Revisiting Australian Pork Sales Response to Advertising 1985 - 1997

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The aim of this paper is to provide information on the impact of advertising on Australian pork consumption from 1985 to 1997. Questions like whether advertising is playing a positive role in increasing pork consumption in Australia and how much of the change in consumption can be directly ascribed to advertising will be tackled. The results from this research will be quite useful not only to pig producers but also to pork marketing agents. Producers will know whether their levies on advertising are benefiting them. Also, the Australian Pork Corporation (APC) as the marketing agent may get a better idea for future marketing strategies.

The objective of this paper is to measure the pork sales response to advertising 1985-1997 by including brand advertising in the model, then compare it to other studies on this topic to see whether brand advertising matters in measuring the pork consumption.

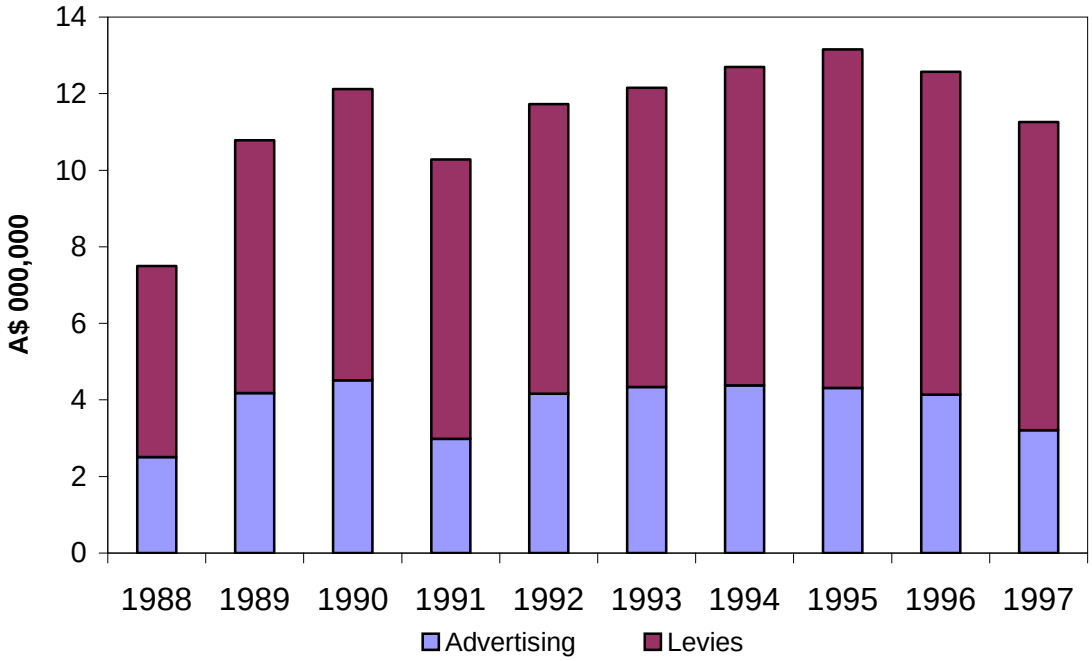
The paper consists of seven sections. The first section is background information on the Australian pig industry, its advertising activities and existing problems. The second section is the review of previous studies in this area. The third section is the model, which gives details of generation of this model and its advantages. The fourth section is the method for estimating the model. The fifth section is description of the data. The sixth section is the discussion of results. The seventh section is the simulation result and the final section ends up with the conclusions.

Background

Originally as a sideline to the dairy industry, the Australian pig industry has developed very rapidly, even though it is still quite small compared to the rest of the world. During the process of development, pig producers voiced their concerns over their market share and the need to gain an increased portion of the consumer's dollar. This led to the establishment of a marketing agent with the statutory power to levy all producers to carry out policy formulation and executive functions. Currently, the Australian Pork Corporation (APC) levies producers at a rate of A$ 1.65/head (Annual Report). The levy has been used for advertising, administration, public relations, equipment and plant etc. Approximately two-thirds of the levy is invested in advertising.

Figure 1 shows the proportion of advertising out of levies in the period of 1988-1997.

Figure 1 Advertising Expenditure and Levies Collected in the Australian Pig Industry 1988 - 1997



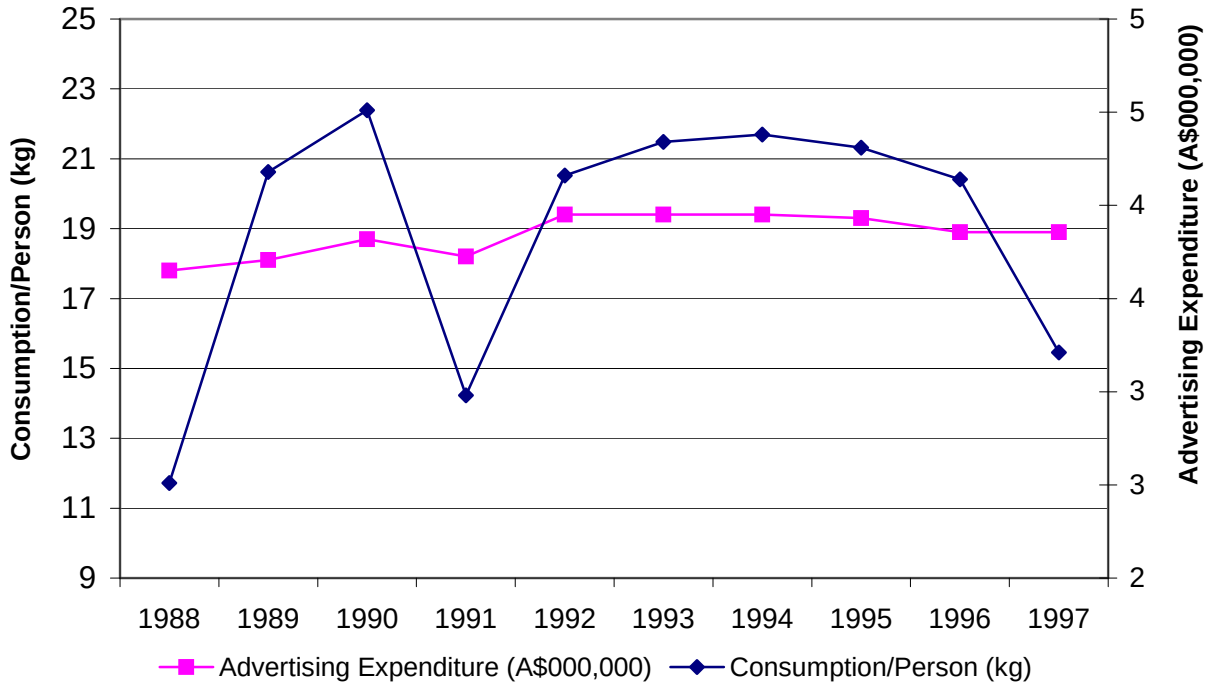
Source: Australian Pork Corporation

Pig meat advertising in Australia can be mainly disaggregated into generic advertising and brand advertising. Generic advertising, as the dominant pattern, is concentrating on fresh pork, while brand advertising generally focuses on ham and other processed products. However, brand advertising is becoming more and more extensive in Australia. Nowadays, restaurant advertising is also playing a role for certain meats. For example, McDonald's features beef as part of their advertising. It also appears on menus and recipes in the restaurant as a combination of generic advertising and brand advertising. Generic advertising is more likely to increase total industry sales, while brand advertising is more likely to increase or maintain a specific firm's market share. In Australia, generic advertising on pork is either done by APC or through the cooperation between the APC and supermarkets or butchers' shops. Brand advertising is supported by different brand companies. Many examples can be seen on TV programs, magazines, press kits, radio etc.

Economic theory suggests that if demand is responsive to advertising, the quantity demanded will be increased for any given price. However, the Australian Bureau of Agricultural & Resource Economics (ABARE) statistics on the consumption of pig meat shows that the consumption per person in Australia has been varying. This can be seen explicitly from Figure 2. Even though advertising expenditure by APC is quite stable,

consumption per person varies a lot. It is clear there are factors other than advertising that are significantly affecting sales.

Figure 2 Advertising Expenditure and Consumption Per Person of Pig Meat in Australia 1988 - 1997



Source: ABARE

Impact of Advertising on Pig Meat Consumption

Economists have different results on the impact of advertising on meat demand. Brester and Schroeder (1995) found that impact of generic advertising on meat demand is not significant, while the impact of branded advertising is significant. Ball and Dewbre (1989) found that generic advertising increased the profits of pork producers in Australia. Hoover et al. (1992) found that generic advertising on pork is effective in short term. Their simulation results indicated that when supply-response and cross-commodity impacts are taken into account, even if advertising causes demand to shift, expected producer returns temporarily increase but long-run returns are not appreciably different from returns where no advertising had occurred. However, the analysis suggests there are some positive long-run advertising impacts such as increased market share, potential for using advertising to smooth out price variability faced by producers, and the like.

There have been several studies done on the effectiveness of generic meat advertising in Australia (Ball & Dewbre, Goddard & Griffith, Piggott, Alston & Chalfant). These three studies used different equations with different functional forms in estimating meat sales

response to advertising in the period of 1977-1988. However, the previous studies only looked at generic advertising and did not account for other media information as brand advertising effects on pork consumption. So far, nobody has included the brand advertising or the brand for chicken in their analysis, so results may have been biased by the exclusion. As well, the previous studies are contradictory about the effects of generic pork advertising. Ball & Dewbre found that generic advertising in Australia in 1977–1988 increased pork consumption while Goddard & Griffith found that in the same period advertising response was insignificant. Piggott concluded that in 1978–1988 APC advertising was not significant in the pork market.

Empirical Model

The empirical model used for analyzing the demand for meats in Australia is a two-stage Australian meat demand system with a translog functional form. A model representing the aggregate demand for meat in Australia is specified in the first stage, and then a system of equations representing the individual commodities in the meat market is specified in the second stage.

The first stage of the model specification corresponds to the first stage of the two-stage budgeting procedure. An aggregate demand for meat can be formulated, giving total expenditure on meat as a function of weighted average price of meat, real household disposable income, real advertising expenditure, quarterly dummy variables and lagged total expenditure. Dummy variables are used here to capture seasonality. Lagged total expenditure is to indicate habit formation. This equation can be written in the form:

$$\ln TEXP = C + B\ln P + D\ln A + E\ln Y + \sum M_i D_i + GT + F\ln TEXP(-1)$$

where C B D E M G F are estimated parameters;

TEXP = total expenditure on meat, $\sum_{i}^{n} P_i X_I$;

I=1,2,…n n=number of types of meat;

P = weighted average price of the different types of meat $\sum_i P_i Q_I / \sum_i Q_I$;

A = total advertising expenditure for meat $\sum_i A_i$;

Y = household disposable income;

D = quarterly dummy variables;

T = time trend;

TEXP (-1) = lagged dependent variable $P_i X_I$ (-1) .

The second stage of the model specification corresponds to the second stage of the two stage budgeting procedure. A system of n demand equations corresponding to the number of meats used in this study is derived from an indirect translog utility function which in turn is derived from a direct translog utility function introduced by Christensen, Jorgenson and Lau (1975). It can be expressed as,

$$W_i = \frac{C_i + \sum_j B_{ij} \ln P_j^* + \sum_j D_j \ln A_j + \sum_{i=1}^{3} M_i D_i + G_i T + X_i(-1)}{\sum_i C_i + \sum_i \sum_j B_{ij} \ln P_j^* + \sum_i \sum_j D_{ij} \ln A_j + \sum_j \sum_i M_{ij} D_{ij} + \sum_i G_i T + \sum_i X_i(-1)}$$

for i, j = 1… n, where $B_{ij} = B_{ji}$;

Wi = expenditure share on meat of type i, $P_jX_j/\sum_i P_jX_j$;

$P_j^* = P_j / \sum_j P_jX_j$;

A_I = advertising expenditure on meat of type i .

Because the expenditure shares must sum to one, only n-1 of the equations are independent. The expenditure share equations for the translog models are homogeneous of degree zero in the parameters, hence a normalization of the parameters is required for estimation.

A number of studies have been conducted in an attempt to discriminate among some of the available functional forms. On the basis of conformity to standard restrictions and statistical tests, the translog was found to be the preferred form by Berndt, Darrough and Diewert (1977). Others have found the generalized Leontief form to perform better in some cases and the translog form to produce better results in other cases (Wales 1977).

As the first attempt at estimation of a complete demand system for Australian meats, translog is a reasonable choice. The translog functional form has been found the best choice in some of the previous studies and the fact that it has not been rejected in any other studies suggests that so far, at least on the empirical evidence, it provides a good approximation of consumers true preferences (Tielu 1987).

Methods

All equations in the demand system were estimated using TSP Version 4.4. The first stage equation were estimated using ordinary least squares and the second stage demand systems were estimated using maximum likelihood methods.

The maintained hypothesis for the demand systems consists of the unrestricted form of the five equations that had been estimated.

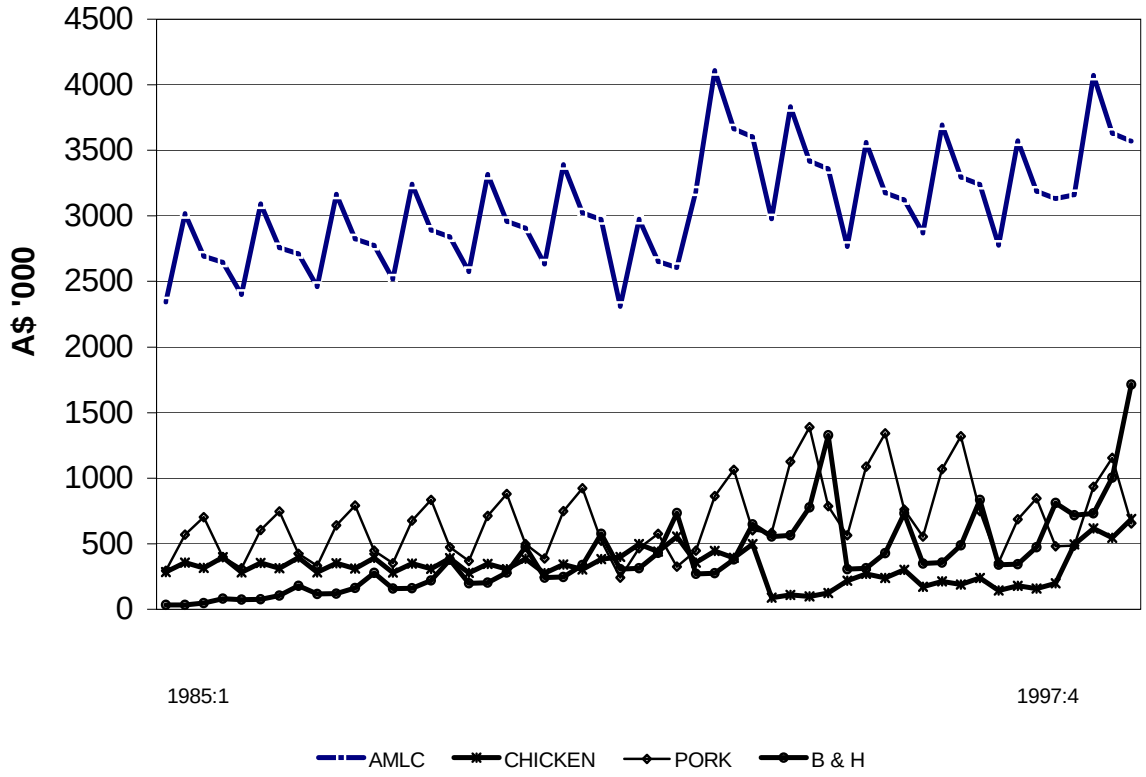
Data Description

Data used in this study were quarterly data from the first quarter 1985 (1985:1) to the fourth quarter 1997 (1997:4).

Meat commodities that were included as potential substitutes for pork were beef, lamb and chicken. The commodities considered in the market for pig meat were fresh pork, bacon and ham. Data on commodities' production, imports, exports, net change in stocks, household income, population, consumer price index (CPI) came from the Australian Bureau of Statistics (ABS). Retail prices of different meat products were obtained from ABARE. Data for advertising expenditure was obtained from Australian Independent Media Data Pty. Limited.

Figure 3 describes the advertising expenditure spent on beef & lamb, chicken, pork and bacon & ham in each quarter from 1985 to 1997. Data from the AMLC represents generic advertising on beef and lamb. Chicken advertising data, mostly by brand, includes advertising by Ingham, Steggles and other chicken companies. Pork advertising data represents generic advertising by APC. Bacon & ham advertising data are by brand, includes various brand companies' advertising.

Figure 3 Meat Advertising in Australia



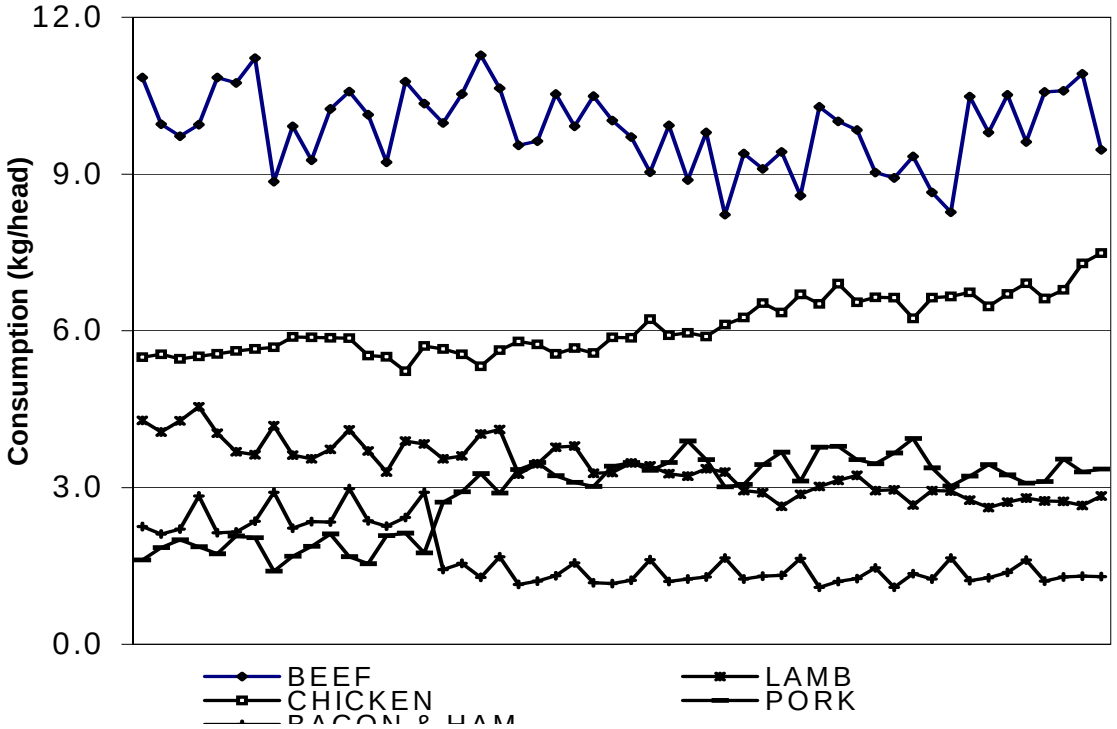
The apparent consumption of meat was calculated in the following manner:

Disappearance = net change in stocks + commercial production + estimated home production + imports – exports

The data described above were transformed into per capita data by dividing each series by Australian population.

Per capita consumption of beef, lamb, chicken, pork and bacon & ham were shown in Figure 4.

Figure 4 Per Capita Consumption of Meat in Australia



Estimation

Per capita data were the bases of estimating the aggregate expenditure function and the system of expenditure share equations. All the retail prices, income and advertising expenditures were deflated by the consumer price index. Expenditures on each commodity were obtained by multiplying the per capita quantity data by the deflated retail prices. Total expenditure on meat was obtained by adding up consumer expenditures on five types of meat.

For the expenditure share equations, the ratio of prices to total expenditure were scaled to equal to 1.0 in 1991:1. It has been demonstrated that the elasticities and the fitted w_i's are invariant to such rescaling (Christensen and Manser, 1976).

Results

Aggregate Expenditure Model

Results from the aggregate expenditure model are reported in Table 1. As expected, the weighted average price of meats was significant. The price elasticity implies that for a 1 percent increase in the average price of meat, consumption on average decreases by about 0.35 (0.65 - 1) percent.

When consumers' incomes increase, it is generally expected that for normal goods they would increase their level of consumption of a good. As a result, the total expenditure is expected to increase with disposable income. The results confirmed this expectation. For a 1 percent increase in real income per person, the consumption of meat on the average increases by about 0.84 percent. This impact of disposable income on total expenditure on meat is statistically significant at the 1 percent level.

Seasonality in the expenditure on meats is significant and no significant response to aggregate advertising occurred in the aggregate model. For a 1 percent increase in advertising expenditure, the consumption of meat on the average decreases by about 0.003 percent. These results suggest that significant advertising effects may occur through substitution among meats at the second stage. The addition of the lagged dependent variable even did not significantly improve the fit of the aggregate demand equation.

Table 1. Results from the Aggregate Expenditure Model

Variable	Coefficient	t-statistic
C	-1.42168	-0.811
WPM	0.653372	5.022
LADV(-1)	-0.0030804	-0.394
LY	0.679428	3.051
DUM1	0.122957	3.067
DUM2	0.143579	3.141
DUM3	0.106212	3.887
T2	-0.00290398	-3.602
LTEXP(-1)	0.064527	0.541
R^2	0.583	
Durbin's h	2.17	
F-value	7.325	

The overall results from the aggregate model suggested that price, income and seasonality are significant at the 1 percent level. Advertising is not a significant factor in affecting total expenditure on meat. As indicated by the coefficient of determination, approximately 58 percent of the total variations in the meat aggregate expenditure can be explained by the variables in the model. Durbin's h is 2.17, which indicates there is positive serial autocorrelation.

Expenditure Share Model

In the disaggregated demand system, only four equations were fitted to provide a complete system of demand equations for the five commodities used in this study.

Price and Expenditure Elasticities

Price and expenditure elasticities for the period 1985–1977 (with advertising) are reported with t-statistics underneath in the brackets in Table 3. In order to clarify, price and expenditure elasticities with t-statistics for the period 1977–1997 (without advertising) are also reported in Table 3.

Economic theory suggests that consumers' demand for a product is inversely related to price and positively related to expenditure. The results are consistent with consumer demand theory, except for the expenditure elasticity for beef. The results indicate that people will consume less beef if their meat expenditure increase and this impact is significant at the 1 percent level. For the period 1985–1997, except beef, all the other meats are price elastic, while all the meats are price elastic for the period 1977-1997. In terms of uncompensated price elasticities, they are consistently negative, implying downward sloping demand curves.

On the basis of consumer demand theory, consumers are expected to respond negatively to changes in own price and prices of complementary goods, but positively to changes in substitutes' prices. For the period of 1985–1997, lamb is a substitute for chicken and bacon & ham, but chicken is a complement for lamb and bacon & ham, while bacon & ham are complements to lamb and chicken. Except the beef demand with respect to lamb price, chicken price and bacon & ham price, other estimates are not statistically significant. In terms of expenditure elasticities for the same period, meat expenditure has an important impact on the demand of beef, lamb, chicken and bacon & ham, but not on the pork at the 10 percent level.

For the period of 1977-1997, both lamb and chicken are complements to bacon & ham, while bacon & ham are complements to lamb, but substitutes for chicken. Half of the price elasticity estimates are statistically significant. All the expenditure elasticities for this period are significant too.

Table 3. Price and Expenditure Elasticities

Price Elasticities	Beef	Lamb	Chicken	Pork	Bacon & Ham	Expenditure Elasticities
1985-1997						
Beef	-.933 (-7.01)	.503 (6.61)	.619 (9.56)	.245 (1.72)	.420 (3.03)	-.854 (-4.08)
Lamb	.353 (1.14)	-2.61 (-4.73)	.099 (.287)	-.553 (-.734)	.0975 (.249)	2.62 (5.04)
Chicken	-.130 (-.468)	-.145 (-.438)	-4.51 (-6.87)	.263 (.328)	-.127 (-.495)	4.65 (14.02)
Pork	-.195 (-.321)	-.393 (-.550)	.622 (.803)	-1.32 (-.851)	-.183 (-.250)	1.46 (1.60)
Bacon & Ham	-.336 (-.435)	-.002 (-.005)	.005 (.014)	-.459 (-.521)	-2.70 (-2.82)	3.49 (2.91)
1977-1997						
Beef	-1.35 (-9.43)	.481 (5.19)	.813 (11.67)	.329 (3.14)	.785 (7.21)	-1.06 (-4.36)
Lamb	.228 (.732)	-1.87 (-4.12)	-.531 (-1.94)	.252 (.540)	-.381 (-1.35)	2.30 (4.09)
Chicken	.493 (2.18)	-.928 (-.3.40)	-3.94 (-11.66)	-.655 (-1.75)	-.706 (-.034)	5.04 (11.57)
Pork	-.455 (-.987)	.221 (.383)	-.504 (-1.14)	-3.84 (-4.03)	1.56 (3.12)	3.02 (3.59)
Bacon & Ham	1.07 (2.88)	-.420 (-1.42)	.256 (1.17)	1.22 (3.09)	-4.89 (-10.09)	2.77 (3.96)

At the beginning of this estimation, all the products in the group for meat were thought to be substitutes. But an examination of the cross effects of price changes suggests that some of them such as lamb, chicken and bacon & ham are gross complements.

Price and expenditure elasticities compared to previous studies are reported in Table 4. It turns out there is no big difference between the estimation of this model and the results from Goddard's.

Table 4 Comparison of Price and Expenditure Elasticities

Price Elasticities	Beef	Lamb	Chicken	Pork	Expenditure Elasticities
This Model (1985-1997)					
Beef	-.933 (-7.01)	.503 (6.61)	.619 (9.56)	.245 (1.72)	-.854 (-4.08)
Lamb	.353 (1.14)	-2.61 (-4.73)	.099 (.287)	-.553 (-.734)	2.62 (5.04)

Chicken	-.130 (-.468)	-.145 (-.438)	-4.51 (-6.87)	.263 (.328)	4.65 (14.02)
Pork	-.195 (-.321)	-.393 (-.550)	.622 (.803)	-1.32 (-.851)	1.46 (1.60)
Goddard (1977-1988)					
Beef	-1.33 (-16.1)	.07 (1.6)	-.09 (-3.3)	-.03 (-.4)	1.38 (13.8)
Lamb	.53 (3.9)	-1.27 (-10.0)	-.06 (-0.9)	-.09 (-.8)	.89 (5.3)
Chicken	.24 (3.0)	.081 (.935)	-0.63 (-7.0)	.013 (1.2)	.23 (2.7)
Pork	.40 (2.9)	0.03 (0.5)	.05 (0.7)	-1.04 (-5.5)	.50 (2.8)

Advertising Elasticities

The estimated advertising elasticities given in Table 5 indicate the average percentage change in demand that would have been resulted from a 1 percent change in advertising expenditure. Thus, for example, a 1 percent increase in advertising expenditure undertaken by the Australian Meat & Livestock Corporation (AMLC) is estimated to result in a 0.139 percent increase in beef demand as well as 0.327 percent increase in lamb demand. Applying the same interpretation to the other advertising elasticities, it can be seen that a 1 percent increase in advertising by AMLC will have a negative influence on pork and bacon & ham demand and positive effect on chicken consumption. Pork consumption will be reduced by 0.253 percent, bacon & ham demand will be reduced by 0.754 percent and chicken consumption will be increased by 0.044 percent.

Empirical evidence suggests that advertising increases consumer demand for the advertised product. But in this case, the advertising elasticities for chicken and bacon & ham are negative and statistically significant. Advertising elasticities might reasonably be expected to be positive and/or insignificant. The results also indicate that all the advertising elasticities are significant at the 5 percent level except the one for pork. It seems that advertising by the Australian Pork Corporation (APC) is not effective.

Table 5. Advertising Elasticities

	AMLC	Chicken	Pork	Bacon & Ham
Beef	0.139 (2.58)	0.128 (3.56)	0.020 (0.697)	0.205 (6.84)
Lamb	0.327 (2.20)	-0.220 (-2.25)	-0.122 (-1.61)	-0.166 (-2.20)
Chicken	0.044 (0.469)	-0.156 (-2.72)	0.041 (0.806)	-0.093 (-2.18)
Pork	-0.253 (-1.08)	0.240 (1.52)	0.055 (0.403)	0.325 (2.60)
Bacon & Ham	-0.754 (-2.54)	-0.458 (-2.26)	-0.067 (-0.396)	-1.03 (-6.26)

Comparisons on advertising elasticities are presented in Table 6. By using the same data set but different demand system, both Goddard's and Piggot's studies indicate that APC advertising is not significant. By using the improved data from the Australian Media Company with translog demand system, APC advertising turns out even less significant than before.

Table 6 Comparison of Advertising Elasticities

This Model (1985-1997)	**AMLC**	**APC**
Beef	.139 (2.58)	.020 (.697)
Lamb	.327 (2.20)	-.122 (-1.61)
Chicken	.044 (.469)	.041 (.806)
Pork	-.253 (-1.08)	.055 (.403)
Goddard (1977-1988)		
Beef	-.0004 (-.153)	.0006 (.548)
Lamb	.003 (.846)	-.002 (-1.33)
Chicken	-.006 (-2.28)	.002 (.964)
Pork	.003 (.639)	-.001 (-.758)
Piggot (1978-1988)		
Beef	.0157	.0038
Lamb	-.008	-.0069
Chicken	-.054	-.0247
Pork	.001	.0122

SIMULATION

Simulation was run for the period of 1990:1 to 1997:4. The results reported in Table 7 show that APC advertising is not significant. Since AMLC is least significant in affecting the consumption of other commodities, AMLC advertising expenditure is chosen as an indicator for two scenarios. If advertising from AMLC is decreased by 20 percent, consumption of beef and lamb will decrease, consumption of chicken will increase, no effect on pork and bacon & ham consumption. If advertising from AMLC is decreased by 50 percent, beef and lamb demand will be decreased, chicken demand will be increased and no big effect on consumption of pork and bacon & ham.

Table 7 Simulation Results

Variable	AMLC (base)	AMLC↓20%	AMLC↓50%
Texp	1517.518	1516.31977	1513.801
Beef	9.65078	9.63934	9.61535
Lamb	3.07410	3.07322	3.07134
Chicken	6.42876	6.42949	6.43091
Pork	3.33718	3.33319	3.32484
Bacon & Ham	1.35511	1.35587	1.35742

CONCLUSIONS

The estimation results tell us that APC advertising is not bringing significant effect on pork sales in Australia. For a 1 percent increase in APC advertising, it will only increase the consumption of pork by 0.055 percent on average. Even though much information on brand advertising is included, APC advertising impact is not improved. The results might imply that APC advertising is not a profitable investment to pig producers in Australia. However, there is more required for this model, because interactive effects among these commodities, tests for some properties and tests for functional forms have not been done at this stage.

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Appendix

Table 2. Parameter Estimates for Expenditure Share Model

Parameter	Estimate	t-statistics
C1	-.142091	-.618759
B11	.182124	3.20136
B12	.030981	1.35772
B13	.048857	3.55462
B14	.054924	2.14878
B15	.054713	1.84102
D11	.227326	1.17006
D12	-.400509	-1.34373
D13	-.044933	-.670844
D14	-.030574	-.584252
C2	-.203679	-3.92058
B22	.091624	1.68855
B23	.032134	2.02735
B24	.044638	1.23264
B25	.025609	1.55547
D21	.045449	1.07348
D22	-.079343	-1.31067
D23	-.478887E-02	-.357414
D24	.766961E-02	.559393
C3	-.251594	-2.94421
B33	.171097	1.60175
B34	.011724	.361735
B35	.033587	2.11663
D31	.055120	1.22711
D32	-.079572	-1.32100
D33	-.010969	-.759177
D34	.460326E-02	.373747
C4	-.113716	-2.96194
B44	.036460	.521901
B45	.038239	1.17174
D41	.071251	1.24951
D42	-.101550	-1.34339
D43	-.012287	-.675210
D44	-.012409	-.854926
B55	.090974	1.50611
D51	.082873	1.33077
D52	-.065350	-1.27649
D53	-.652575E-02	-.490853
D54	.039336	1.31527
F1	-.111391E-02	-.826057
F2	-.765041E-03	-.456320

F3	-.310717E-02	-1.40433
F4	-.674870E-02	-1.47447
F5	-.729865E-02	-1.49392
G1	-.354732E-02	-1.48241
G2	-.431049E-03	-1.34279
G3	-.769681E-03	-1.47367
G4	-.958747E-03	-1.47697
G5	-.189374E-03	-.923483