The Relationship between Fat, Weight and the Price of Lamb

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A contributed paper presented to the 1993 Annual Conference of the Australian Agricultural Economics Society, February 9 - 11, 1993, University of Sydney.

*NSW Agriculture Orange. This research has been partly funded by the Meat Research Corporation. The authors are grateful for helpful comments and assistance from Jason Barker, Helen Nicol, Arthur Gilmour, Neil Fogarty and David Harris.

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Introduction

Waugh (1928) pointed out that there are two sources of variation in the prices of agricultural products such as lamb. First, average prices vary through time in response to general changes in demand and supply. Second, 'at any particular time, prices vary according to differences in the quality or appearance of the individual lots sold' (Waugh, 1928, p.185). He went on to argue that because a producer has greater control over quality factors than over general market conditions, analysis of this second source of price variation 'may prove to be fully as useful as the studies of factors causing the general level of prices to change from day to day or from season to season' (p. 187).

The objective of the analysis reported in this paper has been to establish the contribution of variations in fat cover and weight to variations in the price of lamb in the Homebush livestock auction and wholesale markets. Few such analyses of Australian livestock industries have been undertaken despite the availability of an extensive body of data from Livestock Market Reporting Services (LMRS). From an analysis of lamb prices in Victoria, West (1984) found significant variation in the relationship between price and fat cover and weight through time and perhaps, between selling centres, and cautiously concluded that 'there is some reason to believe that best prices are paid for lambs with fat scores and carcase weights in the middle of the range and that fat scores and carcase weights on either side receive less' (p.7).

West's findings are in accord with the casual observation that in the Homebush livestock markets, fat class 4 lambs receive a premium (in cents per kg carcase weight) over fat class 3 lambs which in turn receive a premium over fat class 2 lambs. A price discount for excessive fat cover only applies to fat class 5 lambs. Most lambs sold at Homebush weigh between 14 and 16 kg carcase weight with a fat score of 3 to 4.

This pattern of price differentials in the livestock market is in conflict with the view that Australian consumers would prefer larger, leaner lamb. There have been a number of studies of the attitudes of Australian consumers to the attributes of lamb (Thatcher and Couchman, 1983; Kingston, 1988; Hopkins and Congram, 1985; Hopkins, Congram and Shorthose, 1985). Hopkins, Congram and Shorthose concluded that: "more than 75% of consumers favoured cuts from carcases which had a 'GR' fat measurement of between 6 and 10 mm (Fat Class 2) and weighed more that 20 kg (Weight Class X)".

A major weakness of these attitudinal studies is that they do not attempt to measure the value placed by consumers on the product attributes in question. Mullen and Wohlgenant (1992) used a contingent valuation approach to value changes in two important attributes of lamb loin chops – fat cover and area of red meat. When lamb chops from a 17 kg carcase, fat class 2, are selling for $5.50 per kg, the expected discount for a fat class 3 chop with the same area of red meat is

$2.29 per kg, a factor of about one half. They were not able to identify a significant price premium for chops with an area of red meat larger than presently provided by lamb carcases of 17 kg.

This analysis of the relationship between price and weight and fat cover in a traditional livestock auction market should provide some insights into the importance of linking production decisions about weight and fat cover with the decision about whether the lambs are to be sold through an auction market or through a system in which price is explicitly linked to weight and fat cover.

Casual observation suggests that price differentials for fat cover and weight in the wholesale market are more in line with consumer preferences. If a divergence is found between price differentials in the two markets then this is further evidence that there may be gross benefits to the industry from developing a system of weight and grade or description selling.

Finally, the analysis should provide insights about whether the weight and fat classes used in the LMRS are based on changes in these factors that are of significance to lamb buyers operating in auction markets. If these classes are useful then significant price differentials should be observed between classes.

The Data

Data were taken from the daily reports of the sheep market at the Homebush livestock markets issued by the NSW LMRS. Sheep and lamb sales were held at Homebush on Tuesdays and Thursdays. The data cover the period from January 1987, when the LMRS started reporting the lamb wholesale market on a weight and fat class basis, until February 1989. Data were available until August 1989 when the livestock market was closed. However because the numbers of lambs sold fell markedly throughout 1989, these data were not used.

The wholesale market was reported on Wednesdays over the same period. It remained active after the livestock market closed and hence the data through to August 1989 were used.

Lambs are sold by pens on a per head basis. The market reporter assesses the average dressed weight of the lambs in the pen and after deducting an estimate of the value of the skins quotes an estimated dressed weight price in cents per kilogram. Price quotations are also made on a cents per kg liveweight basis and a per head basis and for skins. The market reporter assesses the average fat score of the pen on a scale of 1 to 5 where 1 is very lean. The reporters estimate the depth of soft tissue at the 12th rib, 110mm from the carcase midline, the GR site. The five classes are <5mm; 5 – 10 mm; 10 – 15 mm; 15 – 20 mm and > 20mm. Until October 1987, lambs were classified on a dressed weight basis into three weight classes – <16 kg; 16 – 19kg; and > 19kg – which are referred to below as weight classes 1 to 3. After that four weight classes, referred to as 4 – 7, were used – <16kg; 16 –18kg; 18 – 20 kg; and >20 kg. Lambs are also classified as to whether they are new season lambs or suckers and weaned lambs. New season lambs are not always available. Lambs have no permanent incisor teeth.

At the conclusion of the sale, a report is issued which contains average price quotations for all weight and fat classes for which there were sufficient pens to form a reliable quotation. There are many weight and fat combinations for which a market quotation is not made. There were only six observations for fat class 1 lambs and one of these appeared to have been mis-reported. These observations were discarded.

The total number of sheep and lambs in the market is known. Reporters estimate the percentage of animals in each weight and age class and then within each of these classes, the shares in each fat class.

Concern about the quality of the data arises from several sources. First, the original observations are for pens of animals rather than for individual animals. This averaging process may obscure the relationship between price and product attributes. Second, the data for individual pens are averaged to form a final market report. Note that West (1984) used individual pen data in his study. In this study the daily market quotations were averaged again to give quotations on a monthly basis. Third, there is concern about the accuracy of market reporters. The concern is not so much about their technical ability, which is monitored to some degree and has been reported in several papers (Naughtin (1980); Naughtin and Holland (1982); and Alston, Nguyen and Tunstall (1986)) but about their interpretation of fat classes. Some in the industry suggest that there is a perception that fat class 4 lambs are in some sense 'well finished' or ideal and that market reporters respond by classifying 'well finished' fat score 3 lambs as fat score four lambs.

In the wholesale market lambs are traded by private treaty and hence the market report is based on the cooperation of wholesalers in divulging prices that they receive for different types of lamb. The fat classes are the same as in the livestock market but weight class 1 lambs are less than 16.5 kg, class 2 lambs are 16.6 – 18.5 kg, class 3 lambs are 18.6 – 20 kg and class 4 lambs weigh more than 20 kg. No distinction is made between young and old lambs.

Models to Explain Price Variation

As noted above Waugh pointed out that price is expected to be related to the attributes of the product. However price also varies with general supply and demand conditions. To eliminate this source of variation, Waugh expressed actual prices as ratios to the average market quotation. In the analysis reported below all monthly prices have been normalised by the price in each month of fatscore 4 lambs in either weight class 2 or 5. This category of lamb was always the most plentiful in supply.

There are a number of alternative ways of expressing the fat, weight and age classes. Some, (O'Connell (1986)) seem to have used the raw class scores for fat and weight. In other studies (Waugh; Ladd and Suvannunt (1976); and Ladd and

Martin (1976)), the attributes were measured as continuous variables. Both approaches introduced quadratic terms for the explanatory variables to allow the price differential to change as the explanatory variable changed.

The approach adopted here was to express the weight and fat classes as dummy variables. Age (lamb and young lamb) was also expressed as a dummy variable. This approach has a number of attractions. First, it allows price differentials to vary both in size and sign by weight and fat class. Hence it allows the price differential in moving to fat class five to be negative whereas the price differential in moving to fat class four to be positive. Second, because weight and fat cover are classified according to the LMRS system, it allows an explicit analysis of the appropriateness of the LMRS classes. If the LMRS does efficiently discriminate between lambs that differ in economic value then the price differentials associated with each weight and fat class are expected to be significant. Third, the approach allows us to examine whether there is interaction between weight and fat cover such that at higher weights, the penalty against fat is reduced, for example.

The final issue is that of functional form. Ladd and Suvannunt (1976) noted that many hedonic pricing models use double log or semilog specifications. The immediate practical objection to log models is that it is not possible to take the logs of dummy variables whose value is one. Ladd and Suvannunt (1976) argued against such specifications because they were not consistent with their hypothesis that the price of a product was the sum of the products of the marginal yields of product characteristics and the implicit prices of these characteristics. In the case of lamb, the price of lamb is hypothesised to be the sum of the level of fat cover by the implicit price of fat and the weight of the lamb by the implicit price of weight.

The base models estimated below for the periods in which weight classes differed were:

1. $P = \alpha + \delta_2 F2 + \delta_3 F3 + \delta_5 F5 + \theta_1 W1 + \theta_3 W3 + \in L;$
2. $P = \beta + \lambda_2 F2 + \lambda_3 F3 + \lambda_5 F5 + \rho_4 W4 + \rho_6 W6 + \rho_7 W7 + \sigma L.$

where P is monthly average price of lamb in cents per kg dressed weight normalised by the price of fatscore 4, weight class 2 or 5 lambs. A dummy variable for young lamb, as distinct from lamb, is represented by L and dummy variables for fat and weight classes are represented by F and W. The use and interpretation of dummy variable models is well presented in Kmenta (1986). To avoid a singular matrix, and hence allow estimation of all coefficients, one weight and one fat class has to be omitted as explanatory variables. The dummy variables for fat class 4 and for either weight class 2 or 5 were dropped. In addition the few observations for fatscore 1 lambs were discarded and hence this dummy variable was also omitted.

When the coefficients for these models are multiplied by the average price for fatscore 4, weight class 2 ($1.50/kg) or 5 ($1.45/kg) lambs, they can be interpreted as price differentials associated with changes in weight, fat and age. The constant terms are the average prices for fatscore 4, weight class 2 or 5 lambs. The δ and λ

terms are the price differentials associated with a change in fat class for weight class 2 or 5 lambs. The θ and ρ terms are the price differentials associated with a change in weight class for fatscore 4 lambs. The $\in$ and σ terms are the price differentials associated with young lamb as distinct from lamb for fatscore 4 weight class 2 or 5 lambs.

As noted above, there may be interaction between weight and fat cover, such that price differentials for changes in fat cover for example, are not constant across all weight classes as implied by the models above. Similarly the differentials for weight and fat class may differ for lamb and young lamb. This issue was examined by introducing interaction dummy variables defined as the product of two dummy variables.

The effects of general trends in the demand and supply of lamb were accounted for by normalising by the price of fat class 4 weight class 2 or 5 lambs. However lamb production and prices are highly seasonal and seasonal dummy variables were introduced to see if they improved the explanatory power of the models. Young lambs were never available during Autumn. To isolate the effects of seasonality and age required a system of seasonal intercept and seasonal/age interaction dummy variables[1].

The full model estimated was:

3. $$P = \beta + \lambda_1 F2 + \lambda_2 F3 + \lambda_5 F5 + \rho_4 W4 + \rho_6 W6 + \rho_7 W7 + \sigma L + \omega_{24} F2{*}W4 + \omega_{34} F3{*}W4 + \omega_{36} F3{*}W6 + \omega_{37} F3{*}W7 + \omega_{54} F5{*}W4 + \omega_{56} F5{*}W6 + \omega_{57} F5{*}W7 + \theta_{2L} F2{*}L + \theta_{3L} F3{*}L + \theta_{5L} F5{*}L + \tau_{4L} W4{*}L + \tau_{6L} W6{*}L + \tau_{7L} W7{*}L + \kappa_s S + \kappa_a A + \kappa_w WI + \kappa_{sL} S{*}L + \kappa_{wL} WI{*}L$$

where interaction terms were omitted either because they were associated with fatscore 4 and weight class 5 or because there were no observations for some fat and weight class combinations and where S, WI and A refer to Summer, Winter and Autumn. The constant term now refers to fat class 4, weight class 2 lambs sold in Spring. A similar model was estimated for the earlier period when there were only three weight classes.

As noted above an alternative approach is to model the weight and fat classes as continuous variables by assigning to each class the mid-point of the range of weight or fat cover for that class. A limited attraction of this approach is that the use of continuous variables conserves degrees of freedom and reduces problems of collinearity. A more important attraction here is that it provides a means of pooling data from the three and four weight class observation periods. The model estimated was:

4. $$P = \beta_0 + \beta_w W + \beta_f F + \beta_{ww} W^2 + \beta_{ff} F^2 + \beta_{wf} W{*}F + \beta_a L$$

A dummy variable model was also used to analyze price differentials in the wholesale market. Again prices were normalised by the price of fat score 4 weight class 2 lambs. The base model took the form:

5. $P = \beta + \lambda_1 F1 + \lambda_2 F2 + \lambda_2 F3 + \lambda_5 F5 + \rho_1 W1 + \rho_3 W3 + \rho_4 W4$

A model that included weight fat interaction terms was also estimated.

Results

The results for the base models for the two observation periods are presented in Tables 1 and 2 below. Both models have good statistical properties. All coefficients are statistically significant. The R^2 for the models were 0.63 and 0.60. Both models had low Durbin-Watson statistics but as we are not estimating traditional time series models not much importance was placed on this test and no adjustments were made. There was some evidence of heteroscedasticity. Although this problem has not been fully investigated, an estimator that gave heteroscedastic-consistent estimates of standard errors and variances was used.

The direction of the price differentials is consistent with our expectations for livestock auction markets such as Homebush. Buyers discount changes in fat cover in either direction from fatscore 4 as evidenced by the negative signs on all fatscore dummy variables. The differentials are reasonably similar in both periods although the discount for fatscore 5 lambs is almost twice as large in the first period.

The picture with respect of weight differentials is not quite so clear cut. In the both periods the lighter weight classes (1 and 4) were not significantly different from weight classes 2 or 5 and a move to a heavier weight was discounted. This was surprising since although there is little evidence that consumers are prepared to pay a premium for larger cuts of lamb (Mullen and Wohlgenant, 1992), killing charges are levied on a per head rather than a weight basis.

As expected, young lamb attracted an average premium of about fourteen cents per kg relative to lamb.

The full models with interaction and seasonality effects are presented in Tables 3 and 4. The change in the log likelihood ratio was significant for the period during which there were three weight classes. In the more recent period the log likelihood test statistic was 24 but the χ^2 value for 18 degrees of freedom and a five percent level of significance was 29 suggesting that the addition of the seasonality and interaction terms has not improved the explanatory power of the model.

In both models seasonality and its interaction with age seemed to make the greatest contribution to the improvement in explanatory power. If just these variables were introduced into the four weight class model, then there was a increase in the explanatory power of the model. In this case the test statistic was 12 and the χ^2 value for 5 degrees of freedom was 11.07. The null hypothesis could be rejected at a 2.5 percent significance level. These full models suggest that there are small premiums for lambs in Summer, Autumn and Winter but that these are offset for young lambs by discounts in Summer and Winter. In fact the discount for young fatscore 4 weight class 2 lambs in Summer in the three weight class model is larger than the premium for being young in Spring and means that in Summer young lambs sell at a discount to lambs[2].

The fat and weight interaction terms made the next largest contribution to the explanatory power of the models. In the four weight class model the fat class 3 weight class 7 term was significant, offsetting (by 14.5 cents/kg) the large discounts for the separate fat class 3 (22.5 cents/kg) and weight class 7 (23.1 cents/kg) dummy variables. In the three weight class model, there was a significant discount for leaner but lighter lambs and perhaps some suggestion of a premium for leaner lambs if they were also heavier.

Interaction terms between age and either fat class or weight class made little contribution to the explanatory power of either model. Interaction effects between season and fat, and weight were not examined

Precise estimation of the interaction terms was always likely to be difficult in this study where age, weight and fat cover were highly correlated. However in our view adding all these interaction and seasonal effects has made so little contribution to the models, especially the four weight class model that is of most relevance now, that attempts to estimate these interaction effects more precisely do not seem to be warranted.

The model estimated by scaling the weight and fat classes to continuous variables is presented in Table 5. As for the dummy variable models the coefficients from this model were converted to price changes by multiplying by the average price of fat class 4 weight class 2 or 5 lambs which was $1.47 per kg over the two observation periods. By differentiating with respect of weight and fat and setting fat depth to 17.5mm and weight to 17 kg, the midpoints for fat class 4 and weight class 5, the changes in price from a marginal change in either fat cover or weight were estimated to be 0.67 cents per kg and –2.33 cents per kg respectively, noting again that the coefficients on weight were not statistically significant. From the base, four weight class model, the price change from moving to fat class 3 was –15.7 cents per kg or –3.2 cents per kg for a change in fat cover of one millimetre (average) and the price change from moving to weight class 6 was –5.9 cents per kg or –2.9 cent per kg for an average change in weight of one kilogram. Hence while both approaches estimated a similar price differential for a change in weight,this was not the case for a change in fat cover. The inclusion of seasonality and interaction effects between age, and weight and fat resulted in a small but statistically significant improvement in the explanatory power of the model but there was little change in the values of the main parameters. There seems to be little reason to prefer the continuous variable model to the dummy variable models.

Analysis of the wholesale market has been less comprehensive to date. A base model and a model with weight fat interactions terms were estimated. No attempt has been made to examine the question of seasonality at this stage. The log likelihood statistics for the base and interaction models were 532 and 545 and hence the interaction model was preferred because of its greater explanatory powers and is reported in Table 6 below. Of the main dummy variables only Fat1 was not significant. Three of the 10 interaction terms were significant.

In the wholesale market there is a premium of 36 cents per kg for a shift to fat class 3 and a smaller premium of 11 cents per kg for a shift to fat class 2. This is a clear divergence from the livestock market but one that was not unexpected. As in the livestock markets there are discounts for lambs in heavier weight classes and a premium for weight class 1 lambs. The interaction terms suggest that lambs that are leaner and lighter are penalised whereas lambs that are leaner and heavier are rewarded. Hence the premium for a shift to a fat score 2 weight class 4 lamb is (11.2 – 17.9 + 9.9) 3.2 cents per kg.

Discussion

The analysis above confirmed widely held views in the industry about price differentials for fat cover that exist in livestock auction and wholesale markets for lamb. Price premiums were paid for fat class 4 and fat class 3 lambs in these respective markets. Industry views about the price differentials existing for weight were less clearly stated but there was general consensus that premiums should be paid for heavier lambs because of savings in processing costs and because of attitudinal studies that suggested that consumers would prefer larger cuts of lamb. In both the livestock and wholesale market we found that for fat class 4 lambs, an increase in weight attracted a discount. There was some limited evidence that a shift towards lambs that were both leaner and larger would attract a premium or at least, be discounted less.

The analysis raises a number of points for discussion. First, the analysis clearly confirms that buyers discriminate between lambs that differ in fat cover and weight. Additionally the system of weight and fat classes used in the Market Reporting Service in both the livestock and wholesale markets seems to do a good job in reflecting differences in economic value to buyers in these markets. Freebairn (1973) argued that these were necessary conditions for benefits to be gained from a uniform grading system.

The second point for discussion concerns the divergence observed in this study between price differentials for fat cover in the livestock and wholesale markets and the divergence between what is observed in these markets and perceived consumer preferences for leaner and perhaps larger lamb. In our view these divergences will not be eliminated just by providing a grading or description system but require that lambs be traded on a description or 'weight and grade' basis. The fact that these divergences exist suggests that there are potential gross benefits to the industry from introducing a description system and encouraging trading on this basis and we note that the MRC is currently providing financial support to this end.

A third point for discussion concerns how these divergences in valuing fat cover and weight arise. Some of the more nebulous characteristics of traditional livestock auction markets, said to contribute to this divergence, are that they are 'conservative', 'inefficient', 'lack competition', 'transmit price signals poorly'. The introduction of a grid or description selling system is expected to overcome these problems. In our view it may be more helpful to recognise that these two selling systems provide different services with respect to the transfer of information and risk and this may explain divergences in how fat and weight are valued. In auction markets where buyers purchase pens of lambs with varying and uncertain weight and fat cover, it may be prudent to buy fatter, lighter lambs to meet consumer requirements for tenderness, knowing that excess fat can be trimmed. In a grid selling system more of the risk is transferred to the producer.

Finally, one of the arguments for the establishing LMRS's across Australia was that the data collected would allow analyses such as that reported here. As Waugh pointed out back in 1928, quantitative analyses of the contribution of product attributes such as fat cover and weight are likely to be just as relevant to farmer's production decisions as analyses of price variation from general supply and demand conditions. Despite this, very few such analyses have been conducted either of livestock markets or of grain and horticultural markets.

Table 1:	**Base model for three weight classes**		
	Coefficient	t-statistic	Price differential (c/kg)
Intercept	0.98	87.40	147.4
Fat 2	-0.26	-8.62	-39.6
Fat 3	-0.11	-8.02	-17.0
Fat 5	-0.16	-6.42	-24.5
Weight 1	-0.02	-1.07	-2.6
Weight 3	-0.05	-3.00	-6.8
Young Lamb	0.08	4.82	12.0
Log Likelihood	138	R^2	0.63

Table 2:	**Base model for four weight classes**		
	Coefficient	t - statistic	Price differential (c/kg)
Intercept	0.98	87.80	141.3
Fat 2	-0.23	-10.40	-33.9
Fat 3	-0.11	-7.79	-15.7
Fat 5	-0.09	-6.17	-12.8
Weight 4	0.03	1.62	3.6
Weight 6	-0.04	-2.55	-5.9
Weight 7	-0.13	-8.49	-18.3
Young Lamb	0.11	10.20	16.4
Log Likelihood	266	R^2	0.60

Table 3: Full Model for Three Weight Classes

	Coefficient	t – statistic	Price differential (c/kg)
Intercept	0.97	51.8	145.8
Fat 2	–0.26	–20.90	–38.6
Fat 3	–0.14	–8.74	–21.2
Fat 5	–0.20	–6.19	–29.2
Weight 1	–0.02	–1.05	–3.1
Weight 3	–0.08	–4.33	–11.8
Young Lamb	0.12	3.22	17.4
Summer	0.04	1.73	6.4
Autumn	0.05	2.51	7.9
Winter	0.04	2.12	6.4
YL * Summer	–0.18	–4.48	–26.9
YL * Winter	–0.09	–2.72	–14.0
F2 * W1	–0.07	–2.17	–9.9
F3 * W1	–0.01	–0.36	–1.5
F3 * W3	0.06	1.83	8.3
F5 * W3	0.01	0.21	1.3
F2 * YL	0.12	2.24	18.4
F3 * YL	0.05	1.79	7.7
F5 * YL	0.07	1.59	10.5
W1 * YL	0.03	0.93	4.5
W3 * YL	0.04	1.26	6.3
Log Likelihood	163	R^2	0.75

Table 4:	**Full Model for Four Weight Classes**		
	Coefficient	t – statistic	Price differential (c/kg)
Intercept	1.00	66.0	144.6
Fat 2	–0.31	–4.49	–45.0
Fat 3	–0.16	–8.73	–22.5
Fat 5	–0.12	–3.28	–17.1
Weight 4	0.00	0.01	0.0
Weight 6	–0.08	–4.26	–11.2
Weight 7	–0.16	–10.10	–23.1
Young Lamb	0.10	3.31	14.3
Summer	0.02	0.94	2.4
Autumn	0.03	1.88	4.6
Winter	–0.00	–0.14	–0.4
YL * Summer	–0.04	–1.52	–5.7
YL * Winter	–0.07	–1.83	–10.0
F2 * W4	0.07	0.89	9.7
F3 * W4	0.01	0.47	2.1
F3 * W6	0.06	1.38	8.1
F3 * W7	0.1	3.10	14.5
F5 * W4	0.02	0.52	3.1
F5 * W6	0.03	0.71	4.0
F5 * W7	0.00	0.13	0.7
F2 * YL	0.03	0.58	4.2
F3 * YL	0.06	1.81	8.1
F5 * YL	0.05	1.71	6.6
W4 * YL	0.03	0.97	4.6
W6 * YL	0.02	0.68	3.2
W7 * YL	0.03	0.97	4.5
Log Likelihood	278	R^2	0.64

Table 5: Continuous Variable Model

	Coefficient	t – statistic	Price differential (c/kg)
Intercept	–0.09	–0.36	
Weight	0.04	1.64	6.3
Fat	0.09	10.10	12.8
$Weight^2$	–0.001	–0.91	–0.1
Fat^2	–0.001	–3.69	–0.2
Weight*Fat	–0.002	–3.22	–0.3
Young Lamb	0.102	10.30	15.1
Log Likelihood	363	R^2	0.53

Table 6: Price Differentials in Homebush Wholesale Market			
	Coefficient	t – statistic	Price differential (c/kg)
Intercept	1.00	huge	193.9
Fat1	–0.05	–1.60	–10.6
Fat2	0.06	6.16	11.2
Fat3	0.19	11.70	36.0
Fat5	–0.13	–13.10	–25.7
Weight1	0.05	4.51	8.9
Weight3	–0.02	–2.20	–3.1
Weight4	–0.09	–8.20	–17.9
F1*W1	–0.14	–3.80	–26.7
F1*W3	0.01	0.21	1.7
F2*W1	–0.04	–1.72	–7.8
F2*W3	0.01	0.50	1.5
F2*W4	0.05	1.98	9.9
F3*W1	–0.04	–1.72	–8.6
F3*W3	–0.03	–1.49	–6.4
F3*W4	–0.03	–1.19	–5.7
F5*W3	–0.02	–0.98	–3.1
F5*W4	0.06	2.69	12.1
Log likelihood	545	R^2	0.72

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Endnotes

1. If the season/age interaction terms were omitted, the coefficient on the dummy variable for young lamb became insignificant in the model with three weight classes.

2. In the three weight class model the net discount for a fatscore 4, weight class 2 young lamb in Summer over a fatscore 4, weight class 2 lamb in Spring is (17.4+6.4–26.9) 3.1 cents per kg.