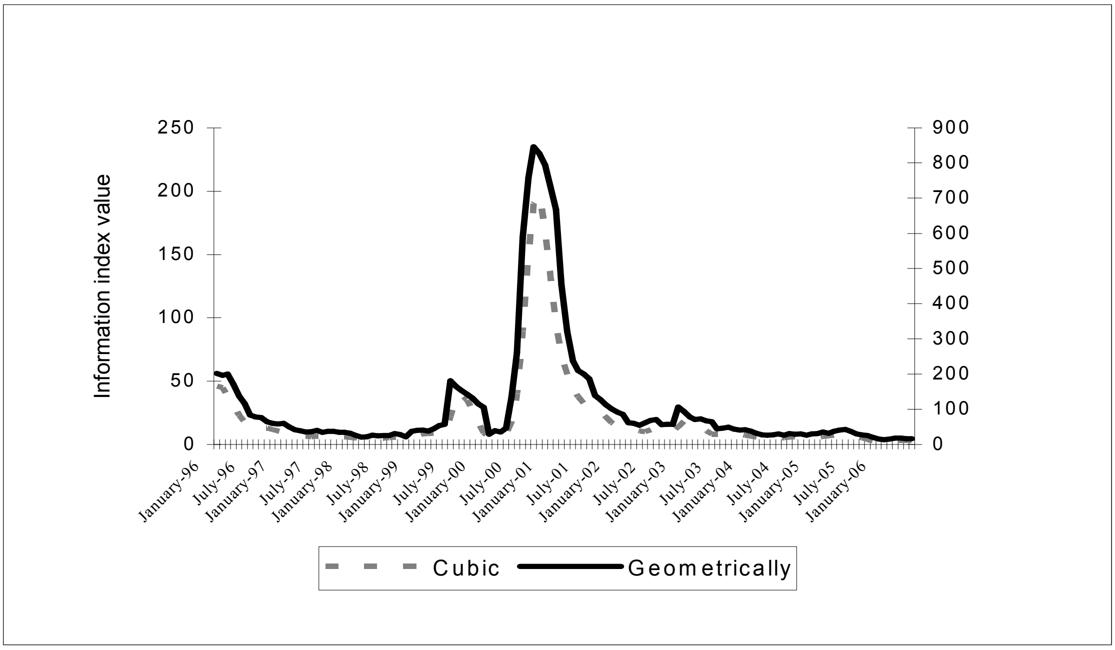


Figure 4.6 Comparison between the weighted information indices estimated through a cubic (n=6, m=2) and a geometrically declining functions (n=6, d=10%).



To end with this section Table 4.1 shows the descriptive statistics of the analyzed variables during the sample period. As can be observed fresh fish represents the largest expenditure share among the five food groups considered in this study with about 35% of total expenditure in average terms, followed by pork, beef and chicken with a relatively similar importance of about 20% each one. Sheep meat is the least important meat type with only about 9% of total fresh meat and fish expenditure.

Regarding meat prices lamb and beef are considered the most expensive meat types with an average of 7.57 and 7.42 €/Kg. respectively. Conversely chicken is the cheapest fresh meat product (2.8 €/Kg). Fish and pork prices lie in between. However, it is interesting to note that both products show the highest volatility, especially pork.

Finally, the value of the information index ranged between 2.47 and 196.31 with an average of 20.12 during the sample period used in this study.

Table 4.1 Descriptive statistics of the analyzed variables (1997, Jan.-2006, Sep.).

Variable	Mean	S.D.	Variance	Minimum	Maximum
Beef expenditure share	0,178	0,024	0,001	0,100	0,243
Pork expenditure share	0,217	0,031	0,001	0,164	0,307
Chicken expenditure share	0,163	0,014	0,000	0,122	0,192
Fish expenditure share	0,355	0,026	0,001	0,277	0,414
Lamb expenditure share	0,087	0,018	0,000	0,057	0,156
Beef price	7,421	0,535	0,286	5,894	8,560
Pork price	4,817	0,785	0,616	2,884	6,150
Chicken price	2,805	0,451	0,203	2,077	3,630
Fish price	5,443	0,610	0,373	4,421	6,647
Lamb price	7,574	1,061	1,126	5,798	10,530
Information index	20,119	35,148	1235,374	2,470	196,310

Chapter 5
Estimation and results

The objective of this chapter is to discuss the results obtained from estimating models presented in Chapter 3, using the data discussed in Chapter 4.The chapter proceeds as follows. As a first step, weak separability between fish and meat products is analyzed. Second, misspecification tests are carried out in order to find the best model. Finally, food demand elasticities are obtained. Results from AIDS and GAIDS model with and without including the food safety information index are compared.

5.1. 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. If it is the case, the allocation of expenditure within a weakly separable group of goods depends only on the relative prices of the goods in that particular group. Thus, separability assumptions can be used to restrict attention to a group of closely related goods and to reduce the number of relevant prices to an empirically tractable size. In the case of Spain, several studies dealing with the demand for meat products (Angulo and Gil, 2006; Garcia and Albisu, 1995; and Laajimi and Albisu, 1997; among others) have concluded that fish is not weakly separable from meat.

In spite of this empirical evidence, in this study we have explicitly tested for weak separability. The test proposed by Hayes et al. (1990) has been used to tackle with this issue. We have followed a two step procedure. First, weak separability between fish and meat types is considered. If the null hypothesis of weak separability is rejected the same test is used to check if meat and fish jointly considered as weakly separable from the rest of food products, also considered as a whole. The AIDS functional form is used for simplicity.

Weak separability adopts the following expression:

$$\gamma_{hj,g} = \gamma_{hg} w_{hj} \qquad (5.1)$$

where $\gamma_{hj,g}$ is the cross effect between product j pertained to group h (beef, lamb, pork and chicken) and group g (integrated by fish only).Those parameters are obtained by estimating a demand system with five products: beef, lamb, pork, fish and chicken with the latter eliminated due to the adding up restriction.

γ_{hg} is the cross effect between the two groups: h(meat) and g (fish). These parameters are obtained by estimating a demand system with only two groups; meat and fish.

w_{hj} is the share of the product j (the share of the different meat types in total meat expenditure).

From (5.1) we get three restrictions as the poultry equation has been eliminated due to the adding up restriction. The test statistic was 55.0, which was well over the critical value at the 5% level of significance (x^2(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, in a second step, the fresh meat and fish group can be considered weakly separable from the rest of food products, also considered as a whole. In this case, the test statistic was 8.53 with the critical value of a x^2(4) = 9.49 at the 5% level of significance indicating that fish and meat can be treated as a separable group from other food groups.

5.2. Estimation and misspecification tests

Our specification strategy started by estimating a static AIDS by fitting (equation 3.14) for beef, pork, sheep and fish by the Seemingly Unrelated Regression (SUR) 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[4].

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 corresponding elasticities. Results are shown in Table 5.1 (first column) and indicate that the model had serious misspecification problems

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

Table 5.1 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.
[e] ARCH-LM test. Critical values at the 5% level of significance are 3.93, 3.93, 3.94, 3.94 and 3.96 for models (1), (2), (3), (4) and (5), respectively.

Non-normality is associated to excess kurtosis indicating that the static AIDS was not able to capture the changing behaviour that took place between 2000 and 2001 as a consequence of the BSE. To tackle with this issue, a cubic BSE information index shown in Figure 4.6 was introduced. Misspecification tests (Table 5.1, second column) again indicated that the model was not correctly specified. The introduction of seasonal dummy variables did not improve the performance of the model (Table 5.1, third column). Finally, a dynamic version of the model was considered by introducing in each equation the twelve-period-lagged budget shares of the five products, in order to guarantee the adding-up restriction[5]. As can be observed in the last column in Table 5.1, misspecification tests indicated the statistical adequacy of the dynamic AIDS with seasonal dummies and the BSE information index. The estimated parameters of this dynamic AIDS model with and without the food safety information index are presented in tables 5.2 and 5.3.

As mentioned in chapter 3 a great disadvantage of the use of the AIDS model appears when we want to incorporate demand shifters such as the BSE information index because the AIDS model estimates of real variables (such as market shares and elasticities) are sensitive to the choice of scaling of the exogenous variables. With the aim of overcoming this problem and to capture the effect of the non economic variables like BSE information on the demand for meat and fish, 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:

$$\tilde{c}_i = c_{i0} + a_i T + \sum_{k=1}^{11} \theta_{ik} S_k + \sum_{j=1}^{5} \phi_{ij} IN \tag{5.2}$$

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_i, θ_{ik}, φ_{ij} are parameters to be estimated.

[5] 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.

Table 5.2 Parameters estimates of the dynamic AIDS model with centred monthly seasonal dummies.

Parameters	Beef		Pork		Sheep		Fish		Chicken	
a_i	- 0.260	(0.173)	0.224	(0.132)	0.201	(0.091)	0.515	(0.130)	0.320	(0.074)
θ_{i1}	0.041	(0.015)	-0.022	(0.012)	-0.065	(0.008)	0.023	(0.011)		
θ_{i2}	0.050	(0.017)	-0.053	(0.015)	-0.072	(0.010)	0.053	(0.013)		
θ_{i3}	0.058	(0.017)	-0.085	(0.015)	-0.069	(0.010)	0.072	(0.013)		
θ_{i4}	0.057	(0.017)	-0.085	(0.015)	-0.059	(0.010)	0.061	(0.013)		
θ_{i5}	0.062	(0.019)	-0.094	(0.016)	-0.068	(0.011)	0.069	(0.014)		
θ_{i6}	0.067	(0.019)	-0.099	(0.016)	-0.070	(0.011)	0.075	(0.014)		
θ_{i7}	0.068	(0.019)	-0.093	(0.016)	-0.070	(0.011)	0.071	(0.014)		
θ_{i8}	0.065	(0.019)	-0.079	(0.016)	-0.061	(0.011)	0.057	(0.014)		
θ_{i9}	0.075	(0.021)	-0.094	(0.017)	-0.080	(0.011)	0.072	(0.015)		
θ_{i10}	0.073	(0.021)	-0.091	(0.018)	-0.085	(0.011)	0.067	(0.015)		
θ_{i11}	0.061	(0.019)	-0.061	(0.016)	-0.081	(0.010)	0.053	(0.014)		
α_i	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)		
lw_{bi}	0.385	(0.153)	-0.084	(0.126)	-0.174	(0.081)	-0.090	(0.120)		
lw_{pi}	0.344	(0.210)	-0.029	(0.169)	-0.248	(0.110)	-0.054	(0.160)		
lw_{fi}	0.558	(0.285)	-0.319	(0.241)	-0.241	(0.147)	-0.067	(0.211)		
lw_{si}	0.086	(0.193)	-0.025	(0.150)	-0.128	(0.100)	0.040	(0.148)		
γ_{bi}	0.215	(0.027)								
γ_{pi}	-0.044	(0.017)	0.102	(0.019)						
γ_{si}	-0.031	(0.014)	0.005	(0.012)	0.015	(0.018)				
γ_{fi}	-0.076	(0.017)	-0.067	(0.015)	0.012	(0.012)	0.176	(0.019)		
γ_{ci}	-0.064	(0.010)	0.004	(0.008)	-0.000	(0.010)	-0.045	(0.009)	-0.014	(0.270)
B_i	0.037	(0.033)	0.033	(0.028)	0.019	(0.017)	-0.068	(0.024)		

Note: Standard Error in parentheses

Table 5.3 Parameters estimates of the dynamic AIDS model with centred monthly seasonal dummies and food safety information index.

Parameters	Beef		Pork		Sheep		Fish		Chicken	
a_i	0.048	(0.162)	0.166	(0.126)	0.141	(0.086)	0.378	(0.123)	0.268	(0.074)
θ_{i1}	0.035	(0.014)	-0.022	(0.012)	-0.063	(0.007)	0.026	(0.011)		
θ_{i2}	0.050	(0.016)	-0.054	(0.015)	-0.072	(0.010)	0.055	(0.013)		
θ_{i3}	0.056	(0.016)	-0.085	(0.015)	-0.068	(0.010)	0.075	(0.013)		
θ_{i4}	0.055	(0.016)	-0.085	(0.015)	-0.059	(0.010)	0.063	(0.013)		
θ_{i5}	0.060	(0.017)	-0.094	(0.016)	-0.067	(0.011)	0.071	(0.014)		
θ_{i6}	0.061	(0.018)	-0.098	(0.016)	-0.068	(0.011)	0.079	(0.014)		
θ_{i7}	0.061	(0.018)	-0.092	(0.016)	-0.068	(0.011)	0.076	(0.014)		
θ_{i8}	0.054	(0.018)	-0.078	(0.016)	-0.059	(0.010)	0.064	(0.014)		
θ_{i9}	0.063	(0.019)	-0.092	(0.017)	-0.076	(0.011)	0.079	(0.015)		
θ_{i10}	0.066	(0.019)	-0.090	(0.018)	-0.083	(0.011)	0.070	(0.015)		
θ_{i11}	0.053	(0.018)	-0.059	(0.016)	-0.079	(0.010)	0.058	(0.014)		
ϕ_i	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
α_i	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)		
lw_{bi}	0.269	(0.147)	-0.031	(0.130)	-0.140	(0.079)	-0.079	(0.120)		
lw_{pi}	0.098	(0.203)	0.067	(0.175)	-0.177	(0.108)	-0.011	(0.162)		
lw_{fi}	0.378	(0.267)	-0.264	(0.243)	-0.190	(0.143)	-0.015	(0.212)		
lw_{si}	-0.161	(0.189)	0.067	(0.157)	-0.056	(0.099)	0.085	(0.149)		
γ_{bi}	0.092	(0.038)								
γ_{pi}	0.003	(0.022)	0.088	(0.022)						
γ_{si}	0.010	(0.020)	-0.007	(0.012)	0.002	(0.019)				
γ_{fi}	-0.055	(0.019)	-0.082	(0.015)	0.005	(0.012)	0.181	(0.018)		
γ_{ci}	-0.050	(0.015)	-0.001	(0.009)	-0.010	(0.011)	-0.049	(0.010)	-0.232	(0.328)
B_i	0.017	(0.029)	0.035	(0.026)	0.024	(0.016)	-0.057	(0.023)		

Note: Standard Error in parentheses

Taking into account the results of misspecification tests shown in Table 5.1, a dynamic version of the GAIDS model represented in equation (3.16) has been estimated by substituting the pre-committed quantities (c_i) by (5.2). The resulting model is highly non-linear, which makes difficult to find convergence as the likelihood function is flat over a substantial range of δ values. Deaton and Muellbauer (1980) explain that the δ parameter can be interpreted as the "outlay required for a minimal standard of living when prices are one." Convergence is likely to fail because the likelihood function is flat over a substantial range of δ values. As the estimated model did not converge when δ was included in the model, this study followed the practice of previous authors (Piggott, 1997) by performing a grid search where δ is set to a range of possible values. In each case, the model is reestimated treating the δ term as constant. The value of the likelihood function at the alternative δ values is used to rank the different model specifications. Finally, the model is re-estimated using the δ value that providing the largest likelihood value. With this procedure the likelihood of convergence increases as the δ value begins near a local optimum.

The estimated parameters of this dynamic GAIDS model with and without the food safety information index are presented in Tables 5.4 and 5.5.

Table 5.4 Parameters estimates of the dynamic GAIDS model with centred monthly seasonal dummies.

Parameters	Beef		Pork		Sheep		Fish		Chicken	
c_{i0}	-1.567	(0.466)	-1.851	(0.794)	-0.513	(0.239)	-1.865	(0.841)	-1.686	(0.898)
a_i	0.007	(0.162)	0.007	(0.003)	0.002	(0.001)	0.010	(0.003)	0.008	(0.004)
θ_{i1}	-0.385	(0.252)	-0.592	(0.333)	-0.339	(0.090)	-0.527	(0.361)	-0.468	(0.368)
θ_{i2}	-1.114	(0.437)	-1.543	(0.513)	-0.659	(0.176)	-1.430	(0.580)	-1.595	(0.639)
θ_{i3}	-1.379	(0.562)	-1.959	(0.631)	-0.772	(0.235)	-1.754	(0.736)	-2.020	(0.830)
θ_{i4}	-1.840	(0.689)	-2.383	(0.741)	-0.942	(0.292)	-2.063	(0.869)	-2.691	(1.015)
θ_{i5}	-1.248	(0.502)	-1.883	(0.578)	-0.715	(0.206)	-1.378	(0.668)	-1.785	(0.736)
θ_{i6}	-0.414	(0.244)	-1.083	(0.316)	-0.380	(0.091)	-0.559	(0.350)	-0.606	(0.355)
θ_{i7}	-0.951	(0.383)	-1.642	(0.456)	-0.606	(0.151)	-1.301	(0.517)	-1.430	(0.555)
θ_{i8}	-0.594	(0.259)	-1.256	(0.335)	-0.441	(0.096)	-0.893	(0.369)	-0.944	(0.376)
θ_{i9}	-0.614	(0.299)	-1.287	(0.373)	-0.496	(0.115)	-0.840	(0.416)	-0.926	(0.434)
θ_{i10}	-0.829	(0.459)	-1.431	(0.499)	-0.595	(0.082)	-1.082	(0.587)	-1.134	(0.658)
θ_{i11}	0.212	(0.210)	-0.080	(0.284)	-0.173	(0.072)	0.370	(0.303)	0.368	(0.304)
α_i	-3.570	(2.482)	5.538	(2.234)	-2.228	(0.937)	2.982	(1.773)	-1.723	(1.013)
lw_{bi}	0.153	(0.079)	-0.006	(0.054)	-0.051	(0.034)	-0.109	(0.051)		
lw_{pi}	0.150	(0.103)	0.004	(0.076)	-0.052	(0.047)	-0.145	(0.068)		
lw_{fi}	0.100	(0.113)	0.036	(0.093)	-0.125	(0.059)	-0.071	(0.077)		
lw_{si}	0.057	(0.091)	-0.041	(0.073)	-0.010	(0.042)	-0.075	(0.058)		
γ_{bi}	0.100	(0.187)								
γ_{pi}	0.123	(0.192)	-0.125	(0.225)						
γ_{si}	-0.111	(0.067)	0.112	(0.088)	0.001	(0.051)				
γ_{fi}	-0.000	(0.119)	-0.191	(0.125)	0.045	(0.054)	0.134	(0.087)		
γ_{ci}	-0.113	(0.060)	0.081	(0.081)	-0.049	(0.033)	0.012	(0.049)	0.176	(0.138)
B_i	0.035	(0.024)	-0.051	(0.022)	0.023	(0.009)	-0.025	(0.017)		

Note: Standard Error in parentheses

Table 5.5 Parameters estimates of the dynamic GAIDS model with centered monthly seasonal dummies and food safety information index.

Parameters	Beef		Pork		Sheep		Fish		Chicken	
c_{i0}	-0.344	(0.247)	-0.273	(0.711)	-0.300	(0.393)	-0.903	(0.506)	-0.468	(0.466)
a_i	0.000	(0.000)	0.001	(0.000)	-0.000	(0.000)	0.001	(0.001)	-0.001	(0.000)
θ_{i1}	0.740	(0.260)	1.459	(0.598)	-0.041	(0.070)	0.762	(0.312)	1.128	(0.373)
θ_{i2}	0.995	(0.361)	1.751	(0.766)	-0.021	(0.104)	1.107	(0.455)	1.431	(0.523)
θ_{i3}	1.253	(0.470)	2.115	(0.983)	0.081	(0.148)	1.554	(0.642)	1.865	(0.719)
θ_{i4}	1.607	(0.611)	2.763	(1.226)	0.297	(0.222)	2.253	(0.932)	2.557	(0.997)
θ_{i5}	1.583	(0.578)	2.659	(1.170)	0.249	(0.221)	2.177	(0.899)	2.501	(0.939)
θ_{i6}	0.804	(0.371)	1.002	(0.795)	-0.086	(0.102)	0.840	(0.449)	1.107	(0.546)
θ_{i7}	1.790	(0.618)	2.864	(1.243)	0.431	(0.249)	2.869	(1.005)	2.946	(1.039)
θ_{i8}	1.138	(0.469)	1.916	(0.991)	0.041	(0.146)	1.267	(0.628)	1.618	(0.717)
θ_{i9}	1.070	(0.424)	1.722	(0.892)	-0.004	(0.133)	1.268	(0.564)	1.583	(0.643)
θ_{i10}	1,662	(0.596)	2.841	(1.207)	0.245	(0.207)	2.338	(0.888)	2.683	(0.961)
θ_{i11}	0.499	(0.260)	0.512	(0.589)	-0.160	(0.067)	0.498	(0.292)	0.698	(0.368)
ϕ_i	-0.001	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
α_i	0.016	(0.086)	-0.052	(0.127)	0.198	(0.055)	0.601	(0.121)	0.237	(0.048)
lw_{bi}	0.128	(0.074)	-0.065	(0.067)	-0.026	(0.041)	-0.303	(0.067)		
lw_{pi}	0.098	(0.100)	-0.108	(0.093)	-0.007	(0.056)	-0.033	(0.095)		
lw_{fi}	0.133	(0.130)	-0.174	(0.133)	-0.002	(0.072)	-0.019	(0.125)		
lw_{si}	-0.054	(0.085)	-0.028	(0.077)	0.046	(0.051)	-0.003	(0.083)		
γ_{bi}	0.128	(0.022)								
γ_{pi}	-0.029	(0.018)	0.062	(0.060)						
γ_{si}	0.005	(0.003)	-0.001	(0.013)	0.045	(0.017)				
γ_{fi}	-0.060	(0.014)	-0.023	(0.031)	-0.050	(0.015)	0.191	(0.018)		
γ_{ci}	-0.043	(0.008)	-0.009	(0.012)	0.001	(0.007)	-0.586	(0.011)	0.144	(0.072)
B_i	0.035	(0.029)	0.165	(0.055)	-0.058	(0.020)	-0.130	(0.046)		

Note: Standard Error in parentheses

5.3. Elasticities

The most important economic information in demand systems is provided by elasticities. Demand elasticities from both the dynamic AIDS and GAIDS models are calculated following the formulas shown in Table 5.6.

Table 5.6 Expression of most relevant elasticities from AIDS and GAIDS models[6]

	AIDS	GAIDS
Expenditure	$\eta_{iM}=\frac{\beta_i}{w_i}+1$	$\eta_{iM}=1+\left[\frac{1}{M}(-p_i c_i+w_i^*(M\text{-}M^*)+B_i)\right]/w_i$
Marchalian price	$\eta_{ij}=-\delta ij+\frac{\gamma_{ij}}{w_i}-\frac{\beta_i\alpha_i}{w_i}-\frac{\beta_i}{w_i}\sum\gamma_{ij}\ln p_j$	$\eta_{ij}=-d_{ij}+\frac{1}{Mw_i}\left\{c_i p_i(1\text{-}w_i^*)+M^*(\gamma_{ij}\text{-}B_i(\frac{p_i}{M^*})+\alpha_i+\sum\gamma_{ij}\ln p_j)\right\}$
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 $\varphi_i=\frac{\theta_i}{w_i}$. 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, which measure 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 ($\varphi_{i,IN}$) equals the derivative of the logarithm of total quantity with respect to the logarithm of the information index, which equals to the weighted sum of the derivative of pre-committed (direct effect) and supernumerary quantities with respect to the BSE information index. Mathematically:

$$\varphi_{i,IN}=\frac{\partial\ln x}{\partial\ln IN}=\frac{\partial\ln c_i}{\partial\ln IN}*\frac{c_i}{x_i}+\frac{\partial\ln x^*}{\partial\ln IN}*\frac{x^*}{x_i} \qquad (5.3)$$

[6] A detailed derivation of the GAIDS model elasticities is available in Chapter 3.

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, (5.3) can be rewritten as.

$$\varphi_{i,IN} = \frac{\partial \ln c_i}{\partial \ln IN} * \frac{c_i}{x_i} + \frac{\partial \ln x^*}{\partial \ln M^*} * \frac{\partial \ln M^*}{\partial \ln IN} * \frac{x^*}{x_i} \tag{5.4}$$

Let us consider the three derivatives in (5.4). 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 (5.2), the direct elasticity of BSE information is given by:

$$\frac{\partial \ln c_i}{\partial \ln IN} = \frac{\partial c_i}{\partial \ln IN} / c_i = \frac{\phi_{ij} IN}{c_i} \tag{5.5}$$

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.

$$\frac{\partial \ln M^*}{\partial \ln IN} = \frac{\partial M^*}{\partial \ln IN} / M^* \ = \frac{-p_i \phi_{ij} * IN}{M^*} \tag{5.6}$$

Finally, let us consider $\frac{\partial \ln x^*}{\partial \ln M^*}$ in (5.4). 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.

$$\frac{\partial x^*}{\partial \ln M^*} = \frac{M^*}{p_i} * w_i^* + \frac{M^*}{p_i} * B_i \tag{5.7}$$

Dividing both sides of (5.7) by x_i^* and taking into account that $\frac{p_i q_i^*}{M^*} = w_i^*$ we get:

$$\frac{\partial \ln x^*}{\partial \ln M^*} = 1 + \frac{B_i}{w_i^*} \tag{5.8}$$

Taking into account (5.5), (5.6) and (5.8) the expression of the total BSE information elasticity is now given by:

$$\varphi_{i,IN} = \frac{\phi_{ij} IN}{c_i} * \frac{c_i}{x_i} + \frac{-p_i \phi_{ij} * IN}{M^*} * (1 + \frac{B_i}{w_i^*}) * \frac{x^*}{x_i} \tag{5.9}$$

Table 5.7 shows the estimated conditional (as we have assumed weak separability) 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 (Figure 2.8). 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 5.7 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 of lamb consumption as consumers have limited choices within lamb meat shifting to substitutive goods. 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) of fish prices can lead to a higher (lower) demand of lower quality fish, with total fish consumption 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.

Regarding BSE information elasticities, comparing both 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 2.6. The impact on beef consumption is negative, while is positive for the rest of products. The magnitude of the positive effect is relatively higher in the case of lamb than in the other cases, as this was the fresh meat which benefited from the reduction of beef consumption due to the BSE information spread on mass media (see Chapter 2). In the case of the GAIDS model, the direct effect is not significant.

For comparison purposes, Table 5.8 shows the income and own-price elasticities calculated without introducing the BSE information index in both AIDS and GAIDS models. The most interesting result is that in both cases, the price elasticity for beef is positive. As can be observed in Figures 2-2 and 2-3, after the BSE crisis the demand for beef recovered just in a period characterized by 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.

Another interesting result is that, without the BSE information index, AIDS elasticities seems to be more plausible than those calculated from the GAIDS. These results reinforce the adequacy of the GAIDS when demand shifters are introduced. When only seasonal or other types of dummy variables are considered the CUUS property is maintained and the AIDS system performs relatively well.

Table 5-8. Calculated expenditure and own price elasticities from both the AIDS and the GAIDS models

	AIDS	GAIDS
Marshalian own-price		
Beef	0.511 (0.237)	0.231 (0.312)
Pork	-0.483 (0.071)	-0.626 (0.201)
Lamb	-0.603 (0.068)	-0.134 (0.123)
Fish	-0.246 (0.062)	-0.599 (0.144)
Chicken	-0.375 (0.059)	-0.401 (0.639)
Expenditure		
Beef	1.303 (0.047)	0.880 (0.240)
Pork	1.039 (0.005)	1.131 (0.158)
Lamb	1.244 (0.042)	0.799 (0.105)
Fish	0.817 (0.015)	0.847 (0.067)
Chicken	0.894 (0.010)	2.094 (0.500)

Note: Standard Error in parentheses

Chapter 6
Conclusions

The amplification of food scares by mass media has increased consumers' concerns about food safety worldwide. In Spain, the BSE crisis provoked a significant reduction in beef consumption indicating that food safety concerns may have a potentially impact on meat consumers' preferences in addition to the traditional economic factors of income level and prices.

The objective of this thesis has been to assess consumers' reactions to food safety information provided by mass media. Specifically, this thesis has focused on the effect of BSE information on the demand for fresh meat and fish in Spain. A better understanding of the consumers' responses to such type could be important to both policy analysts and the meat industry.

After two years of research and a careful literature review, a number of decisions have been adopted in order to achieve the above mentioned objective. Although we believe that the adopted decisions have been found in sound scientific background, we recognize that in some cases other alternatives would have been also plausible; thus generating, on the other hand, new areas for further research. In the following lines we will try to summarize the main decisions adopted and the conclusions obtained. In some cases, we will make some self-criticism and outline further possibilities to be analyzed in the future.

As the main objective was to analyze the impact of BSE information on meat demand, the first decision has been the measurement of BSE information and how to introduce such information in meat demand analyses. The most common way in the literature to measure food safety information has been to construct an information index from published work. While dealing with health issues, articles published in medical journals and magazines can be a good source, as the information published is highly technical (it is assumed that information read by health agents finally will reach citizens), in the case of food safety and food scares, mass media is the relevant information source. The main disadvantage is that usually this type of information uses to amplify the potential impact of the food scare. In this study, we have developed an information index based upon the published news related to the mad-cow disease in the most popular Spanish newspaper "El País". Other mass media such as television or radio also can be used, but in Spain this information is unavailable, at least at a reasonable cost. We recognize that the newspaper journal's audience is lower but our aim was merely to account for the amount of information available to the society. We think the information we have collected is appropriate for the purpose of this research.

On the other hand, no discrimination between positive and negative messages was carried out because such discrimination can be highly subjective, as mentioned in Chapter 4. Moreover, to take into account the lagged and diminishing effect of information over time, we have adopted in our study weighted information indices, which better fits to how information is spread to society and impact on consumers' mind than a simple count of the number of published articles. Finally, as we are dealing with a specific food scare, the BSE, only information related to this specific case has been collected avoiding any reference to other issues as foot and mouth disease or avian influenza. An alternative way for modeling the food safety information effect on the demand for food products could be through the use of a Structural Time Series (STS) approach apply to demand systems. Basically, this approach consists of introducing structural change (instead of food safety information indices) and time varying coefficients in demand systems. Although some authors, such as Mazzocchi (2006), have compared results from both approaches in an AIDS framework and with a relatively simple information index, no attempt has been done up to know in relation to the GAIDS and the type of index considered in this study. This could be an obvious area for further research.

The second related decision has been how to incorporate BSE information on meat demand. Instead of including this information index ad hoc, as an additional shifter in a demand system, we have modified the consumers' utility function by incorporating both quantities of goods and perceived qualities. From the modified consumers' optimization problem we have got the demand equations. We think our approach is more consistent as it is based on theoretical background. In any case, alternative theoretical models can be use in the future to derive the demand system equations.

The third decision was about the functional form of the demand equations. The AIDS model has been extensively used in demand modeling, and this is the approach we have followed here. However, if budget shares are a linear function of demand shifters, the parameter estimates and the corresponding elasticities are not invariant to the units of measurement of both quantities and prices. To solve this problem, we have specified, as suggested by recent literature (See Chapter 3), the generalized version of the AIDS (GAIDS). Results from both models are compared along the study. In any case, further research is still needed about consistency of results depending on the functional form finally chosen (Rotterdam Models, Generalized Addilog Demand System…).

Our final decision, in terms of the methodological approach, has been to keep scientific rigor in all our work in order to specify a demand system satisfying all theoretical restrictions (homogeneity and symmetry) and econometric requirements (normality and non autocorrelated residuals). Moreover, we have explicitly test about weak separability of meat and fish in relation to other food groups and the possibility of considering fresh fish integrating the same group together with the rest of fresh meats.

Obtained results suggest a number of points. First and consistent with previous literature, fresh fish should be incorporated in a meat demand system. Second, dynamic models have to be specified in order to overcome misspecification problems. 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. In our case, results obtained from the GAIDS model are more consistent, in the case of introducing the food safety information index, with expectations taking into account the evolution of meat consumption in Spain during the last decade. However, when only seasonal or other types of dummy variables are considered the CUUS property is maintained and the AIDS system performs relatively well.

Information on BSE 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 by the food scare (beef), while the effect is positive in other cases, mainly for lamb, the principal substitute of beef meat in term 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. Although, this study has been proved to be useful in better understanding meat demand in Spain, it can be extended in many ways. First, it is straight forward to incorporate food safety information affecting other meats (Foot and Mouth, avian influenza…) to have a global picture of meat consumption in Spain. Second, as mentioned above, further research is needed in order to compare results from introducing food safety information indices with other alternatives as the STS. And last, but no least, this work can be extended to other countries, in order to check if consumer reactions can be generalized or they are country specific depending on specific regulations) or to other more recent food scares such as the avian influenza.

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