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## A fresh meat almost ideal demand system incorporating negative TV press and advertising impact

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### Abstract

This paper investigates fresh meat consumption in Belgium during 1995–1998 through the specification of a three-equation almost ideal demand system (AIDS) incorporating a media index of TV coverage and advertising expenditures as explanatory variables. Estimated parameters and elasticity coefficients are plausible and consistent with demand theory. Own-price elasticities are relatively low, indicating a low fresh meat demand sensitivity to price changes over this period which was dominated by mass media reports about the potential health risks associated with meat consumption. The scope of the paper extends beyond the estimation of elasticity coefficients and includes the specification of a media index and simulations that provide insights into the impact of negative press relative to advertising efforts. Specifically, the impact of television publicity is shown to have been particularly negative on beef/veal expenditures in favour of pork/mixture. This finding corroborates expectations since mass media issues mainly pertained to BSE (mad cow disease) and hormone residues during the investigated period. With relatively little effort being undertaken and with its current strategy, fresh meat advertising is found to have only a minor impact compared with negative press. © 2001 Elsevier Science B.V. All rights reserved.

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### 1. Introduction

During recent years, fresh meat consumption heavily declined in Belgium as it did in most European countries. A considerable body of scientific research has recently been presented with respect to the impact of meat safety scares on consumers, producers, industry and government policies (McDonald and Roberts, 1998; Latouche et al., 1998; Henson and Northen,

2000; Lloyd et al., 2000; Verbeke et al., 2000). Major meat-health issues in the EU and Belgium included BSE, growth hormone abuse, preventive antibiotic residues, pathogens, classical swine fever, and the dioxin crisis in Belgium. Each of these crises generated a considerable amount of negative mass media coverage relating fresh meat consumption to potential human health risks.

This paper specifies an almost ideal demand system (AIDS) for fresh meat in Belgium to focus on health risk and media coverage impacts on consumer behaviour. Particular emphasis is directed to the impact of communication through mass media publicity and fresh meat advertising on consumption decisions. The

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potential negative impact of media coverage of health issues on fresh meat consumption decisions has been addressed by Eales and Unnevehr (1988), Carson and Hassel (1994), Robenstein and Thurman (1996), Kinnucan et al. (1997) and Verbeke et al. (1999). Findings almost unanimously point towards falling meat intake in response to negative press coverage. A related topic with clear policy relevance involves the potential of communication through generic or brand advertising, specifically in this era dominated by negative publicity from mass media. Such advertising efforts for fresh meat have been shown to be effective under specific circumstances (Jensen and Schroeter, 1992; Forker and Ward, 1993; Ward and Lambert, 1993; Piggott et al., 1996; Ward, 1999). However, it has also been reported that a similar quantity of unfavourable news weighs far more heavily in consumer decision-making than favourable news (Mizerski, 1982; Smith et al., 1988; Chang and Kinnucan, 1991; Kinnucan and Myrland, 2000).

This analysis is based on an empirical Bayesian approach with the specification of an AIDS for fresh meat consumption in Belgium. Since its introduction by Deaton and Muellbauer (1980), the AIDS model has been used in a number of empirical studies on food consumption in general and meat consumption in particular. In our case, monthly time series data are used for the estimation of model parameters and fresh meat elasticity coefficients.

The scope of this paper clearly extends beyond presenting elasticity coefficients as is done in many applications of the AIDS model. A first extension includes the specification of a media index based on TV news reports as a measure of consumer awareness of meat-health issues. Second, the estimated parameters are used to simulate the impact of negative press and advertising on meat demand, expenditure shares and overall meat expenditures. Specifically, the potential of commercial advertising to counter negative press or publicity is explored. The following section introduces the AIDS framework for the analysis. Next, data sources and descriptive statistics are presented. Major attention is paid to the specification of the negative press variable or media index. The presentation of the empirical results and elasticity coefficients is followed by simulations and discussion. Finally, conclusions and recommendations are set forth.

## 2. The almost ideal demand system framework

The AIDS model is generated from a consumer cost minimisation problem as expressed by a cost or expenditure function (Deaton and Muellbauer, 1980; Green, 1985) that defines the minimum expenditure necessary to attain a specific utility level at a given set of prices. By logarithmic differentiation of the expenditure function with respect to prices, demand functions are obtained in budget share form. The resulting original AIDS demand functions in budget share form are given by

$$w_{it} = \alpha_i + \sum_{j=1}^m \gamma_{ij} \log p_{jt} + \beta_i (\log y_t - \log P_t) \quad (1)$$

The left-hand side of Eq. (1) indicates the budget share of the  $i$ th commodity in period  $t$ , or  $w_{it} = p_{it}q_{it}/y_t$  with  $p_{it}$  as its price,  $q_{it}$  as its quantity and  $y_t$  as total expenditure. The right-hand side of the equation includes the parameters  $\alpha$ ,  $\beta$  and  $\gamma$ ,  $p_{jt}$  as the price of commodity  $j$  in period  $t$ , and the price index  $P_t$  that is defined as

$$\begin{aligned} \log P_t = & \alpha_0 + \sum_{k=1}^m \alpha_k \log p_{kt} \\ & + \frac{1}{2} \sum_{k=1}^m \sum_{j=1}^m \gamma_{kj} \log p_{kt} \log p_{jt} \end{aligned} \quad (2)$$

Each  $\gamma_{ij}$  represents the change in the  $i$ th commodity's budget share with respect to a change in the  $j$ th price with real expenditures held constant. The  $\beta_i$  coefficients represent the change in the  $i$ th commodity's budget share with respect to a change in real expenditures with prices held constant. To be consistent with economic demand theory, the adding up restriction, homogeneity and symmetry properties are imposed in Eq. (1). Then, Eq. (1) represents a system of demand functions which add up to total expenditure (i.e. for each observation the sum of the budget shares over all equations always equals one). The homogeneity of degree zero in all prices and total nominal expenditure in proportion will not affect the physical quantities of commodities demanded or the real purchasing power of the household. Hence, in absence of changes in relative prices or real total expenditure, the budget shares will be constant. Both Marshallian or

uncompensated and Hicksian or income-compensated measures of elasticities can be computed following Blanciforti and Green (1983).

As indicated by Chang and Kinnucan (1991), classical static demand theory assumes perfect information and constant tastes and preferences at the consumer level. However, consumers frequently possess less-than-perfect information and, moreover, tastes and preferences may change as new or better information is received. When the assumption of constant consumer preferences is relaxed, consumer demand models can be extended to incorporate elements of dynamic consumer behaviour by allowing some parameters that characterise these preferences to vary with exogenous variables (Chang and Green, 1992; Rickertsen et al., 1995; Briz et al., 1998; Rickertsen, 1998). One way to include the effects of information is to assume that the price coefficients of the expenditure function depend upon information frequency levels and advertising expenditure levels. The incorporation of explanatory communication variables is here realised through changing the original AIDS Eq. (1) and price index (2) into

$$\begin{aligned}
 w_{it} &= \Omega_{it} + \sum_{j=1}^m \gamma_{ij} \log p_{jt} + \beta_i (\log y_t - \log P_t), \\
 \Omega_{it} &= \alpha_i + \lambda_{i1} \text{BVADV}_t + \lambda_{i2} \text{PKADV}_t + \lambda_{i3} \text{NPR}_t, \\
 \log P_t &= \sum_{k=1}^m (\alpha_k + \lambda_{k1} \text{BVADV}_t + \lambda_{k2} \text{PKADV}_t \\
 &\quad + \lambda_{k3} \text{NPR}_t) \log p_{kt} \\
 &\quad + \frac{1}{2} \sum_{k=1}^m \sum_{j=1}^m \gamma_{kj} \log p_{kt} \log p_{jt}
 \end{aligned} \tag{3}$$

In Eq. (3),  $\text{BVADV}_t$  and  $\text{PKADV}_t$  denote actual TV advertising expenditures, respectively, for beef/veal and pork/mixture in period  $t$ . The variable  $\text{NPR}_t$  represents the media index. This is a measure of television coverage or negative press related to fresh meat issues. The exact specification of this media index is presented in the next section.

In the conventional AIDS model, the intercepts are constants, restricted to sum to one across the equations. The conventional adding up restriction is preserved in the extended model by imposing  $\sum_{i=1}^m \lambda_{i1} = \sum_{i=1}^m \lambda_{i2} = \sum_{i=1}^m \lambda_{i3} = 0$ . The other parametric restrictions implied by demand theory

(homogeneity and symmetry) are unaffected by the modification of the intercepts.

### 3. Data sources, descriptives and specifications

#### 3.1. Descriptive statistics of the raw data

Based on an in-depth survey of the econometric measurement literature, Clarke (1976) concluded that estimation using monthly, bimonthly or quarterly data is most likely free of data interval bias. Econometric literature indicates that the impact of communication on demand is generally a matter of months rather than of quarters or years. Therefore, monthly observations were used with the data extending from January 1995 to December 1998, giving a total of 48 data points for each variable. Quantity and price data originated from the GfK consumer household panel (GfK, 1999) and pertained to at-home consumption. The great value of panel data as the basic mode of data collection for the measurement of communication effects on demand has been stressed by Simon and Arndt (1980).

Using the panel data observations a three-equation demand system was specified and estimated with the three product groups defined as beef and veal, pork and meat mixtures, and poultry. The rationale for the aggregations follows from previous research on Belgian meat consumers (Peeters et al., 1997; Verbeke, 1999; Verbeke and Viaene, 1999). First, aggregation of beef and veal in the context of this research is reasonable since both beef and veal originate from the same animal species and have been facing similar controversy and publicity with respect to potential human health risks. Additionally, both beef and veal are priced in the upper price range and are hence considered as the more expensive fresh meats (Verbeke and Viaene, 1999). Second, the aggregation of pork and meat mixture is justified by the fact that about 85% of the raw meat used in mixtures is pork. Additionally, both meat types are positioned as the more convenient and easy to prepare fresh meats. The resulting three-equation demand system, including beef/veal, pork/mixture and poultry covers 92% of fresh meat expenditures in Belgium. For simplicity, the expressions “beef/veal” and “pork/mixture” are used interchangeably with “beef” and “pork”, respectively, in the remainder of this paper (e.g. in the simulation graphs).

Table 1

Descriptive statistics of the time series data in the AIDS model, January 1995 to December 1998

Variable	Minimum	Maximum	Mean	S.D.	Unit
<b>Beef/veal</b>					
Quantity	0.73	1.44	1.06	0.17	kg per capita per month
Price	7.95	9.17	8.60	0.31	€/kg
Share	31.2	42.3	36.1	2.9	% of meat expenditures
<b>Pork/meat mixtures</b>					
Quantity	1.49	2.73	2.06	0.28	kg per capita per month
Price	4.70	6.35	5.59	0.33	€/kg
Share	39.1	50.8	45.8	2.9	% of meat expenditures
<b>Poultry</b>					
Quantity	0.66	1.39	0.94	0.16	kg per capita per month
Price	4.04	5.65	4.84	0.33	€/kg
Share	15.5	24.5	18.1	2.1	% of meat expenditures
Beef/veal advertising	0	8.67	1.65	2.31	1000 € per month
Pork/mixture advertising	0	3.57	0.43	0.88	1000 € per month
<b>TV coverage</b>					
Actual	0	19	3.9	3.6	Messages per month
Media index	0.05	33.7	15.1	8.2	Stock of knowledge

Considerable variation in the variable values is seen across the data period (Table 1). Per capita consumption volumes range from 0.73 to 1.44 kg per month for beef/veal, from 1.49 to 2.73 kg per month for pork/mixture and from 0.66 to 1.39 kg per month for poultry. Prices vary from 7.95 to 9.17 €/kg for beef/veal, from 4.68 to 6.35 €/kg for pork/mixture and from 4.04 to 5.65 €/kg for poultry. The resulting expenditure shares vary between 31.2 and 42.3% for beef/veal, between 39.1 and 50.8% for pork/mixture and between 15.5 and 24.9% for poultry.

Since the specific objective of the paper is to account for the impact of communication on meat demand, advertising and publicity variables are included in the demand system as previously described. Advertising expenditures have most frequently been used as a measure of advertising activities. In Belgium, generic meat advertising efforts are typically undertaken by a promotion board and funded partly by government (taxpayers) and partly by check offs from all participants in the meat chain. Generic advertising efforts outweigh brand advertising, which is mainly undertaken by retailers or specific organisations with fully integrated meat chains. Our study relies on actual TV advertising expenditures and hence assumes every nominal amount of money spent as an identical treatment without imposing an advertising lag

structure. This is reasonable given the relative short period underlying the analysis. Generic and brand TV advertising expenditure for beef/veal is denoted BVADV, while TV advertising for pork is expressed as PKADV. During the time interval considered, no expenditures were assigned to television advertising for poultry or other fresh meats. Given the limited time period covered, neither advertising expenditure data nor meat prices are deflated.<sup>2</sup>

<sup>2</sup> Reviewers raised the issue of addressing the dynamics of response to advertising shocks by using a distributed lag structure, similar as for the negative press index (see below). In the above model the negative press index was introduced using a predetermined lag structure and there is clear empirical evidence that press stories had a cumulative effect. In the models set forth in this paper (Eq. (3), Table 2) all advertising is included in the form of contemporaneous promotion expenditures. The same model was estimated with both the beef and the pork advertising following the same weighting procedures used for the negative press stories. However, in this case, the beef or pork coefficients were not statistically significant. The authors recognise that, with longer datasets, a lag structure for beef and pork advertisement may exist and merits consideration. However, with the limits of the current data, lag structures for beef and pork advertising are not evident. In a number of studies on US beef promotions, Ward has concluded that the carryover effects are not evident based on various distributed lag models covering a much longer period than used in the present analysis. The interested reader may contact the authors for more details.

### 3.2. Specification of the media index

Much previous research on media impact relied on basic input from scientific journal databases such as MEDLINE. The underlying hypothesis is that those scientific medical journals are read by medical personnel, consumer advocates or the popular media, who in turn transfer the information to consumers (Rickettsen and von Cramon-Taubadel, 2000). Although journal database indices often perform reasonably well, the explicit assumption of full information flow from science to consumer is recognised as the major drawback to this approach. Therefore, the effect of mass media publicity (non-commercial communication) about meat is included in our AIDS model as an information index based on the number of TV news reports of meat issues, which are clearly closer to consumer knowledge. Over the time period under consideration, the vast majority of these news reports dealt with potential negative effects of meat consumption on human health. Contrary to the situation in e.g. the UK, multiple and less sharp peaks in TV coverage of meat-health issues are observed in Belgium. Over the period of 1995–1998, 77% of all TV coverage was related to beef, with the lead clearly being taken by messages related to beef hormone abuse in 1995 and BSE (mad cow disease) from May 1996. Other issues dealt with the occurrence of residues or pathogens.

Several types of indices have previously been introduced for use in econometric demand analysis, ranging from dummy variables (Tansel, 1993), actual message numbers (Smith et al., 1988) 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 our study, an index based on the number of 'negative' minus 'positive' TV reports is proposed as a proxy for consumer awareness of meat issues. This approach is fairly similar to the one used by Burton and Young (1996) which, however, was based on newspaper articles and did not discriminate between negative and positive reports. The rationale for subtracting positive from negative reports, leading to a number of reports  $N_t$  in month  $t$ , is that both message types are assumed to have an opposite impact on consumer decision-making. While this approach was

based on theoretical arguments, practically it is very similar to just using the negative press stories as the correlation between negative stories only and the difference (as used here) is 0.98. There were 190 reports on beef and only 12% were positive. Positive reports were around 6% of the total reports on pork. No TV coverage of poultry issues occurred during the data interval. Hence, in either case it was impractical to try to disaggregate or weight and separate out the positive from negative effects thus leading to the rationale for using the difference between the number of negative and positive stories.<sup>3</sup>

The effect of mass media coverage is expected to be cumulative extending back several months. In order to capture this, a five-period distributed lag in TV coverage is specified, thus extending the total response interval to a period of 6 months for negative press. This lag is consistent with recommendations by Clarke (1976) and with the approaches followed by Brown and Schrader (1990), Ward and Lambert (1993) and Kinnucan et al. (1997), as well with widely recognised findings from social psychology and consumer behaviour research. Thus, the lagged index reflects the presumed delayed impact of messages as information is added to the stock of knowledge or beliefs in consumers' minds.

Given the limited number of observations, and knowing that each lag reduces the degrees of freedom, an alternative approach was devised for creating the cumulative press variable  $NPR_t$ . In the extreme, the cumulative effect could be

$$NPR_t = N_t + N_{t-1} + N_{t-2} + N_{t-3} + N_{t-4} + N_{t-5}$$

where each period is given the same weight. Alternatively, the cumulative effects could be weighted as

$$NPR_t = m_0 N_t + m_1 N_{t-1} + m_2 N_{t-2} + m_3 N_{t-3} + m_4 N_{t-4} + m_5 N_{t-5}$$

where the lagged mass media coverage values are weighted by coefficients  $m_j$ . A useful definition of the

<sup>3</sup> Furthermore, it is generally easier to classify negative stories than positive ones. Also, most of the positive messages were broadcast accompanied by pictures, for example, of a 'mad' cow, a slaughterhouse or a hypodermic syringe (beef hormone), thus visually drawing the consumer's attention back to the initial problems.

$m_j$  weights is

$$m_j = 1 + \tau(6j - j^2) - \frac{1}{6}j$$

where  $j$  denotes the lag, and  $\tau$  is determined when estimating the AIDS model using a maximum likelihood search over  $\tau$  values. If  $\tau = 0$  the decay is linear and, for example, if  $\tau = 2$  some lagged effects exceed the current media coverage effect. Also, define  $M_m$  as the maximum weight among the  $m_j$ . With this specification, the negative press variable finally enters the model using  $\text{NPR}_t = \sum N_{(t-j)}(m_j/M_m)$ , with  $\tau > 0.5$ . Here,  $\tau = 2$  is chosen but the results were not very sensitive to the value of  $\tau$  beyond 0.5, where  $N_{(t-2)}$  and  $N_{(t-3)}$  receive most weight.

#### 4. Empirical results

The AIDS equations were used to estimate the parameters of the demand system for a group of three fresh meat types in Belgium, thus assuming weak separability from other food and non-food commodities. Hence, choices and preferences within the meat basket are assumed to be independent of price changes for other goods. Homogeneity and symmetry restrictions were imposed in accordance with the theoretical properties of demand systems. Since the adding up condition holds by restrictions, one equation was dropped from the model in order to avoid singularity. The system is invariant to which equation is deleted and the parameters of the dropped equation (poultry) are derived from the adding up conditions.

The demand model is tested for negativity, which implies that the matrix of Hessian price effects must be negative semidefinite (Molina, 1994). A Lagrange Multiplier test is applied to detect heteroscedasticity of the disturbance term (Breusch and Pagan, 1979). The LM heteroscedasticity statistic is 0.02 for the beef/veal equation and 1.03 for the pork/mixture equation. Both are insignificant, which means that there is no ground for rejecting the null hypothesis of homoscedasticity.  $R^2$  equals 0.42 for the beef/veal equation and 0.30 for the pork/mixture equation. The econometric parameter estimates, associated standard errors and  $t$ -values are presented in Table 2.

Parameters relating to beef/veal and poultry price effects are statistically significant at the 5% level

or better.<sup>4</sup> None of the price effects relating to pork/mixture are statistically significant. With respect to expenditure effects, the beef/veal and pork/mixture parameters are highly significant. Expenditure, Marshallian and Hicksian elasticities computed at the means from the coefficient estimates are presented in Table 3. Expenditure elasticity coefficients are positive as expected for normal goods and equal 1.13 for beef/veal, 0.88 for pork/mixture and 1.05 for poultry. These magnitudes indicate that fresh meat is still quite sensitive to expenditure with beef/veal and poultry being a little more sensitive than fresh pork/mixture. The finding that the beef/veal expenditure elasticity clearly exceeds one corroborates expectations in that beef/veal is perceived as more expensive meat and the typical meat for festive and special occasions in Belgium (Verbeke and Viaene, 1999).

Price elasticity estimates are conditional on nominal expenditure on meat being constant. Own-price elasticity coefficients are all negative, indicating the expected inverse relationship between price and quantity demanded. As expected for normal goods, the Hicksian own-price elasticities are smaller in absolute terms than Marshallian elasticities. The differences between uncompensated and compensated price elasticities result from relatively high meat expenditure elasticities. In terms of magnitudes, all own-price elasticities are less than or equal to one in absolute value, indicating inelastic demand relationships. The own-price compensated elasticities for beef/veal, pork/mixture and poultry equal  $-0.09$ ,  $-0.61$  and  $-0.15$ , respectively. Hence, beef/veal is the least price sensitive fresh meat while pork/mixture is the most price sensitive, which is assumed to result from the fact that this meat type is constantly affected by retail price promotions.

The Hicksian values provide the most accurate picture of cross-price substitution since they provide a measure of substitution effects net of income effects. Most Hicksian cross-price elasticity coefficients are positive, implying that net substitutability among fresh meats prevails when the income effect is removed. The negative cross-price elasticities for beef/veal and

<sup>4</sup> Elasticity coefficients are derived following Blanciforti and Green (1983) and Green (1985). The price slope coefficients can either be positive (as in the current analysis), or negative, and still provide elasticity coefficients in line with classical demand theory.

Table 2

Parameter estimates from the almost ideal demand system for fresh meat

Parameter <sup>a</sup>	Estimate	S.E.	t-value <sup>b</sup>
Intercepts			
$\alpha_1$	0.202279	0.053716	3.77**
$\alpha_2$	0.529089	0.051217	10.33**
$\alpha_3$	0.268632	0.037748	7.12**
Price effects			
$\gamma_{11}$	0.194900	0.076000	2.56**
$\gamma_{12} = \gamma_{21}$	-0.019500	0.798500	-0.24
$\gamma_{13} = -\gamma_{11} - \gamma_{12} = \gamma_{31}$	-0.175400	0.046000	-3.81**
$\gamma_{22}$	-0.034800	0.100500	-0.35
$\gamma_{23} = -\gamma_{22} - \gamma_{21} = \gamma_{32}$	-0.054300	0.044300	1.22
$\gamma_{33} = -\gamma_{31} - \gamma_{32}$	0.121100	0.046000	2.63**
Expenditure effects			
$\beta_1$	0.045770	0.021810	2.10**
$\beta_2$	-0.055250	0.025600	-2.16**
$\beta_3 = -\beta_1 - \beta_2$	0.009490	0.019540	0.48
Beef and veal advertising effects			
$\lambda_{11}$	0.000051	0.000045	1.13
$\lambda_{12}$	-0.000096	0.000044	-2.17**
$\lambda_{13} = -\lambda_{11} - \lambda_{12}$	0.000045	0.000026	1.71*
Pork advertising effects			
$\lambda_{21}$	-0.000221	0.000091	-2.21**
$\lambda_{22}$	0.000251	0.000078	2.28**
$\lambda_{23} = -\lambda_{21} - \lambda_{22}$	-0.000030	0.000065	-0.46
Negative press effects (media index)			
$\lambda_{31}$	-0.001036	0.000613	-1.69*
$\lambda_{32}$	0.001712	0.000545	3.14*
$\lambda_{33} = -\lambda_{31} - \lambda_{32}$	-0.000676	0.000434	-1.56

<sup>a</sup> Parameter subscripts denote as: 1: beef/veal; 2: pork/mixture; 3: poultry.<sup>b</sup> Significance levels.\*  $P < 0.10$ .\*\*  $P < 0.05$ .

Table 3

Estimated own-price, cross-price and expenditure elasticity coefficients

Meat type (mean expenditure share, %)	Price			Expenditure
	Beef/veal	Pork/mixture	Poultry	
Beef/veal (36.1)	Marshallian	-0.50	-0.12	-0.51
	Hicksian	-0.09	0.39	-0.30
Pork/mixture (45.8)	Marshallian	-0.01	-1.01	0.14
	Hicksian	0.31	-0.61	0.30
Poultry (18.1)	Marshallian	-0.98	0.27	-0.47
	Hicksian	-0.60	0.75	-0.15

poultry are a notable exception. This finding points towards complementarity and can be explained by the fact that both meat types are perceived as the leaner alternative to pork/mixture and are frequently bought jointly for barbecuing.

Most parameters relating to advertising expenditures and negative press coverage are found to be significant. A notable exception is  $\lambda_{11}$  denoting a marginally insignificant own advertising effect for beef/veal using a one-tail test. Nevertheless, the coefficient is positive as could be expected. Also, beef/veal advertising has a significant negative effect on pork/mixture consumption and a marginally significant but positive effect on poultry consumption. Pork advertising has a significant positive effect on pork/mixture consumption, mainly at the expense of beef/veal consumption. The TV coverage effect is significantly negative for beef/veal and positive for pork/mixture consumption. This largely corroborates expectations given the nature of the TV coverage, with mainly negative associations pertaining to hormones and BSE as beef issues. The impact of the advertising and TV coverage will be further explored and discussed in the simulations' sections below.

## 5. Simulating the media impact: negative press versus advertising

As indicated earlier, TV advertising or promotion has the expected positive effects on beef or pork demand, while the negative press index has opposite impacts on the demand for beef (negative) and pork (positive). While a number of policy issues can be addressed using simulation techniques, we will focus on two of the more important questions: how much change in fresh meat demand can be expected from TV promotion, and what are the relative impacts of the negative press compared with the TV promotions? In each of the following simulations, the impacts are measured by adjusting one or more variables relative to the mean values of all other variables in the models. The adjustments of the investigated variables range from 50 to 150% of their mean level using increments of 10%.

In Fig. 1, beef/veal prices on the bottom left axis range from 50 to 150% of the mean price. Demand declines from 1.4 to near 0.8 kg per capita per month, thus clearly illustrating the important role of pricing

in the demand for beef/veal. Responses were also simulated for pork/mixture and poultry but are not presented here. For comparison, beef/veal advertising also ranges from 50 to 150% of its mean level on the bottom right axis. While the advertising has the expected positive effect, its impact on beef/veal demand is extremely small compared with price effects.

Given a beef price fixed at the mean level in Fig. 1, what are the relative impacts of beef and pork promotions? In Fig. 2a and b, changes in both beef and pork promotions are simulated while holding prices and all other factors constant at their mean values. In contrast to Fig. 1, the simulated effects are now shown in terms of market shares so that the different simulations can be easily compared. Beef advertising has the expected positive impact on beef/veal shares while pork advertising reduces beef/veal's share of the market as seen in Fig. 2a. Yet what is more important is the relatively small change in the beef/veal share over the simulated values, from about 0.357 to 0.365 or slightly under 1%. Pork/mixture's share of the market is simulated in Fig. 2b and the conclusions are quite similar with pork advertising positively and beef/veal advertising negatively impacting the pork/mixture market share. Combined, Fig. 2a and b show that beef and pork promotions have relatively small impacts on the demand for both meats based on the estimates for the data period of the analysis.

From the previous simulations, the promotion elasticity can be calculated. Using Fig. 1, an estimated advertising elasticity shows that for every 10% increase in advertising, the quantity demanded increases by 0.05–0.13%, depending on the promotion level and at the mean negative press index level. This elasticity is what would be expected; most generic promotion elasticities are quite small and these results are generally consistent with other studies. It is equally important to note that advertising elasticity says nothing about the rate-of-return. Small share changes can translate in large relative gains when calculating the rates-of-return to a particular promotion effort (see Ward (1998) for an example of the rate-of-return in the US beef case). Hence, while the elasticity is of interest, it generally has less meaning to decision-makers responsible for generic promotion programs.

The AIDS estimates in Table 2 show the significant impact of TV press reports and the particularly negative impact on beef/veal demand. Given the estimated

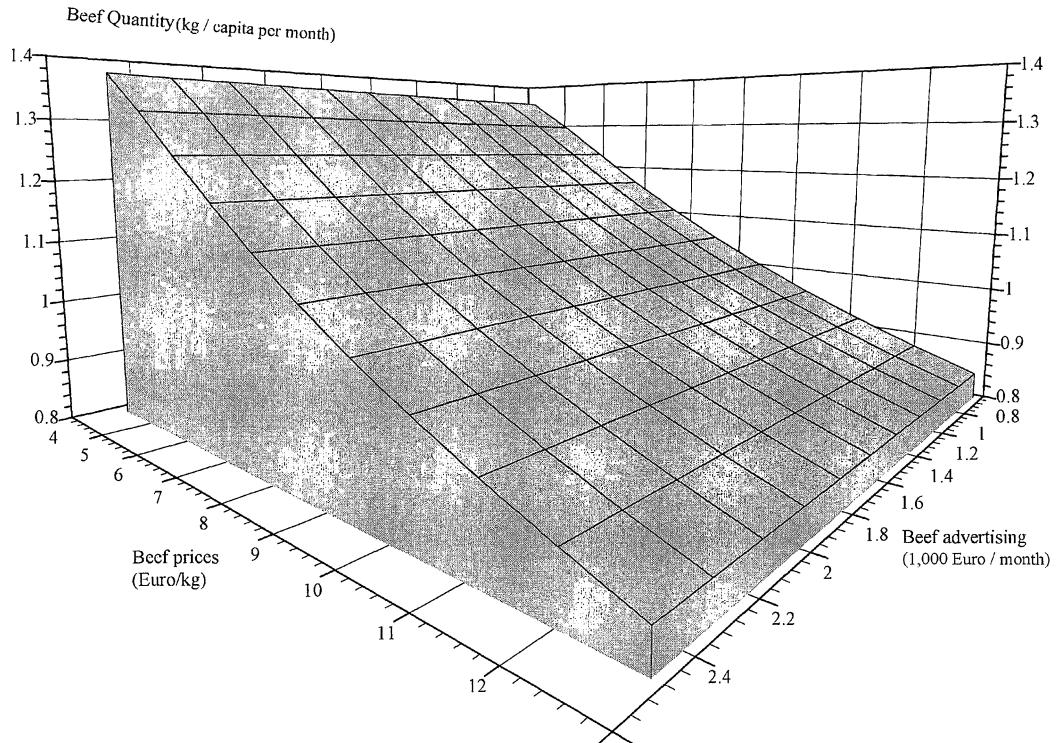


Fig. 1. Beef/veal demand response to changes in own-price and advertising expenditures.

responses, is it reasonable to expect that beef/veal advertising could offset the negative impact of TV stories? This issue is investigated in two phases.

First, Fig. 3 depicts the estimated impact of advertising and negative press on beef market shares. In this particular example, prices, incomes and other demand drivers are held fixed at their mean values. TV coverage of meat-health issues has an impact on beef/veal's market share as simulated on the bottom right axis in Fig. 3. Beef/veal shares decline from 0.37 to near 0.35 as the number of negative stories increases. While the positive impact of beef/veal advertising could counter some of the negative press, it is clear from the differing slopes of the border lines in the graph that beef/veal promotions can hardly be expected to fully offset the effect of negative press. It is not relevant to show the same graph for pork/mixture since the pork industry is the beneficiary of the negative press stories.

Second, simulations have been performed to assess the amount of beef TV advertising expenditures needed to offset negative press, i.e. to maintain the

initial beef/veal market share. The results are displayed in Fig. 4, with the horizontal axis indicating the media index. TV advertising expenditures are assumed to begin either from zero or from their mean level of 1650 € per month. Generally, for each unit increase of the media index, beef TV advertising expenditures must go up by about 500 € per month to maintain the beef share at its original level. At the mean media index level of 15.1, beef TV advertising expenditure would need to be increased to about 8000 € per month or about five times its mean value over the data period. Finally, if negative TV stories continue to be broadcast and the media index increases to its simulated maximum of 28.7, a 10-fold increase in the beef TV advertising expenditures will be needed to offset the negative press effect.

Given the promotion efforts and the resulting demand responses observed in recent history, the promotion gains are small relative to the impact of negative press. If the effectiveness of TV promotions could be improved, the expenditure levels needed to offset the

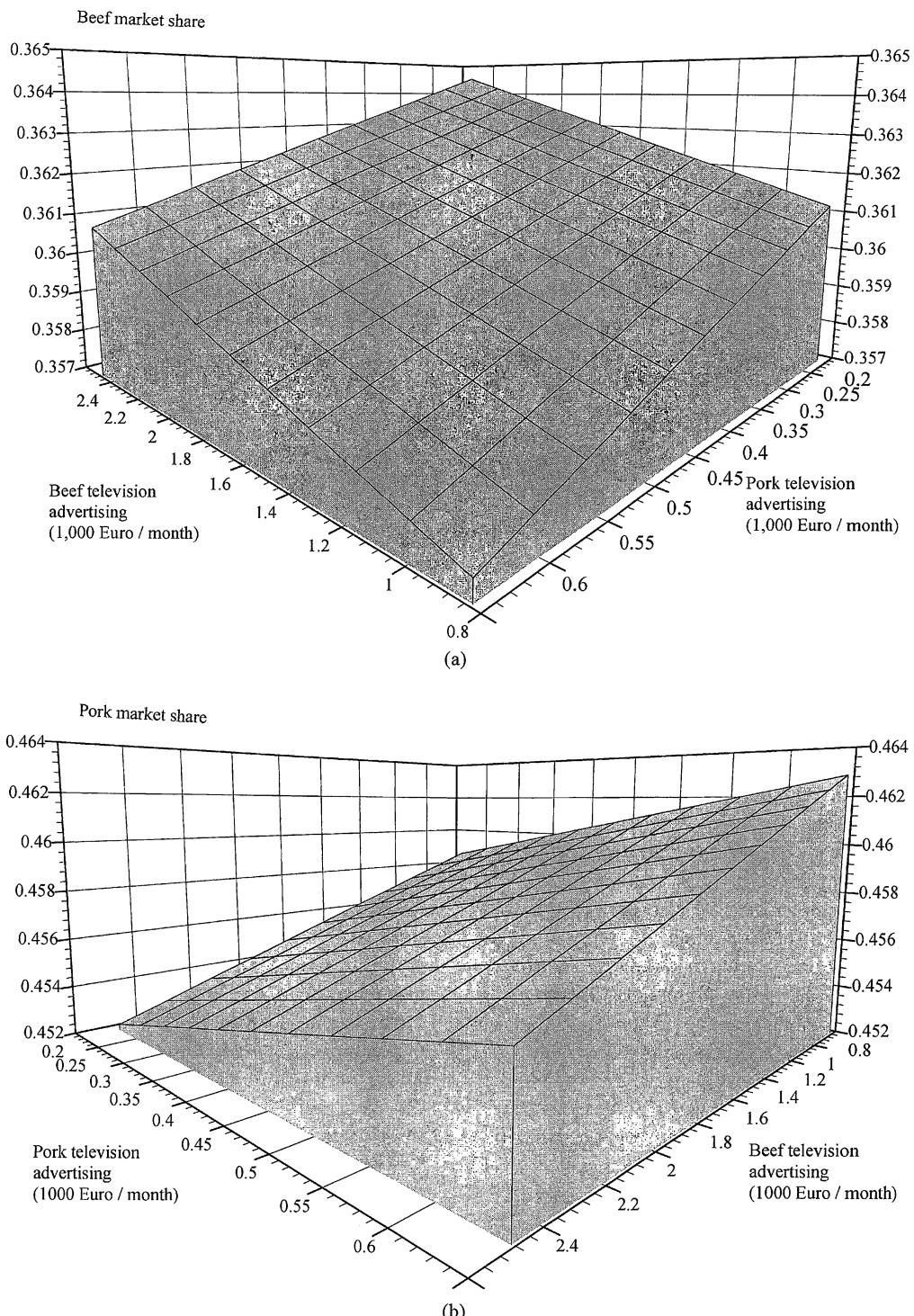


Fig. 2. (a) Beef/veal market share response to changes in beef and pork advertising expenditures; (b) pork/mixture market share response to changes in pork and beef advertising expenditures.

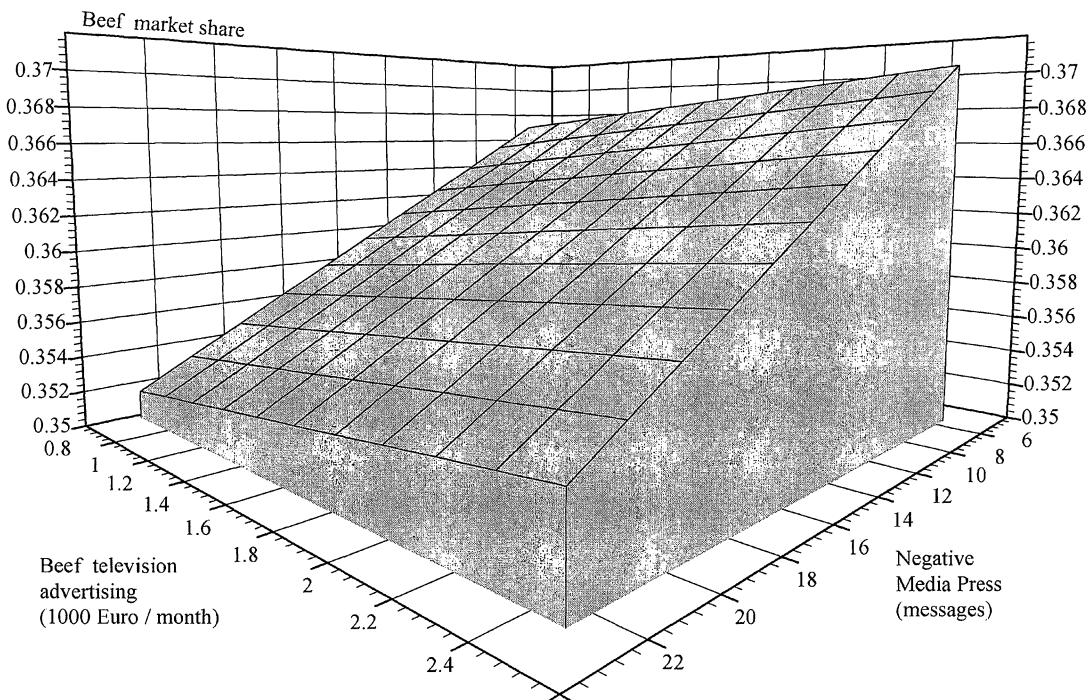


Fig. 3. Beef/veal market share response to changes in own advertising expenditures and negative press (media index).

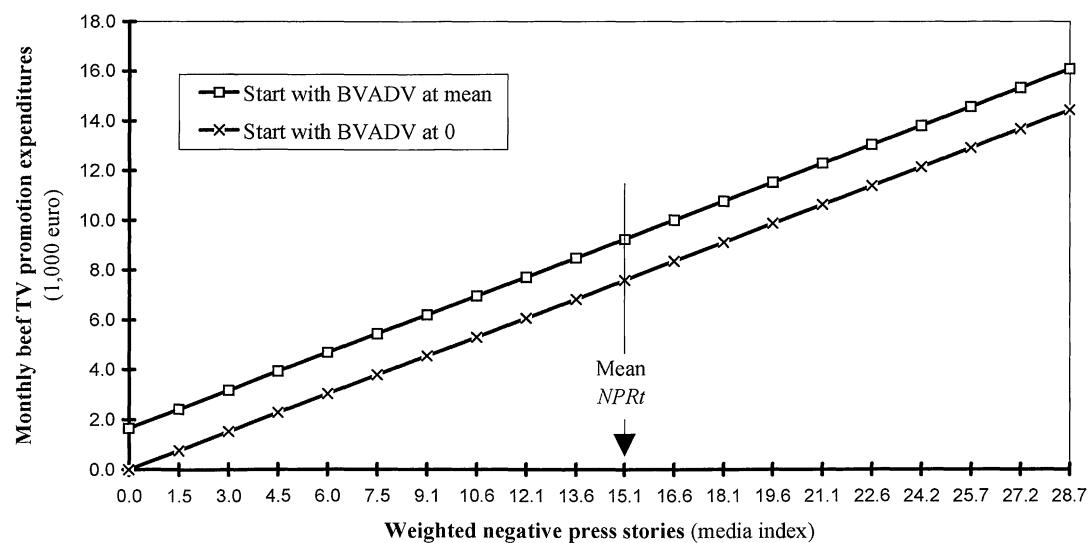


Fig. 4. Beef/veal TV advertising expenditures needed to counter negative press.

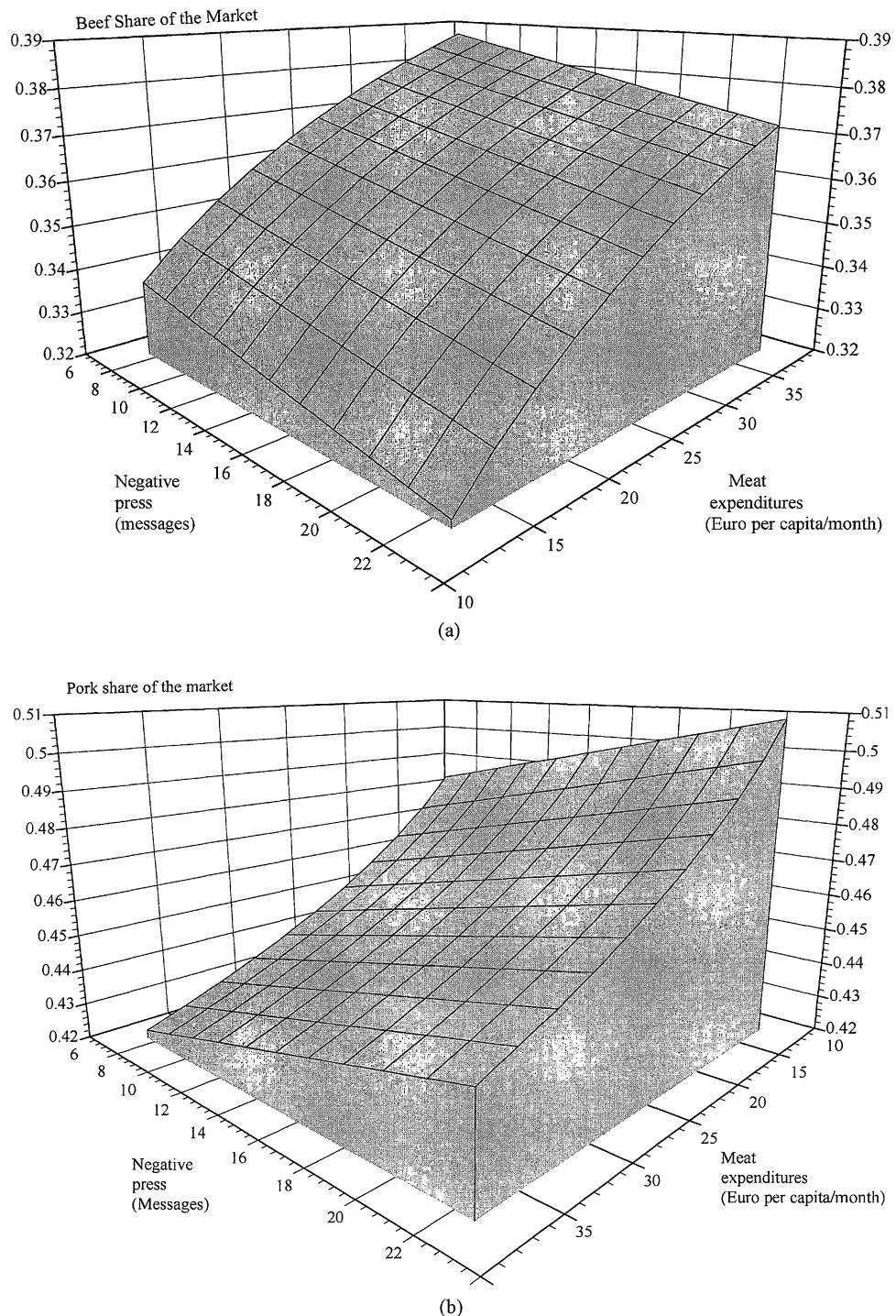


Fig. 5. (a) Beef/veal market share response to changes in total meat expenditures and negative press; (b) pork/mixture market share response to changes in total meat expenditures and negative press.

negative press would be somewhat less. Nevertheless, it is apparent for the beef/veal industry that the conditions leading to the negative press must be changed and that the content and mechanism of beef/veal advertising needs to be improved if this industry expects to reverse the current problems with media coverage and its impact on beef demand.

## 6. Expenditures and the negative media

The AIDS model in budget share form based on meat expenditures enables one to investigate what really drives changes in fresh meat demand: negative TV coverage or the level of expenditures on all meats? Changes in the total expenditures on meats (i.e. the  $y_t$  in the AIDS model from Eqs. (1) and (3)) along with changes in the amount of negative TV coverage are simulated in Fig. 5a and b.

What is most apparent in both graphs is that changes in total expenditure on meats generate considerably greater shifts in market shares than result from negative press. In Fig. 5a, beef/veal's share of the meat market, even with the most negative levels of press, increases from 32 to over 37% as total expenditures range from 50 to 150% of the current level. As the number of negative press stories declines the share increases to over 38%.

Clearly, the beef/veal industry would benefit from an overall growth in consumer spending on all meats regardless of negative TV coverage. Therefore, the growth in total expenditures could far outweigh the negative press impacts. In contrast, pork/mixture loses market share as total meat expenditures increase, with the shares declining from over 48 to near 42% (Fig. 5b). Pork industry gains from negative TV coverage are easily seen in the form of the positive slope on the bottom left axis in Fig. 5b.

## 7. Simulating cumulative expenditure changes

In all of the previous figures, responses were simulated using mean values as the base. An alternative approach to showing the impacts is to calculate the change in expenditures over the actual data period (January 1995 to December 1998) assuming that a particular condition had not occurred. For example, the model allows one to predict expenditure on each meat type under actual market conditions and then compare this to a situation in which there were no negative press stories. The cumulative expenditure changes would be attributed to the negative press in this example. In Fig. 6 such simulations have been completed for each of the investigated media efforts. Changes in expenditure are shown for beef/veal, pork/mixture and

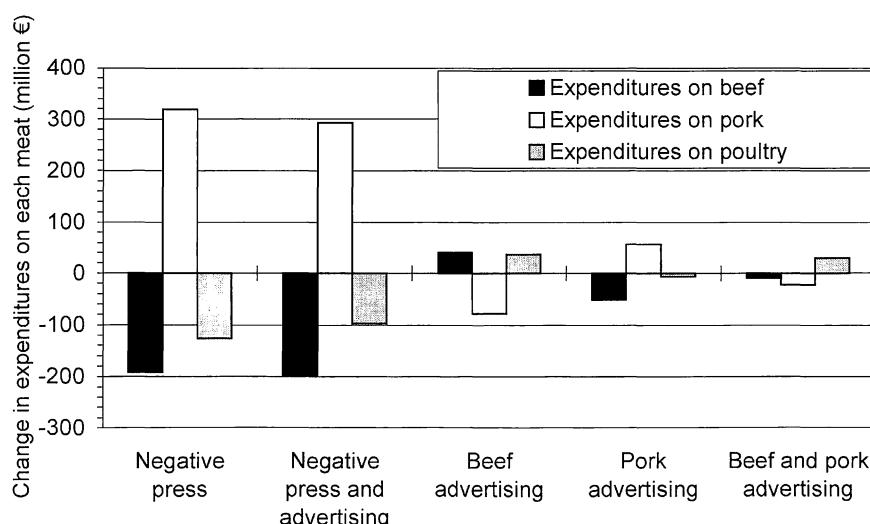


Fig. 6. Accumulated change in fresh meat expenditures (gain or loss) attributed to advertising expenditures and/or negative press (January 1995 to December 1998, million €).

poultry under the condition that the media efforts were zero compared to the actual ones.

The first three bars in Fig. 6 measure the cumulative impact of the TV coverage of meat-health issues. Negative press resulted in an overall lower expenditure of about 195 million € for beef/veal and 125 million € for poultry, both to the benefit of pork expenditures (the positive middle bar). The picture for negative press and advertising together is fairly similar, which confirms the finding that advertising effects are modest compared with the impact of negative press. The beef/veal expenditure gain attributed to beef/veal advertising amounts to some 40 million €, which is in absolute value almost five times lower than the impact of negative press. Pork/mixture is the major loser as a result of beef/veal advertising and beef is the major loser as a result of pork advertising. It is noteworthy that the combined impact of beef and pork advertising resulted in small losses of expenditures for both meats to the benefit of poultry.

What is most noteworthy is the ranking of these impacts as shown from the left to the right in Fig. 6, with the dominance of negative press on beef and poultry and the clear gains to the pork industry. Generic and brand advertisement have effects of the expected signs, but are of little consequence compared with negative press.

## 8. Conclusions

This paper has focused on investigating the impact of negative TV coverage and advertising on meat consumption through the specification and estimation of a three-equation AIDS model with monthly data covering the period of January 1995 to December 1998. Negative press coverage of meat-health issues entered the model as a five-period lagged and weighted index based on the number of negative minus positive TV news reports. The parameter estimates and resulting elasticity coefficients are plausible and largely consistent with classical demand theory. The own-price elasticity coefficients of the fresh meats are relatively low compared with previously reported elasticity coefficients from other countries. Although the current model does not deal with parameter changes, it appears reasonable to assume that fresh meat demand has become less price sensitive in an

era dominated by continuous reports about potential health risks.

Simulations based on our AIDS estimates provide in-depth empirical insights into the impact of negative press and advertising. Findings from this time series analysis show the immense impact of negative publicity and largely corroborate previous research by Verbeke et al. (2000) based on cross-sectional data from a sample of Belgian meat consumers. The simulations based on the model estimates clearly extend beyond the estimation of elasticity coefficients and herewith respond to a major criticism by Ward (1999, p. 518) on the use of many demand models in empirical research.

The findings are most alarming with respect to television publicity, i.e. TV coverage of the potential adverse health effects of meat consumption, and are not very promising with respect to advertising. The latter may be not so surprising. Following Forker and Ward (1993), some advertising expenditure threshold may have to be exceeded before any significant results are noticed. This certainly holds in times dominated by extensive negative media coverage that largely outweighs similar amounts of positive coverage aimed at consumer reassurance. While the own beef advertising effect is found to be statistically insignificant, the hypothesis that television publicity negatively affects beef/veal demand is statistically supported and fully explored in the simulations. At the mean media index level, beef TV advertising expenditures would need to be increased to about five times their mean level in order to maintain beef expenditure share. Shifts are seen towards consuming pork/mixture, both as a result of a response to negative beef/veal press and positive own advertising effects.

The impact of the negative press and advertising is also illustrated by the calculation of expenditure gains or losses at the industry level. Again a negative press/advertising ratio of about 5 is found, with the total beef expenditure gain attributed to own advertising being five times lower in absolute value than the total loss resulting from negative publicity. The results clearly show the dramatic impact of negative press on the beef/veal industry, as well as the relatively modest performance of brand and generic advertising efforts. Increases in total meat expenditures could outweigh the negative press impacts for the beef industry. However, total consumer spending on meat, first, tends to slowly decrease rather than increase over time, and

second, is difficult to influence directly by the affected sectors. Therefore, eliminating the grounds for negative press, and searching for better and more effective ways of communicating emerge as recommendations for the meat industry, and particularly for the beef sector.

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