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Determination of Grade Prices for Wool

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The importance of welfare losses resulting from discrepancies between Australian Wool Corporation and trade valuations of different grades of wool is discussed. Cross-sectional data are used to relate variations in wool attributes to variations in price during 1976–7 and a model is derived for determining grade prices that are consistent with market valuations of different grades. The spatial consistency of the model is tested using data from eleven time periods and from two geographically isolated markets. Comparisons between trade valuations and the grade price differentials used in the Minimum Reserve Price Scheme by the Australian Wool Corporation are made.

Price differentials between different types of wool at auction are partially determined by the Australian Wool Corporation (AWC) through the processes of market intervention. Where price differentials do not reflect free market valuations, extra costs are created in the marketing system and inequities occur in the distribution of both wool returns and benefits derived from the price stabilization scheme. In this paper a technique is developed to generate grade prices reflecting market valuations which may be used to minimize the extra costs and inequities.

The approach assumes a high degree of consistency in grade price differentials over time and hence that future valuations of wool attributes within the market will reflect previous valuations. If differentials are not consistent over time then the scope for developing a system based on historical price information to predict future differentials is severely restricted. The regression approach used in the study does however provide a measure of the importance of this assumption.

Since the beginning of the 1974–5 season, growers have contributed a fixed proportion of their wool returns towards the maintenance of a reserve price scheme which is operated by the AWC. This scheme, called the Minimum Reserve Price Scheme (MRPS), results in the acquisition of wool by the AWC when prices fall below a minimum level which is predetermined on an annual basis. The MRPS operates simultaneously with the Flexible Reserve Price Scheme (FRPS) which is used for acquisition when prices fall below levels that may be predetermined on a short term basis. The essential difference between the MRPS and the FRPS is that with the MRPS the Corporation is a buyer of last resort and hence with purchases made under this scheme the differences in prices for different grades of wool must be determined institutionally. When discrepancies occur between free market price differentials and

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Corporation price differentials, some types of wool may accumulate in quantities out of proportion with their importance in the national clip. Such discrepancies may occur for political reasons, because of operational inefficiency of the scheme or, possibly, because discrepancies may be seen as short-run phenomena and are not adjusted in the interests of maintaining stability.

1 Pricing Efficiency Implications

For market intervention to be both efficient and equitable, it must ensure a return to growers that is consistent with the market valuation of their produce over the period that the objectives of the scheme are defined. While adjustment may be undesirable in some situations, the cost of non-adjustment should be considered:

(i) If the Corporation determines reserve prices by using the same criteria as trade buyers, no additional substitution between types due to the intervention process will occur. If one attribute is favoured, *e.g.*, fineness of fibre diameter, buyers are expected to bid away from it. This results in a cost of substitution that may be either passed on to the consumer or passed back to the grower in the form of a lower general price level;

(ii) If the Corporation favours a particular wool attribute in its market strategy, the result is a stockpile that does not represent the proportion of types in the general throughput in the market. Such an imbalance increases the operational costs of the scheme in meeting an objective of minimizing average variation in prices over a period for all wool types because a higher stock level must be maintained to achieve objectives. As well, inequities result from stockpile imbalance if the accumulated stocks of specific types are discharged at prices below the initial purchase price or if the costs of continuing to store such lines are borne by the scheme as a whole, not by the producers of the types in question;

(iii) Discrepancies between institutionally determined and market determined grade prices will also result in inequities in the distribution of returns to growers and in the distribution of benefits associated with the scheme. Because all growers contribute the same proportion of their wool revenue to market support, any favouring of one section of the market must be at the expense of the rest of the market. Because substitution between wool types is not perfectly elastic, increased bidding by the Corporation in one section of the market resulting in higher prices in that section will not result in a comparable increase in prices in other sections. Further, if bidding by the Corporation is concentrated in one section of the market, the price stabilizing influence of such bidding will also be concentrated. This results in the most favoured areas of the market achieving a higher degree of price stability, while undervalued areas of the market, which have contributed equally to the costs of price stabilization, must face relatively unchecked price fluctuations; and

(iv) A final, and perhaps most important, effect of discrepancies between institutionally and market determined prices is that growers may receive false price signals. In a free market, changes in supply of specific types are related to changes in relative prices of different types. If one area of the market is favoured and prices are artificially high, growers in that area have less incentive to adjust clip characteristics in relation to the needs of the market. Similarly, producers of unsupported types have less incentive to maintain supply of these types as the benefits they receive from the scheme in terms of both price and price stability are low. This is not to imply that growers have complete autonomy over the characteristics of their wool. Seasonal conditions may influence most wool attributes despite grower initiated feeding and breeding strategies. The effects of false price signals may only be evidenced in changes in supply in the longer term as growers have little control over the characteristics of their wool in the short term. However, in the absence of correct price signals, growers may not even commence changing supply to meet longer term market requirements.

2 Approaches to Institutional Grade Price Determination

Institutions may incorporate buyer preferences into prices for different grades using simple price comparisons. For example, the prices of different grades of the commodity sold on the same day may be compared and the price difference taken as the marginal difference in value which buyers place on the differences in characteristics of different wool types. Where data are available and correct sampling techniques are possible, this approach is adequate, since testing in a classical controlled experiment is possible. However, data requirements for this approach are often prohibitive and calculations for the many wool types tedious.

The approach used in this paper is in the tradition of Lancaster (1966) and Griliches (1971). The demand for a good is seen as the sum of demand schedules for the individual attributes. Cross-sectional price equations are specified with price as the dependent variable and the attributes of the commodity as explanators. The parameters of these explanators are estimated using an ordinary least squares estimator. The attributes are expressed as continuous variables where such specification is appropriate, and as classed binary variables where it is considered that the values for the variables are not linearly related to price or where the attribute cannot be readily described in quantitative terms, as in the instances of fibre diameter and colour in wool respectively.

The possibility also exists that attributes are evaluated interactively, *e.g.* wool which is both fine and high yielding may attract a premium in excess of the sum of the individual valuation of these attributes. If this is so then some biases may be expected using the approach outlined above. This aspect is discussed in more detail in section 6.

An additional source of deviation from free market valuations in the estimates derived from the model may result because price data used in the analysis may be influenced by the operation of the reserve price scheme throughout the observation period. Hence in using any approach to grading prices, some bias from this source will enter the calculations. However, it can be seen intuitively, as well as shown mathematically, that the continual application of the technique in the market over a period of time would result in a convergence of grade prices towards free market valuations.

The model is a statistical technique for measuring marginal valuations of wool attributes. As such, it makes no claim to being an explicit behavioural description of buyer's activity in evaluating different wool types at auction.

3 General Form of the Equation

The general form of the price equation is:

$$(1)\ p_i = a_i + \sum_{k=1}^{K} b_{ik}\, x_{ik} + u_i$$

where p_i is the clean price per kilogram for lot i, x_{ik} is the value of the kth attribute for lot i, and b_{ik} is the value of an additional unit of the attribute k. Where binary variables are used for variables that are not continuous or where non-linearity is expected, the following general form is used:

$$(2)\ p_i = a_i + \sum_{s=1}^{S} b_{is}\, x_{is} + \sum_{n=1}^{N} \sum_{m=1}^{M} b_{inm}\, x_{inm} + u_i$$

where $b_{is}\, x_{is}$ is the value of the sth attribute in the ith lot, where the sth attribute is expressed as a continuous variable, and $bi_{nm}\, x_{inm}$ is the value of the nth class of the mth attribute in the ith lot.

To allow for changes in the average price level over time and between centres, a zero-one variable is specified equal to one at a specific time or market location and zero elsewhere.

4 Choice of Variables

The choice of wool attributes for inclusion in the model is based on a criterion that the attribute fulfils one or more of the following conditions (George and King 1971):

(i) it directly influences processing costs or quantity or quality of the processed output;

(ii) it directly influences the quality of the end products as perceived by the consumer;

(iii) it constrains the end use of the wool; and

(iv) data on the characteristic are available.

These conditions are based on the general assumptions of neoclassical economics that manufacturers attempt to maximize profits in a competitive environment and that consumers rank their preferences for different products in a consistent way.

The following attributes are examined:

(i) Yield: Yield is a measure of the proportion of usable clean wool in the greasy wool and amount of lanolin and by-products in wool. The yield of wool influences the freight costs for clean wool although this effect on costs may be partially or in total offset by gains from the sale of by-products;

(ii) Vegetable matter content: This increases the costs of combing and may decrease the amount of wool top produced from a given quantity of wool;

(iii) Colour: Whiteness is preferred in scoured wool, since stains restrict the dyeing process;

(iv) Tenderness: Low tensile strength of the fibre will result in shorter fibres in the top and greater waste due to short fibres; and

(v) Mean fibre diameter: The diameter of the fibre determines the length of yarn that may be spun from a given weight of clean wool and is associated with the degree of softness, warmth and flexibility of fabrics.

Brearley (1965 *a*, *b*), describes many attributes which may affect the demand for wool. However, many of these attributes are considered to be of lesser importance than the attributes used in the model. Where the information on these attributes is available, the data used are for wool with a uniform level of these attributes.

Data are selected for the Merino Combing Fleece and Crossbred Fleece categories of wool. The data for the Merino Fleece category are from the spinner and good topmaking style groups as defined by the AWC classifications system. The Crossbred Fleece data are drawn from the average and good Crossbred Fleece groups.

Clean prices are derived by dividing the successful greasy price bid for each lot by the yield of the lot. The mean and standard deviation of the yield and price series are 64.4 per cent and 16.6 per cent and 192.7 cents and 32.0 cents, respectively. Vegetable fault averages 3.2 per cent with a standard deviation of 2.01 per cent. For the sample as a whole, 12.4 per cent of the lots are described as part yellow yolk stained and 0.2 per cent as yellow yolk stained; for part tender and tender classifications, the proportions are 9.0 and 4.0 per cent, respectively.

The AWC records details of the wools in all lots sold at auction in Australia. These data are recorded on magnetic tape along with sale details such as final bid prices.

For some of the attributes the units of measurement are not conformable with the way buyers value wool. This is in effect a measurement error and will result in a downward bias in the absolute values of the estimated coefficients (Malinvaud 1966).

Data are selected from sale lots traded at the Sydney and Melbourne auction markets during the 7th, 10th, 11th, 13th, 16th, 20th, 23rd, 24th, 32nd, 39th and 47th weeks of the 1976–7 season.

Only wools sold by sample are included. Wools bought by the Australian Wool Corporation are excluded. While data for wool purchases by the Australian Wool Corporation are excluded, the purchases by the Corporation may change the prices in the market from those which would exist in the absence of intervention.

6 Results

The results of the analysis, derived from equation (2), are presented in Table 1 for Merino Fleece wool and in Table 2 for Crossbred Fleece wool, along with the values for the location and time intercept dummy values. In the tables, premiums and discounts are for additional units or percentage points of each characteristic. For the fibre diameter results, premiums refer to the difference between the stated micrometer (μm) value and 23 μm wool in the merino group and 27 μm for the crossbred group, *ceteris paribus*. The units for yield and vegetable fault are expressed as percentage points and hence values are for an additional one per cent of the attribute.

Table 1: *Market Values of Merino Fleece Attributes*

Sample size = 3 729
R^2 = 0.88

Attribute		Standard error
Yield	0.16c premium per additional 1 per cent	0.05
Vegetable fault	1.84c discount per additional 1 per cent	0.13
Part yellow yolk stain	4.81c discount	0.72
Yellow yolk stain	18.3c discount	6.90
Part tender	4.77c discount	0.57
Tender	13.7c discount	0.82
19 μm	18.7c premium over 23 μm	0.99
20 μm	18.7c premium over 23 μm	0.75
21 μm	11.2c premium over 23 μm	0.60
22 μm	5.43c premium over 23 μm	0.55
23 μm	..	..
24 μm	3.58c discount under 23 μm	0.77
Intercept dummies for weeks:*		
7	2.08c premium over week 10	0.87
10	base period	..
13	9.62c premium over week 10	0.81
16	19.92c premium over week 10	0.82
20	15.41c premium over week 10	0.90
23	46.96c premium over week 10	1.07
24	83.22c premium over week 10	0.79
32	65.90c premium over week 10	1.07
39	62.28c premium over week 10	1.11
47	46.96c premium over week 10	1.10
Intercept dummy for Melbourne	0.68c premium	0.50
Constant	270.38	

* The data selection process resulted in the exclusion of observations from week 11.

Table 2: Market Values of Crossbred Fleece Attributes

Sample size = 1 113
$R^2 = 0.91$

Attribute		Standard error
Yield	0.06c premium per additional 1 per cent	0.10
Vegetable fault	0.32c discount per additional 1 per cent	0.24
Part yellow yolk stain	0.55c discount	1.29
Part tender	4.16c discount	1.17
Tender	11.8c discount	3.04
21 µm	37.96c premium over 27 µm	2.65
22 µm	31.28c premium over 27 µm	2.37
23 µm	22.03c premium over 27 µm	2.03
25 µm	15.26c premium over 27 µm	1.07
27 µm	. .	. .
30–31 µm	21.00c discount under 27 µm	1.10
32–33 µm	34.70c discount under 27 µm	1.31
Intercept dummies for weeks:*		
7	36.45c discount under week 16	1.51
10	33.9c discount under week 16	1.66
11	31.7c discount under week 16	1.77
13	16.4c discount under week 16	1.40
16	base period	. .
20	4.31c discount under week 16	1.37
23	34.55c premium over week 16	1.39
24	47.25c premium over week 16	1.61
32	34.80c premium over week 16	1.67
39	12.75c premium over week 16	1.50
Intercept dummy for Melbourne	1.14c premium	0.97
Constant	287.51	

* The data selection process resulted in the exclusion of observations from week 47.

Pooling of data from the various time and location dimensions resulted in an array of intercept values for the regression equations. Because of the magnitude of the estimation problem and the multicollinearity problems resulting from the use of large numbers of binary slope dummy variables, the latter are not included in the model. However, records of prices over the observation period indicate that some movement between price differentials occurred. This observation has two implications for the results of the model.

First, that the model may have some relevant omitted variables. These are interactive binary attribute variables for each week in the observation period. Kmenta (1971) points out that the bias in a regression equation resulting from the omission of relevant variables will depend on the strength and direction of correlation between omitted variables and included dependent variables. Some upward bias is expected in estimated coefficients due to these omissions, and bias in the variance of the parameter estimates will be positive, and hence, estimates of standard errors will be conservative. While high coefficients of determination of the models indicate that the major value determining attributes have been included in the model, the possible importance of interaction among some attributes and between some attributes and time should not be overlooked.

The second implication of the exclusion of interactive slope variables from the model is that the results derived may be seen as estimates of average price differentials for a season. However, the small standard errors of parameter values indicates a high degree of consistency over the time period and a high level of efficiency in pricing attributes in the market.

The possibility of some interactions among variables was noted in section 3. Some biases in the estimated coefficients may exist as no variables were included for these interactions. However, as with the omission of variables for possible interactions between wool attributes and time the impact of these omissions is likely to be small.

7 Comparisons with Australian Wool Corporation Valuations

There are two components of the current reserve price scheme. First, a set of flexible reserve prices which may be changed at the discretion of the Australian Wool Corporation. Second, a set of minimum reserve prices which are set annually.

The flexible reserve price component was introduced in 1970 with the view that operation of the scheme '. . . should mean a significant reduction in sales of wool at undervalued prices, in relation to prevailing rates, and the prevention of sales of individual lots when bidding on those lots has ceased to be competitive, that is, preventing the occurrence of pot-holes in the course of auction sales.' (Second Reading Speech, Australian Wool Commission Bill 1970). With this form of operation in mind, flexible reserve prices should closely reflect current market price discounts and premiums for wool attributes to provide all growers with the same level of protection against the occurrence of pot-holes. The method developed in this paper has particular relevance to setting these flexible reserve prices as estimates of discounts and premiums can be quickly obtained from the most recently available sale information. Unfortunately, data on AWC flexible reserve prices are not readily available to permit comparisons of the attribute values implicit in these prices with the estimates from the model. The technique developed here may have less relevance to the setting of minimum reserve price differentials because of the possibility of variability in price differentials over time.

Using the 1976–7 AWC Minimum Reserve Price Schedule, it is possible to make comparisons between institutionally and market determined valuations of wool attributes in clean price terms. Differences are presented in Table 3, using the same format as Tables 1 and 2.

During the 1976–7 season, the process of grade price determination in the reserve price scheme placed values on very fine types well above market value and on coarse types below market values. At the time of writing, the welfare implications of false price signals to producers, inequitable distribution of benefits and costs of the scheme and inefficient stock adjustment is of historical interest only. However, these costs must have been considerable.

Table 3: *Comparison of Market Valuations and AWC Minimum Reserve Price Grade Differentials for the* 1976–7 *Season*

Merino Fleece	Market valuation	AWC differentials
Yield	0.16c premium	nil
Vegetable fault	1.84c discount	2.5c discount
Part yellow yolk stain	4.81c discount	10.0c discount
Yellow yolk stain	18.3c discount	15.0c discount
Part tender	4.77c discount	20.0c discount
Tender	13.7c discount	40.0c discount
19 μm	18.7c premium	45.2c premium
20 μm	18.7c premium	27.2c premium
21 μm	11.2c premium	19.4c premium
22 μm	5.43c premium	7.5c premium
23 μm	..	..
24 μm	3.59c discount	12.0c discount
Crossbred Fleece		
Yield	0.06c premium	nil
Vegetable fault	0.32c discount	2.0c discount
Part yellow yolk stain	5.55c discount	15.0c discount
Yellow yolk stain	(a)	20.0c discount
Part tender	4.16c discount	20.0c discount
Tender	11.8c discount	40.0c discount
23 μm	22.0c premium	76.9c premium
24 μm	15.2c premium	12.6c premium
27 μm	..	..
30–31 μm	21.0c discount	37.6c discount
32–33 μm	34.7c discount	52.6c discount

(a) Not estimated.

8 Conclusions

Application of Lancaster's theory of demand to cross-sectional data using regression analysis provides an appropriate technique for measuring buyers' valuations of wool attributes. The estimates derived using this technique appear to be stable over the 1976–7 season and between the Sydney and Melbourne markets. Comparisons between the estimates of market values for 1976–7 and attribute valuations implicit in the AWC minimum reserve price scheme indicate considerable discrepancies may have occurred. Considering the losses which could arise from such differences in values, it would appear that efficiency gains could be obtained from the adoption of the model as a decision tool for determining grade prices in the market intervention process.

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