Another Look at Price Levelling and Price Averaging in the Sydney Meat Market

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Simultaneous equation techniques are used to re-examine the behaviour of monthly wholesale and retail price spreads for beef, lamb and pork in Sydney over the period 1971-1988, so as to understand the factors determining the relationships between the prices at the different market levels. Hypotheses tested relate to price levelling and price averaging, and to marketing cost and turnover effects. Using the preferred three-stage least squares estimates, price levelling is confirmed at both wholesale and retail for all meats, however contrary to earlier results there is no evidence of price averaging in any of the meats. Costs are only important determinants for beef at wholesale and lamb at retail, and only the beef and lamb wholesale spreads and the lamb retail spread are negatively influenced by turnover. A structural change test reveals significantly different behavioural responses in the 1980s compared to the 1970s, so the model is re-estimated for just the 1980s. The results generally agree with those from the longer sample, with the only change being at the retail level where costs become significant for beef as well as lamb. However the level of explanatory power for the 1980-1988 models is substantially reduced from that of the full sample models.

1. Introduction

There continues to be considerable interest by both producers and market analysts in the degree of efficiency achieved by the various sectors involved in the production and exchange of Australian livestock and meat products. One ongoing area of concern is that inefficiencies in the pricing mechanism inhibit the rapid and accurate transmission of changes in supply and demand conditions from one market level to another. This view comes to the fore during periods of rises in retail meat prices, and/or during declines in prices at the farm level. For example, in the slump in pig prices in early 1990, one of the issues seized on by producer organisations and the rural media was that retail pork prices did not follow auction and wholesale prices in their downward trend.

It is worthwhile therefore to understand the factors determining the relationships between prices at different market levels, to formalise this understanding in a quantitative way so that specific hypotheses about alleged inefficiencies can be tested for, and to base these tests on relatively recent data so that the tests are as accurate as possible in reflecting current market behaviour.

A recent study by Griffith *et al.* (1991) compiled an updated set of monthly price spreads for Sydney beef, lamb and pork for the period January 1971 to December 1988[1]. The present paper uses these new data to quantitatively re-examine some hypotheses proposed about the behaviour of wholesale and retail meat price spreads previously analysed in Griffith (1974).

The sample unfortunately ends in 1988 because funds were no longer available to continue the time consuming and costly process of collecting and transforming the raw data into the price spreads. Monthly data are used because we are interested in the short-run behaviour of these prices.

Following from the early published literature on meat price spreads in Australia (Marceau 1967; Hodan 1972; Irish 1972; Australian Agricultural Economics Society 1973; BAE 1973, 1974) and

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Review coordinated by Bob Batterham.

[1] Price spreads are defined as the difference in the value of the product in adjoining market levels expressed on an equivalent weight basis. Discussion of definitions, calculation procedures and tabulated results can be found in Griffith and Whitelaw (1975) and Griffith *et al.* (1991).

from investigations carried out in numerous undergraduate and postgraduate dissertations[2], four main areas of concern relating to meat price transmission have stood out over time. In null hypothesis terms they are:

(a) there is no price levelling;[3]

(b) there is no price averaging;[4]

(c) wholesale (retail) spreads are unrelated to the cost of providing wholesale (retail) market services; and

(d) wholesale (retail) spreads are independent of wholesale (retail) turnover.

Price levelling and price averaging behaviours smooth the impact of fluctuations in raw material prices on the prices charged to consumers (Parish 1967). They are important in a policy context as their presence, while indicating more stable prices to consumers, conversely suggest less stable prices received by producers. The size of price spreads also should be related to the cost of providing marketing services in the longer term, but again smoothing policies by wholesalers and retailers may lead them to absorb short run changes in costs in an effort to keep real prices relatively stable. The relationship between throughput and price spreads has implications for the incidence of costs and the distribution of rewards to marketing firms (Griffith and Moore 1991).

Hypotheses (a)-(d) are examined at both the wholesale and retail levels of the market. The regression models and a description of the variables used are presented in section 2. Results are reported and interpreted in section 3 and the conclusions of the study occupy section 4.

2. Methodology

There have been two paths down which price spread research has progressed (Griffith and Moore 1991, Wohlgenant and Haidacher 1989). The first type of analysis deals with the short run behaviour of price spreads, disequilibrium, and the dynamics of price formation and transmission. The second type relates to the longer run, based on static equilibrium models of firm behaviour (Gardner 1975, Wohlgenant 1989, Griffith and Moore 1991). Different types of approaches have been used in these different types of analyses. In this work interest is in the former.

Several previous studies have examined in a Sydney market context some of the short run hypotheses listed above, but all are now very dated. Woodward in his 1968 dissertation used weekly, monthly and quarterly data to test for price levelling and price averaging by simple regression, and for price levelling only by simulation and spectral techniques. He found price levelling at the wholesale level, no price levelling at the retail level and no price averaging at either market level.

Marceau (1968) went further in that his quarterly regression model tested for price levelling and wage and turnover effects, but price averaging was ignored. Again, single equation methods were used to estimate the required parameters. Price levelling was shown to exist for beef at both wholesale and retail levels of the Sydney market.

The first study to examine the various hypotheses in a simultaneous equation framework was Griffith (1974). His conclusion was that price levelling was common in all meats at both the wholesale and retail levels of the market, and that price averaging existed for beef, lamb and pork at the wholesale level and for beef and lamb at the retail level.

Tambi in his 1975 dissertation investigated price and demand relationships for beef in the Sydney

[2] At the University of New England for example, dissertations in this area include Gordon, M. (1966), *Lamb Marketing Margins in N.S.W.*, University of New England, Armidale, unpublished B.Ag.Ec. thesis; Tambi, M.Z.A. (1975), *A Study of Beef Marketing Margins in N.S.W.*, University of New England, Armidale, unpublished M.Ec. thesis; and Woodward, K.R. (1968), *An Empirical Investigation of the N.S.W. Meat Market*, University of New England, Armidale, unpublished M.Ec. thesis. Woodward's research in particular is a widely quoted study of the New South Wales meat market. At the University of Sydney an example is Halstead, P. (1979), *An Analysis of Price Transmission Lags in the Retail Sector of the New South Wales Meat Industry*, University of Sydney, unpublished B.Sc.Agr. thesis.

[3] Price levelling refers to the practice of wholesalers (retailers) holding their selling prices relatively stable in the face of rising or falling auction (wholesale) prices.

[4] Price averaging refers to the practice of setting a low spread on one meat type and recouping any loss by setting a high spread on other meat types.

market. Using deseasonalised quarterly data he used regressions of price relationships to test for price levelling. The hypothesis of the presence of price levelling was rejected at both the wholesale and retail levels if nominal data were used, but was not rejected at the retail level, and the results for the wholesale level were inconclusive, if deflated data were used.

Individual firm records were used by Naughtin and Quilkey (1979) to examine price levelling in an expenditure model. They found evidence of a substantial degree of price levelling and concluded that it may be a more widespread phenomenon than able to be shown with aggregate data.

2.1 Model Specification

In this study retail and wholesale price spread models are considered separately and each contains three equations for beef, lamb and pork. The models are restricted to the three meats because we are interested in examining the pricing practices of fresh meat wholesalers and retailers. Thus other products like poultry and fish, while important to consumers, are not considered because they are not normally sold by meat wholesalers or retail butchers or in the fresh meat section of supermarkets.

These models are outlined below in general terms. A description of the variables used is given in section 2.2.

Wholesale Price Spread Model

$$PSW_b = f(PA_b, CW_b, LPA_b, PSW_l, PSW_p, T_b, LPSW_b) \quad (1)$$

$$PSW_l = f(PA_l, CW_l, LPA_l, PSW_b, PSW_p, T_l, LPSW_l) \quad (2)$$

$$PSW_p = f(PA_p, CW_p, LPA_p, PSW_b, PSW_l, T_p, LPSW_p) \quad (3)$$

The wholesale spreads (PSW) for beef (b), lamb (l), and pork (p) are specified to be dependent on their respective auction prices, both current (PA) and past (LPA), wholesale costs (CW), turnover (T), on other wholesale spreads and on a lagged dependent variable (LPSW). For price levelling at the wholesale market level, PA will have a negative coefficient. The variable LPA is expected to have a positive coefficient as it represents the longer term adjustment of the price spreads to the trend in farm price. For price averaging, the righthand side PSW variables will have negative coefficients, reflecting the trade-offs or "averaging" between the different price spreads so that no one wholesale price gets too far out of line. The coefficient on CW is expected to be positive and the coefficient on T could be of either sign but is expected to be negative based on previous results. A lagged dependent variable is justified on the basis of partial adjustment behaviour by fresh meat wholesalers. With data observations of a month it is reasonable for market intermediaries to have some desired price spread in mind when developing and adjusting pricing practices, as many of their costs could be regarded as fixed or near-fixed over this length of run. Incorporating a lagged dependent variable also has the advantage of compensating to some extent for autocorrelation, which is to be expected with long time series of monthly observations, and has been found in previous models of price spread behaviour (Marceau 1967).

Retail Price Spread Model

$$PSR_b = f(PW_b, CR, LPW_b, PSR_l, PSR_p, T_b, LPSR_b) \quad (4)$$

$$PSR_l = f(PW_l, CR, LPW_l, PSR_b, PSR_p, T_l, LPSR_l) \quad (5)$$

$$PSR_p = f(PW_p, CR, LPW_p, PSR_b, PSR_l, T_p, LPSR_p) \quad (6)$$

As with the wholesale model, retail spreads (PSR) for beef (b), lamb (l), and pork (p) are considered to be a function of their respective present (PW) and past (LPW) wholesale prices, turnover (T), a common retail cost (CR), other retail spreads and a lagged dependent variable. The same signs are expected on these coefficients as for the wholesale model.

All prices, spreads and costs are undeflated and time subscripts and error terms are omitted.

2.2 Variable Definitions and Data Sources

PA = Monthly estimated dressed auction carcase price, in cents/kg, of composite beef, lamb, and pork carcases sold at Homebush

saleyards and adjusted for byproducts and shrinkage.[5]

LPA = Monthly weighted average of past adjusted auction carcase prices, in cents/kg. The preferred weighting factors[6] used were:
$LPA_t = 0.5*PA_{t-1} + 0.33*PA_{t-2} + 0.17*PA_{t-3}$

PW = Monthly wholesale price, in cents/kg, of composite beef, lamb, and pork carcases sold in the Homebush meat halls and adjusted for shrinkage.

LPW = Monthly weighted average of past adjusted wholesale prices, in cents/kg. The preferred weights used were again:
$LPW_t = 0.5*PW_{t-1} + 0.33*PW_{t-2} + 0.17*PW_{t-3}$

PSW = Monthly wholesale spread, in cents/kg, between adjusted wholesale price and adjusted auction carcase price.

LPSW= Monthly wholesale spread, in cents/kg, lagged one month.

PSR = Monthly retail spread, in cents/kg, between composite retail prices of beef, lamb, and pork at selected retail outlets in Sydney and adjusted wholesale prices.

LPSR = Monthly retail spread, in cents/kg, lagged one month.

CW = An index of monthly wholesale marketing costs for each species. Slaughtering fees still comprise over 50 per cent of wholesale operating costs, so slaughtering fees charged at Homebush abattoir were used as a proxy for all wholesale costs. The base period was January 1971 = 100.00.

CR = An index of monthly retail marketing costs. Since wages contribute over 50 per cent of retail operating expenses, the weekly wage rate for a New South Wales General Butcher Shopman under the Federal Meat Industry Award was used as a proxy for all retailing costs. The base was January 1971 = 100.00.

T = Throughput. Due to the closure of the Homebush abattoir in mid 1988, it was not possible to obtain throughput of local and interstate meat at Homebush meat halls. As a proxy New South Wales production of each meat was used[7].

All the basic auction, wholesale and retail price data came from the records of the now Division of Rural and Resource Economics of NSW Agriculture. The procedures for adjusting and weighting these prices and for calculating the wholesale and retail spreads are outlined in detail by Griffith and Whitelaw (1975), Griffith, Henry and Hough (1980) and Griffith *et al.* (1991). Slaughtering fees came from the records of the Homebush Abattoir Corporation, throughput came from the Australian Meat and Livestock Corporation and wage rates came from the Meat and Allied Trades Federation and the Department of Industrial Relations.

2.3 Method of Estimation

Three alternative estimation techniques were considered in the study: ordinary least squares (OLS), two-stage least squares (2SLS) and three-stage least squares (3SLS). Since the two models are simultaneous, as all equations contain endogenous variables on the right-hand side, then 2SLS should be preferred to OLS as OLS would produce biased and inconsistent parameter estimates. Additionally, since it is reasonable to assume that decisions about the magnitude of the price spreads for each of the meats are made jointly in a typical multi-product wholesale or retail fresh meat business, then 3SLS should be preferred over 2SLS as it takes account of cross equation covariances of residuals. 3SLS is more efficient than 2SLS if those cross equation covariances are not zero (Pindyck and Rubinfeld 1981, pp. 326-39).

[5] An adjustment of prices is necessary to take account of the shrinkage in the meat between various market levels due to refacing, dehydration, spoilage and pilfering.

[6] Several different specifications of this weighting pattern were tried. The coefficients of LPA (and LPW) were fairly insensitive to varying specifications but the significance achieved by the preferred weighting pattern was higher.

[7] It is recognised that production may be a poor proxy for throughput in the Sydney meat market because of interstate trade, exports and stocks. The separate effects of these factors will differ for the various meats. The implied assumption is that the patterns of variations in production are a close approximation to the patterns of variation in the throughput of fresh meat in the Sydney market.

All the equations are overidentified by the order condition (Pindyck and Rubinfeld 1981, p. 326). 3SLS is further preferred in this situation as it provides consistent and efficient estimates whereas 2SLS provides only consistent estimates. The tradeoff is that in 3SLS, problems of poor specification of one equation affect the whole system, whereas in 2SLS the problem is confined to that one equation.

For comparison purposes, results from all three estimation methods were calculated, although only the 3SLS results are discussed here. OLS and 2SLS results can be found in Griffith, Green and Duff (1990). In each equation, examination of the variance-covariance matrix of 2SLS residuals indicated off-diagonal elements, so taking the additional step to 3SLS was appropriate. The data used in the estimation consist of 216 monthly observations over the period January 1971 to December 1988.

3. Results

This section reports estimates of the coefficients of the three wholesale spread equations (1)-(3), and the three retail spread equations (4)-(6), using the TSP 3SLS subroutine. The figures in parentheses are the estimated standard errors, and the figures in square brackets are the estimated short run elasticity values at the means. The equations are linear, so the elasticity values will vary for different values of dependent and independent variables.

One modification was necessary to the initially specified models. Examination of the data summary statistics and then a detailed look at the plots of the dependent variables revealed a marked abnormality in the series during 1981 and 1982. In particular, in November 1981 the pork wholesale price spread began declining sharply to eventually become negative, and did not recover to normal levels until October 1982. During this period the pork retail price spread expanded substantially as the retail price did not follow the wholesale price down, and there also appeared to be some compensatory movements in the wholesale and retail price spreads for beef and lamb. Apparently these marked shifts reflected ownership changes in the pigmeat production and processing sectors and attempts to increase market shares (Griffith and Gill 1987; Griffith 1989). Consequently, a dummy variable (=1 for the period November 1981 to October 1982, =0 elsewhere) was constructed and added to each equation to take account of this abnormality.

3.1 Wholesale Results, 1971-1988

As shown in Table 1, all of the wholesale spreads are significantly negatively related to current auction prices and significantly positively related to past auction prices. This result suggests short run price levelling with longer term adjustment of wholesale spreads to trends in auction prices. This agrees with Griffith (1974), and with Woodward's dissertation (p. 112). Price levelling is therefore confirmed as an endemic pricing practice by fresh meat wholesalers in the Sydney market. The estimated elasticities on current price range from -0.67 for lamb up to -1.81 for pork, with generally similar values on lagged prices. The estimated coefficients on the current and lagged price variables were tested for significant difference by a t test, and for each of the meats the null hypothesis of no difference was rejected. In the case of beef the coefficient on the lagged price is less than that on the current price, so this implies only partial adjustment in the longer term to the short run shifts in the wholesale beef price spread. For lamb and pork the opposite is the case, as the short term shift in the price spread is more than outweighed by the longer term adjustments.

Wholesale costs have a significant positive effect only on the beef spread. The elasticity of 0.40 indicates only partial passing on of cost increases in the short run. No such relationship exists for the lamb or pork spread. This result can be compared to the earlier study (Griffith 1974) which found a significant positive cost effect for beef and pork but none for lamb. In the short run, changes in the cost structure facing wholesalers does not have much effect on their pricing practices.

The expected negative short run relationship between throughput and wholesale spreads occurs in the beef and lamb equations though the elasticities are low. This supports earlier work. However Griffith (1974) also found pork to be significantly negatively influenced by total throughput, whereas

Table 1 : 3SLS Wholesale Price Spread Results, 1971-1988

	Explanatory Variables														
Meat	PA_b	PA_l	PA_p	CW	T_b	T_l	T_p	LPA_b	LPA_l	LPA_p	PSW_b	PSW_l	PSW_p	DUM8182	LAGGED DEPENDENT VARIABLE
Beef	-0.410 (0.043) [-0.97]			3.525 (0.562) [0.40]	-0.004 (0.0007) [-0.29]			0.355 (0.044) [0.83]				-0.012 (0.035)	0.215 (0.049) [0.22]	22.46 (5.60)	0.465 (0.053)
Lamb		-0.374 (0.047) [-0.67]		0.057 (0.484)		-0.014 (0.005) [-0.25]			0.456 (0.043) [0.82]		0.107 (0.084) [0.10]		0.105 (0.097) [0.11]	10.68 (10.87)	0.631 (0.052)
Pork			-0.677 (0.061) [-1.81]	0.575 (0.739)			0.020 (0.007) [0.20]			0.711 (0.064) [1.89]	0.132 (0.071) [0.12]	0.105 (0.049) [0.11]		-24.64 (7.56)	0.632 (0.062)

Standard error in parentheses; short run elasticity at the means in square brackets; R^2 is adjusted R^2

Beef equation	$R^2 = 0.954$	DW = 1.77	DH = 2.19
Lamb equation	$R^2 = 0.910$	DW = 1.67	DH = 3.09
Pork equation	$R^2 = 0.950$	DW = 1.99	DH = 0.20

here the pork wholesale price spread is significantly positively related to pork throughput. Tambi in his 1975 dissertation found aggregate beef margins to be positively but not significantly influenced by throughput. For all the meats then the wholesale price spread is significantly influenced by the quantity of product flowing through the market in that month.

No significant evidence of price averaging exists at all in the wholesale spreads. Only one of the signs is negative, and the coefficients that are significant have positive signs, suggesting some form of complementary relationship rather than price averaging. This result agrees with Woodward's dissertation results, but disagrees with Griffith (1974) who found significant price averaging in all three equations. So there has been a major change in the influence of price averaging on the pricing practices of Sydney meat wholesalers.

The dummy variable for 1981-1982 is negative and significant for pork as expected and positive and significant for beef, suggesting some limited averaging behaviour during this period. The sign on the lamb dummy is also positive but not significant. A very strong partial adjustment effect is also evidenced for all three equations, an effect not considered in earlier work. Over 90 per cent of the variation in wholesale spreads is explained in these models, and the Durbin H statistic suggests some significant remaining autocorrelation in the beef and lamb equations.

3.2 Retail Results, 1971-1988

At the retail level (Table 2), all of the current price coefficients are negative and significantly different from zero, implying that price levelling exists in all three price spread equations. Lagged wholesale price variables also are all significant. These results agree with Griffith (1974), but Woodward in his 1968 dissertation found no substantial evidence of price levelling in the retail market. The price elasticities, ranging from -0.54 to -1.14 for current prices and from 0.40 to 1.54 for lagged prices, are substantially less than the corresponding wholesale equation. The estimated coefficients on the current and lagged price variables were tested for significant difference by a t test, and for each of the meats the null hypothesis of no difference was rejected. In the case of lamb the coefficient on the lagged price is less than that on the current price, so this implies only partial adjustment in the longer term to the short run shifts in the retail lamb price spread. For beef and pork the opposite is the case, as the short term shift in the price spread is more than outweighed by the longer term adjustments. Thus to some extent for beef and lamb, the pricing practices in the wholesale and retail markets offset one another, as partial longer term compensation at one level is related to over compensation at the other level. However for pork, both effects work to impart an upward trend to retail prices relative to farm level prices.

Retail costs are significant and positive only for lamb. Cost has a positive effect for pork and a negative effect for beef, though both are insignificant. Again the cost elasticity is small indicating only partial cost recovery in the short run. Griffith (1974) found all spreads significantly influenced by costs, so this results in another major difference from previous work.

A significant but very inelastic negative throughput effect is recorded in the lamb spread, which agrees with Griffith (1974). Beef and pork show a positive turnover effect, although the effect is insignificant for pork. An implication is that the advice of Macartney (1974) to increase retail margins if throughput falls is being disregarded in beef and pork pricing. The large measurement errors inherent in the proxy variable for retail turnover may be the cause of this perceived disregard.

The null hypothesis of the absence of price averaging is not rejected in all three retail spread equations, although there are two negative though insignificant coefficients. Some evidence of retail price averaging was found in the beef and lamb equations by Griffith (1974), but Woodward could not isolate any consistent instances of price averaging. As at the wholesale market level, this is a major change from past results.

The dummy variable for 1981-1982 is positive and significant for pork as expected. It is negative and significant for lamb, again suggesting some limited averaging during these months. Again a strong

Table 2 : 3SLS Retail Price Spread Results, 1971-1988

	Explanatory Variables														
Meat	PW_b	PW_l	PW_p	CR	T_b	T_l	T_p	LPW_b	LPW_l	LPW_p	PSR_b	PSR_l	PSR_p	DUM8182	LAGGED DEPENDENT VARIABLE
Beef	-0.341 (0.067) [-0.53]			-0.012 (0.022)	0.002 (0.001) [0.07]			0.447 (0.064) [0.69]				0.158 (0.051) [0.18]	-0.065 (0.063) [-0.06]	7.864 (5.24)	0.804 (0.037)
Lamb		-0.402 (0.063) [-0.54]		0.059 (0.024) [0.11]		-0.020 (0.007) [-0.16]			0.295 (0.055) [0.40]		0.195 (0.059) [0.19]		0.225 (0.063) [0.22]	-19.07 (5.04)	0.620 (0.063)
Pork			-0.616 (0.070) [-1.14]	0.021 (0.031)			0.0002 (0.011)			0.830 (0.093) [1.54]	-0.112 (0.072) [-0.12]	0.048 (0.067)		22.89 (5.01)	0.721 (0.039)

Standard error in parentheses; short run elasticity at the means in square brackets; R^2 is adjusted R^2

Beef equation	$R^2 = 0.978$	DW = 2.41	DH = -8.38
Lamb equation	$R^2 = 0.973$	DW = 1.93	DH = 0.86
Pork equation	$R^2 = 0.957$	DW = 2.23	DH = n.a.

partial adjustment effect is shown to exist in each equation, with the coefficient in the beef equation being particularly high. Over 95 per cent of the variation is explained in these models and there is some remaining autocorrelation in the beef equation.

3.3 Structural Change Test

With a large sample size of 216 observations covering 18 years it may be of some importance to determine whether there are any significant structural changes over the data period. This is of particular interest in this model when we consider that the initial results are in some cases different to Griffith (1974) even though similar estimation techniques are used.

A possible reason for these divergences is that in 1980 the calculation techniques for price spreads were changed (Griffith, Henry and Hough 1980). Even though comparison of the old and new calculation methods showed mainly a reduction in auction prices and an expansion in the wholesale price spreads, with little change in other series, it is possible that there are some differences in the estimation results between the current and previous calculation technique regimes.

To test such suspicions dummy variables are included in the equations for the relevant time period (January 1971-December 1979=0; January 1980-December 1988=1) and F tests run to determine the significance of the dummy variables as a group on each equation. If the calculated F value was larger than the corresponding tabulated F value then the null hypothesis that there is no significant difference between the two time periods is rejected.

In every equation significant differences between the two time periods are found (Table 3). The impact of changing the calculation procedures in January 1980 is evident for all three meats at both the wholesale and retail levels, even though most of the changes were at the wholesale level.

The conclusion of these results is that there has been a structural change in the processes determining the behaviour of price spreads in the Sydney market. Thus the analysis was redone for just the most recent time period.

3.4 Wholesale Results, 1980 - 1988

At the wholesale level over the short sample (Table 4), the results are virtually identical to those of the full sample. As a general rule the effects of the lagged dependent variables are less pronounced over the shorter sample, although still statistically significant, and the R^2 are reduced, substantially so for beef and lamb.

Table 3 : Structural Change Test Statistics

Meat	Wholesale	Retail
Beef	3.19*	5.84*
Lamb	3.79*	2.14*
Pork	3.09*	2.86*

*Calculated F value greater than the critical F value = 2.01 (5%, df = 7,567)

Table 4 : 3SLS Wholesale Price Spread Results, 1980-1988

	Explanatory Variables														
Meat	PA_b	PA_l	PA_p	CW	T_b	T_l	T_p	LPA_b	LPA_l	LPA_p	PSW_b	PSW_l	PSW_p	DUM8182	LAGGED DEPENDENT VARIABLE
Beef	-0.481 (0.076) [-0.98]			3.442 (1.021) [0.34]	-0.007 (0.001) [-0.27]			0.401 (0.073) [0.82]				-0.068 (0.049) [-0.07]	0.262 (0.082) [0.27]	26.52 (9.10)	0.313 (0.075)
Lamb		-0.545 (0.063) [-0.71]		-0.782 (0.791)		-0.038 (0.011) [-0.42]			0.497 (0.058) [0.75]		0.114 (0.139)		0.084 (0.118)	9.129 (11.58)	0.505 (0.064)
Pork			-0.638 (0.095) [-1.37]	0.319 (1.166)			0.021 (0.011) [0.16]			0.714 (0.094) [1.53]	0.172 (0.124) [0.16]	0.015 (0.069)		-37.21 (8.81)	0.523 (0.078)

Standard error in parentheses; short run elasticity at the means in square brackets; R^2 are adjusted R^2

Beef equation	$R^2 = 0.689$	DW = 1.57	DH = 3.39
Lamb equation	$R^2 = 0.693$	DW = 1.42	DH = 3.75
Pork equation	$R^2 = 0.911$	DW = 1.87	DH = 2.88

Table 5 : 3SLS Retail Price Spread Results, 1980-1988

	Explanatory Variables														
Meat	PW_b	PW_l	PW_p	CR	T_b	T_l	T_p	LPW_b	LPW_l	LPW_p	PSR_b	PSR_l	PSR_p	DUM8182	LAGGED DEPENDENT VARIABLE
Beef	-0.467 (0.095) [-0.68]			0.109 (0.055) [0.20]	0.010 (0.002) [0.19]			0.443 (0.107) [0.64]				0.112 (0.092) [0.11]	0.073 (0.097)	-2.935 (6.95)	0.680 (0.072)
Lamb		-0.410 (0.083) [-0.50]		0.194 (0.043) [0.35]		-0.031 (0.011) [-0.16]			0.386 (0.081) [0.47]		0.048 (0.081)		0.115 (0.110) [0.11]	-7.795 (7.42)	0.647 (0.090)
Pork			-0.674 (0.092) [-1.11]	0.010 (0.064)			0.005 (0.016)			0.712 (0.134) [1.17]	0.024 (0.099)	0.065 (0.096)		28.60 (6.13)	0.469 (0.081)

Standard error in parentheses; short run elasticity at the means in square brackets; R^2 are adjusted R^2

Beef equation	$R^2 = 0.924$	DW = 2.29	DH = n.a.
Lamb equation	$R^2 = 0.921$	DW = 1.89	DH = 1.04
Pork equation	$R^2 = 0.758$	DW = 2.18	DH = n.a

In specific equations, the influence of the lamb spread in the beef equation is greater though still insignificant, the effect of turnover is more pronounced in the lamb equation, and for pork the elasticity values on the price variables are considerably reduced from their very high values in the full sample results. Additionally for pork, autocorrelation is now evident.

The t test of significant difference between the current and lagged price coefficients replicates the results of the full sample for beef and pork, but for lamb the coefficient on the lagged price is now less than that on the current price.

3.5 Retail Results, 1980-1988

The retail level results for the 1980-1988 period are reported in Table 5. Again the results are not markedly different from those of the full sample. The R^2 are again reduced in the shorter sample and the lagged dependent variables have mostly less influence, but it is only in the pork equation where these changes are large. For beef a major change is that the cost variable is now positive and significant and the impact of the turnover variable has increased substantially. Cost is also more significant in the lamb equation and the dummy variable has lost its significant impact, whereas in the pork equation major changes are the lower elasticity on the lagged price variable and the switch in sign on the almost significant beef price spread.

Again the t test of significant difference between the current and lagged price coefficients generally replicates the results of the full sample. For lamb and pork the conclusions remain the same, but for beef there is now no significant difference between the coefficients on the current and lagged prices.

4. Conclusions

In this study updated empirical evidence has been provided on the forces determining the relationships between monthly prices at the auction, wholesale and retail levels of the meat market in the Sydney area. These relationships were investigated over two sample periods – 1971 to 1988 and 1980 to 1988. Some differences between these two samples were found. The general conclusion for the 1980-1988 period, for the preferred 3SLS estimator, is that at both aggregate wholesale and retail levels, the transmission of supply and demand conditions to the auction level is distorted to some extent during the short-run (periods up to 1 month). Hypothesis (a) relating to the absence of price levelling is totally rejected in the short-run at both wholesale and retail. However over longer periods retail and wholesale prices are quite responsive to changes in auction prices. Both conclusions agree with previous work.

Hypothesis (b) relating to the absence of price averaging cannot be rejected for any of the meats at wholesale and retail. This is a major change from the 1974 results and its cause is unclear. It may have something to do with the promotion campaigns undertaken by the Australian Meat and Livestock Corporation and the Australian Pork Corporation which has aimed to make beef, lamb and pork more differentiated.

The costs of providing retail market services are a significant determinant of the beef and lamb retail spreads so hypothesis (c) is rejected at the retail level for these products. Wholesale costs are significant in only the beef equation, so this hypothesis cannot be rejected for lamb or pork at the wholesale level.

Only the beef and lamb wholesale spreads are significantly negatively influenced by turnover so hypothesis (d) is not rejected for pork. This same hypothesis can only be rejected for lamb at the retail level.

This information on the various factors which influence the behaviour of wholesale and retail meat spreads cannot be used to provide definite policy prescriptions about market competition or profitability issues, but it can give some idea of the relative importance of the various influences in each sector and on each meat type considered. This may then help policymakers to better evaluate the effects of decisions they make concerning those factors which determine price spread behaviour, and may assist livestock producers to understand why prices at the wholesale and retail levels do not immediately and fully respond to price fluctuations at the farm gate.

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