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**THE IMPORTANCE OF HIDDEN GAINS AND LOSSES  
A CASE STUDY OF AUSTRALIAN WOOL**

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*A CES partial equilibrium model of the Australian wool market is specified with extrapolative expectations, foreign wool supply and random disturbances. The model is simulated in a numerical experiment under the assumptions first, that prices are stabilised in a band, and second, that prices are underwritten at some predetermined level. The effects of the stabilisation policies on producer and consumer revenue, stock levels and authority profit are measured under a variety of assumptions about elasticities and the sources of price shocks. It is found that the value of 'revenue effects' expected from theory are minimal and that the published theoretical literature in the area is not useful for predicting winners and losers.*

It is well known from the results of theoretical analysis by Waugh (1944), Oi (1964), Massell (1969), Turnovsky (1974) and others that the operation of a buffer stock in a commodity market will result in revenue transfers between consumers and producers. With linear demand and supply schedules and perfect stabilisation such hidden gains and losses will favour producers when the principal source of shocks in the market is supply side and will favour consumers when the principal source of shocks is demand side. It is not clear how such transfers will be distributed when the linearity assumption is relaxed, or when price rules are introduced that allow the possibility of a buffer stock profit, or prices are distributed asymmetrically. Also, since the distribution and magnitude of transfers depends in principle on the magnitudes of the elasticities of demand and supply and on the quantities in the market, it is difficult to make general statements based on theory alone about the likely magnitude and distribution of transfers in any specific market.

In this study, a numerical analysis is undertaken based on explicit assumptions about agents' behaviour in an attempt to obtain estimates of the likely size and direction of transfers resulting from the imposition of a buffer stock in the Australian wool market. In this regard, the analysis is not an attempt to evaluate the current stabilisation policy operating in the wool market. Rather, it is an attempt to address questions raised in the literature on theoretical stabilisation and to see whether such questions are likely to be specifically relevant to the wool market, and, if possible, to infer whether they have general relevance. The literature on hidden gains and losses of stabilisation is voluminous and attempts, basically, to show that the imposition of a buffer stock on a market will cause revenue flows between consumers and producers. In this paper the question of whether these revenues are likely to be of a magnitude to be of interest is addressed in the context of the Australian wool market under two hypothetical, yet plausible, stabilisation rules.

A numerical solution was favoured over an analytical solution because it enabled non-convexities in price outcomes to be incorporated easily and because it provided greater flexibility in the choice and range of price rules to be examined. Thus some advantages were obtained over the technique used by Campbell, Gardiner and Haszler (1980) because control could be exercised over the source of random shocks in the market and because a number of different types of intervention could be considered.

### Theoretical Considerations

The theoretical basis of revenue transfers resulting from buffer stocks in commodity markets that have been outlined by Waugh (1944) and Oi (1964) arises from the convexity properties of the consumer expenditure and producer revenue functions. Both authors chose linear models that implied quadratic expenditure and revenue functions. It can be easily shown that when a chord representing price instability intersects either of these quadratic functions, expressed as a function of price, the expected levels of consumer expenditure are lower, and producer revenue are higher, than those that would result if prices were completely stable at their expected levels. Thus producers lose from the imposition of stability on prices by an outside agent when the source of price instability is not supply itself, and, similarly, consumers lose from price stabilisation when price instability arises from non-demand factors. Waugh's and Oi's results can be generalised beyond the case of linear demand and supply. Imagine that prices fluctuate so that price  $p_1$  has probability  $q$  and price  $p_2$  has probability  $(1 - q)$ . Comparing producer revenue at average price  $p = q p_1 + (1 - q) p_2$

with expected revenue with fluctuating prices it follows, because the revenue function is convex, that:

$$q R(p_1) + (1 - q) R(p_2) \geq R[q p_1 + (1 - q) p_2]$$

where  $R(\cdot)$  is the revenue function. Thus producers lose from price stabilisation in revenue terms. Using  $E$  to denote the consumer expenditure function it follows similarly that:

$$q E(p_1) + (1 - q) E(p_2) \leq E[q p_1 + (1 - q) p_2].$$

Thus consumers spend less when prices fluctuate than when prices are 'stabilised' at their mean. Massell (1969) extended this framework to examine outcomes for producers (consumers) when the source of variation was supply (demand) and found that producers (consumers) gain from price stabilisation in terms of transfers when the source of market instability is supply (demand).

A buffer stock may stabilise prices using a number of criteria. A number of approaches have emerged in the literature. (Adams and Klein 1978 provide a summary of much of this literature.) The first is the bandwidth rule. With this rule, the authority stabilises prices in a symmetrical band around the expected price in such a way as to ensure that the level of stock is stationary and non-zero in the long run. Townshend (1977) has shown that since prices before stabilisation are a random walk it is inevitable that 'stock out' will occasionally occur; that is, the stock level will reach zero, and hence the price rule will need to be temporarily abandoned. However, for most of the literature the possibility of 'stock outs' is ignored and bandwidth rules are designed so that prices never fall below some predetermined level or rise above some predetermined ceiling. Two arguments have been used to justify this rule. The first is based on the assumption that the purpose of the buffer stock is to reduce risk to producers only. It is assumed that expected utility is maximised and hence stability of prices either upwards or downwards is valued highly by risk averse producers. The second argument is that buffer stocks also have a function in stabilising prices to either processors or consumers and hence removal of high prices will encourage demand.

The second price rule that has attracted attention in the literature is the underwriting rule. With this rule the authority is committed to maintaining prices above some minimum, or 'reserve' level. It will purchase stocks when market prices fall below the 'reserve' level and discharge them when market conditions improve. The stock discharge will usually occur in the period following acquisition providing it does not violate the underwriting constraint. This is, of course, a pure underwriting rule; historically, buffer stocks have been far more complex in their behaviour and have been likely to incorporate elements of both the bandwidth and underwriting price rules. However, for clarity in the analysis these two approaches will be examined separately.

A further price rule that has attracted limited attention is based on optimal control techniques (Hinchy and Simmons 1983). With this approach the stabilisation authority attempts to maximise a welfare function, subject to constraints due to the costs of holding stocks and demand and supply conditions. This approach is not considered in this analysis.

Since the Waugh (1944), Oi (1964) and Massell (1969) results, the literature has developed considerably so that currently, with work by

Newbery and Stiglitz (1981) and others, the emphasis has shifted to examination of the social welfare aspects of price stabilisation. The early literature ignores the efficiency gains to producers who are risk averse; hence it was appropriate for a new framework to emerge that allowed evaluation on utility grounds. However the role of transfer payments remains, in principle, important for consideration of Australian policy in the wool market because wool is exported and hence such transfers will occur across national boundaries and can be expected to influence national income.

### The Model

In order to conduct the numerical experiment an algorithm was developed that could be simulated over a large number of periods and that would reflect specific assumptions about market behaviour. The restricted Constant Elasticity of Substitution (CES) market model underlying the algorithm had two demand functions representing demand for Australian wool and demand for foreign wool, two supply functions representing supplies of Australian wool and supplies of foreign wools, and, in addition, two market clearing identities. The restricted CES model was chosen over alternatives such as linear and log-linear forms on the basis of its simplicity and the ease of interpretation of the elasticities. Turnovsky (1976) has shown that the choice of functional form is likely to influence the direction of revenue flows resulting from stabilisation and has shown the importance of the elasticities in determining the values of such transfers in the log-log case. However, given the necessity of choosing some specific form for the analysis the CES assumptions seemed to be the most innocuous. Using capital letters to denote logarithms and parentheses to denote lags a CES partial equilibrium system was specified:

- (1)  $AD = a_0 + a_1 AD(-1) + a_2 P1 + a_3 P2 + u1$
- (2)  $FD = b_0 + b_1 FD(-1) + b_2 P2 + b_3 P1 + u2$
- (3)  $AS = c_0 + c_1 EP1(-1) + u3$
- (4)  $FS = d_0 + d_1 EP2(-1) + u4$
- (5)  $\underline{AD} = \underline{AS} - \underline{X}$
- (6)  $\underline{FD} = \underline{FS}$

where:

AD = natural logarithms of demand for Australian wool;  
 FD = natural logarithms of demand for foreign wool;  
 AS = natural logarithms of supply of Australian wool;  
 FS = natural logarithms of supply of foreign wool;  
 P1 = natural logarithms of price of Australian wool;  
 P2 = natural logarithms of price of foreign wool;  
 EP1 = natural logarithms of expected price of Australian wool;  
 EP2 = natural logarithms of expected price of foreign wool;  
 ui (i = 1 to 4) = zero mean random disturbance; and  
 X = change in stocks held by the stabilisation authority.

Note: underscoring denotes levels not logs.

The price expectation terms were specified as three year moving averages of previous prices:

- (7)  $EPi = [Pi + Pi(-1) + Pi(-2)]/3 \quad (i = 1 \text{ or } 2).$

The specification chosen was based on naive extrapolative approaches to expectations that have been used successfully in empirical work by Dawbre, Shaw, Corra and Harris (1985).

The lagged dependent term in the demand equations was used to account for lags in consumer adjustments to changes in prices and is consistent with Houthakker and Taylor (1966) approaches to persistence of consumer habits. Houthakker and Taylor show that such behaviour can be described algebraically using a specification similar to that used in equations (1) and (2). In the supply equations it was assumed that full adjustment occurred after a production lag of one period and, so that the analysis could focus on revenue transfers in the absence of efficiency gains, it was assumed that increased stability would not result in an outward shift in the supply curve.

An important aspect of model formulation was calibration of the model. It was necessary to choose a base level of prices and quantities, elasticities and a level of price variability. An equilibrium price was chosen by averaging real greasy wool prices from 1970-71 to 1986-87 expressed in Australian currency in 1986-1987 prices. For the Australian price, average Australian greasy auction prices were chosen, while for the foreign price, a quantity weighted average of South African, South American and some New Zealand apparel wool prices was chosen.

For quantities, only apparel wools were considered and these were restricted to those traded internationally. Average quantities were calculated for the supply of apparel wools from major supplying countries to demanding countries using annual observations from 1970-71 to 1986-87. The restriction of apparel wools to those traded internationally meant that the model covered approximately 90 per cent of apparel type wools supplied from outside the centrally planned economies.

The simulation technique involved introducing random variables to a simulated time path of the model for 1000 periods. The randomness entered the model through the disturbances,  $u_i$  ( $i = 1$  to  $4$ ), and hence variances needed to be chosen for  $u_i$  ( $i = 1$  to  $4$ ). It was decided to make  $u_1$  and  $u_2$  perfectly correlated since it seemed likely, given the demand for wool is a derived demand, that shocks influencing the demand for foreign wools would be the same as shocks influencing the demand for Australian wools. This assumption is a simplification since wools from different origins have qualitative differences that result in them going into different apparel end-uses. However, it is likely to be a reasonable approximation. The coefficient of variation for annual observations of Australian wool prices was measured for a sample period of 1925-26 to 1970-71 excluding prices in the Second World War period and after adjusting for inflation. Thus the series excluded prices occurring after the establishment of the price stabilisation scheme in 1970. The value of the coefficient of variation was found to be 0.40.

Because the origin of shocks to the market is expected from theory to influence the levels and directions of transfers resulting from the stabilisation policy a decision was made to conduct the simulations under two scenarios. In the first it was decided to restrict all price variability to the demand side of the model and to divide the variation between demand for foreign and demand for Australian wools in proportion to their long term quantity weights. In the second scenario it was assumed that all price variability arose from the supply side of the model and again variability was divided between foreign supply and Australian supply on a quantity

basis. Foreign supply and Australian supply were assumed to be independent. The decision to separate demand and supply variability reflected uncertainty about the appropriateness of combining demand side and supply side shocks, given difficulties in combining the results from the literature in the area (Piggott 1978; Watkins 1987 and others) with the model.

It was necessary to make assumptions about the elasticities of demand and supply. A survey of the large amount of empirical literature in the area uncovered measures of elasticities ranging from very low to very high. It was not possible to draw conclusions about the actual values of elasticities without undertaking further empirical work which was beyond the scope of the study. Thus the approach taken was to assume unit short run elasticities for demand and supply, a long run elasticity of demand of -3 and a cross-price elasticity of demand for Australian and foreign wool of 0.5. A simplifying assumption was made with respect to the cross-price elasticities by assuming that they were the same for Australian as foreign wools. That is, demand for Australian wool responded by the same proportional amount to a change in the price of foreign wool as did demand for foreign wool to a change in Australian prices. (Given the respective market shares of Australian and foreign wools of 55 per cent and 45 per cent, respectively, this simplifying assumption should not be an issue.) These values are consistent with the notion that wool is a luxury fibre and that a fairly high level of substitution could be expected to occur between Australian and foreign wools. Empirical testing of the sensitivity of the conclusions of the analysis to changes in assumptions about elasticities is reported below.

The model was simulated over a 1000 year time path without a stabilisation component and demonstrated convergent dynamic properties.

#### Imposition of Stabilisation on the Model

The two price rules, bandwidth and underwriting, were imposed on the model using 'if then' statements in the algorithm. The bandwidth rule was imposed by forcing stock purchases when prices fell below a reserve price and forcing stock sales when prices went over the ceiling price. The stocks were accumulated in a stockpile and the costs of operating the stock were calculated using a real interest rate of 5 per cent and average wool storage costs for 1970-71 to 1986-87 obtained from various publications. A further constraint was imposed so that if stocks fell to zero the ceiling price condition could be violated. When this occurred stocks were held at zero until a low price period occurred and then stock building resumed. Thus the possibility of 'stock out' was allowed.

For the price underwriting rule a constraint was imposed so that when prices fell below the reserve, or underwriting price level, stock purchases would occur until the price was at the underwriting price level. Sales of stock occurred in the following period under the constraint that prices could not fall below the underwriting price level. Thus it was possible for stocks to be accumulated over a number of low price periods and then discharged either all at once or over a number of periods when prices were relatively high. Again a non-negativity constraint was imposed on the stock pile level so that the authority could not sell stock that it did not own.

#### Results with Bandwidth Rule

The simulation strategy involved adjusting the bandwidth over a wide range of values and simulating over a 1000 year period for each price band chosen. The price bands were constrained to be symmetrical around the mean

price of 451 cents and the range of bands chosen was from 392-510 to 448-454. Key variables that were measured were average values for each year of:

- buffer stock profit;
- changes in producer revenue;
- changes in consumer expenditure;
- level of stocks held; and
- coefficient of variation of prices.

The buffer stock profit was calculated as the difference between net sales receipts and costs, which included opportunity costs plus physical storage costs. It is calculated as the average level of profit over the 1000 year time path. The changes in producer revenue and consumer expenditure are the differences between revenues and expenditures under the bufferstock and revenues and expenditures that would have occurred without stabilisation policy. Consumer expenditure includes expenditure on both foreign and Australian wools, while producer revenue refers to Australian producers' revenue only. The average level of stocks includes those periods when no stocks were held and the coefficient of variation (CV) refers to the CV of price after stabilisation.

Table 1 has the results for simulations undertaken using the bandwidth rule with all the random variation in price arising from the demand side. In the first column, the lower bound of the price band is given. Since the band is symmetrically distributed around the mean price of 451 c/kg, the upper band is easily calculated. The second column provides the average levels of profit achieved by the buffer stock under different price bands. It can be seen that the scheme operates at a loss to the stabilisation authority that diminishes as the price band widens. For the extremely narrow band where the floor price is 99 per cent of the equilibrium price the scheme generates a loss of \$153.7m (in 1986-87 prices) and with a band of 424-478 c/kg losses are minimised at \$15.9m. As the price band increases in width beyond 424-478 c/kg the losses increase somewhat and then diminish again. This pattern may have resulted because the frequency of 'stock outs' changes as the bandwidth varies and hence there are variations in the number of periods when the profit (loss) is zero.

The third column describes the effect of the scheme on producers' revenues. Generally, producers lose more revenue as the price bandwidth decreases. However, at very narrow bandwidths the revenue loss diminishes. The negative result is consistent with the theoretical result, that producers can expect to lose from price stabilisation when the major source of market instability is demand side. The most important aspects of these losses are that the magnitude of producer revenue losses is extremely small compared with total Australian producer revenue of \$3.4 billion and that the revenue effects are fairly unresponsive to changes in the bandwidth in absolute terms.

Column 4 is the sum of columns 2 and 3 and represents the producers' net position given that the financing of the stabilisation policy is by the producers themselves. It highlights the relative lack of importance of the revenue effects when set against the operating losses from the scheme.

Column 5 shows the effects of the bandwidth rule on consumer expenditure. Consumer expenditure increases as the bandwidth increases and the effects are positive throughout the range of bandwidths examined. Again the magnitudes are relatively small in value when compared with total expenditures on both foreign and Australian wool consumption. The fact that



TABLE 1

## Simulations of Various Bandwidth Rules With Demand Side Shocks

1	2	3	4	5	6	7
Floor price bandwidth lower bound	Buffer stock profit	Change in producer revenue	Column 2 + Column 3	Change in consumer expenditure	Average stocks	Coefficient of variation of prices
	\$m	\$m	\$m	\$m	kt	
448	-153.746	-5.677	-159.423	4.959	578.805	0.048
446	-113.037	-6.110	-119.147	5.279	427.678	0.075
444	-90.927	-6.260	-97.187	5.600	345.822	0.010
442	-76.654	-6.335	-82.989	5.931	293.059	0.122
440	-73.922	-6.314	-80.236	6.257	283.333	0.142
438	-55.108	-6.252	-61.360	6.658	213.214	0.163
436	-43.121	-6.126	-49.247	7.105	168.532	0.184
434	-32.746	-5.857	-38.603	7.513	129.710	0.203
432	-26.078	-5.680	-31.758	7.911	104.701	0.220
430	-22.767	-5.407	-28.174	8.262	92.247	0.235
428	-18.904	-5.059	-23.963	8.685	77.669	0.251
426	-16.930	-4.754	-21.684	9.041	69.922	0.266
424	-15.862	-4.473	-20.335	9.340	65.616	0.277
422	-18.107	-4.102	-22.209	9.570	73.722	0.287
420	-20.235	-3.722	-23.957	9.845	81.379	0.297
418	-22.498	-3.329	-25.827	10.151	89.500	0.308
416	-22.226	-3.056	-25.282	10.468	88.129	0.317
414	-21.875	-2.864	-24.740	10.756	86.452	0.325
412	-19.264	-2.804	-22.068	11.110	76.388	0.311
410	-17.577	-2.599	-20.176	11.361	69.732	0.338
408	-16.400	-2.359	-18.759	11.643	64.950	0.344
406	-16.539	-2.197	-18.737	11.842	65.206	0.349
404	-17.897	-2.005	-19.903	12.054	70.031	0.354
402	-17.979	-1.839	-19.818	12.250	70.137	0.358
400	-19.475	-1.698	-21.173	12.442	75.493	0.362
398	-20.173	-1.592	-21.765	12.624	77.923	0.366
396	-19.845	-1.480	-21.325	12.799	76.522	0.369
394	-18.202	-1.339	-19.541	12.968	70.184	0.372
392	-15.303	-1.191	-16.495	13.124	59.142	0.375

TABLE 2

## Simulations of Various Bandwidth Rules With Supply Side Shocks

1	2	3	4	5	6	7
Floor price bandwidth lower bound	Buffer stock profits	Change in producer revenue	Column 2 + Column 3	Change in consumer expenditure	Average stocks	Coefficient of variation
	\$m	\$m	\$m	\$m	kt	
448	-88.069	-6.905	-94.974	1.109	331.484	0.043
446	-77.623	-7.320	-84.944	1.371	293.158	0.069
444	-75.588	-7.420	-83.008	1.539	286.133	0.092
442	-93.718	-7.089	-100.807	1.561	354.484	0.113
440	-110.137	-6.603	-116.741	1.578	416.276	0.132
438	-115.234	-6.362	-121.597	1.734	435.606	0.150
436	-114.849	-6.185	-121.034	1.946	434.325	0.167
434	-103.076	-6.185	-109.262	2.258	390.347	0.182
432	-92.182	-6.299	-98.481	2.621	349.618	0.197
430	-75.155	-6.441	-81.596	3.032	285.887	0.210
428	-56.147	-6.602	-62.749	3.468	214.722	0.224
426	-43.040	-6.636	-49.676	3.846	165.616	0.236
424	-32.170	-6.591	-38.761	4.203	124.848	0.247
422	-32.910	-6.218	-39.128	4.498	127.466	0.261
420	-31.693	-5.896	-37.589	4.817	122.723	0.273
418	-29.352	-5.673	-35.025	5.198	113.787	0.285
416	-28.892	-5.427	-34.320	5.574	111.833	0.297
414	-24.559	-5.214	-29.773	5.926	95.406	0.307
412	-22.390	-4.981	-27.371	6.241	87.123	0.316
410	-20.402	-4.741	-25.143	6.565	79.426	0.325
408	-18.433	-4.519	-22.952	6.881	71.842	0.333
406	-17.472	-4.263	-21.736	7.154	67.992	0.340
404	-17.041	-4.066	-21.107	7.349	66.140	0.345
402	-15.956	-3.831	-19.787	7.643	61.825	0.352
400	-14.671	-3.645	-18.316	7.903	56.811	0.358
398	-13.593	-3.439	-17.034	8.163	52.577	0.363
396	-12.912	-3.295	-16.171	8.387	49.836	0.368
394	-12.007	-3.067	-15.075	8.624	46.252	0.373
392	-10.492	-2.923	-13.415	8.822	40.443	0.376

consumer expenditure increased as the bandwidth widened is significant and counterintuitive. Stabilisation theory supports the view that consumer expenditure will increase as the bandwidth diminishes and the policy becomes more aggressive. The explanation may be that price stabilisation creates a second round effect on consumption of foreign wools through its impact on foreign wool prices and that this influences the result.

Column 6 shows the average level of stocks associated with different bandwidth rules over the simulation. Generally they diminish as the width of the bandwidth increases. However, over some observations of price bands slight reductions in average stock levels are associated with reductions in the bandwidth. This reflects the changing proportion of 'stock outs' (periods when stocks were zero) that occurs with different bandwidths. A stock out will raise the level of average stocks above what it would have been in the absence of the non-negativity constraint on stock levels.

Finally, in column 7, the coefficient of variation of prices (CV) under different bandwidths is recorded. The CV increases as the bandwidth increases for obvious reasons. Of most interest with this result is that the CV is most highly correlated with the profits (losses) of the buffer stock.

The simulations were re-run under the assumption that the source of all of the price variability came from the supply side. Variability was apportioned between foreign supply and domestic supply on the basis of average historical levels of quantity, and the two supplies were assumed to be independent. Table 2 reports the results for a number of bandwidth scenarios. Again the scheme ran at a loss for all bandwidths and producers tended to lose, albeit very small amounts, while consumer expenditure effects tended to increase, as the bandwidth widened (also by small amounts). Both consumers and producers still lost in revenue terms. The likely reason for this is that the inclusion of foreign supplies of wool created second round effects on equilibrium that outweighed the first round effects expected from theory. The principal result from these two simulation runs was that the sources of price shocks did not really have much impact on the magnitude of the revenue transfers and did not influence signs at all. This is consistent with Turnovsky (1976) who found that, under highly restrictive assumptions about the nature of demand and supply and costs of holding stocks, the source of price variation was unlikely to be important in the measurement of hidden gains and losses from stabilisation in non-linear models.

#### Results with the Underwriting Rule

The simulations were re-run using an underwriting rule in place of the bandwidth rule. The results for the simulations undertaken using demand side shocks are reported in Table 3 for a range of reserve prices which are reported in column 1. The results are similar to those obtained with the bandwidth rule with some exceptions. As expected, the average level of stocks needed to underwrite the price was considerably lower than under the bandwidth rule. In fact, for the lower underwriting prices the scheme was 'stocked out' for a considerable portion of time. This follows simply because the authority is constrained to sell stocks as quickly as it can without violating its underwriting rule. As a result of lower stock levels the losses incurred by the scheme were lower than under the bandwidth rule. Producers gained from the underwriting rule in terms of revenue, which was the opposite to the result with the bandwidth rule; however, again the magnitude of change in producer revenue were small. Gains and losses from the stabilisation policy, in terms of the profit and the revenue effects,

TABLE 3

## Simulations of Various Price Underwriting Rules with Demand Side Shocks

1	2	3	4	5	6	7
Floor price bandwidth, lower bound	Buffer stock surplus	Change in producer revenue	Column 2 + Column 3	Change in consumer expenditure	Average stocks	Coefficient of variation
	\$m	\$m	\$m	\$m	kt	
448	-34.387	6.286	-28.101	5.766	130,994	0.082
446	-18.232	6.742	-11.491	6.496	71.124	0.124
444	-14.463	7.115	-7.348	7.294	57.684	0.159
442	-10.774	7.550	-3.224	7.817	44.034	0.194
440	-7.632	7.684	0.052	8.235	32.708	0.216
438	-5.571	7.802	2.231	8.488	25.065	0.237
436	-4.088	7.857	3.768	8.819	19.935	0.252
434	-2.935	8.237	5.302	9.246	15.345	0.269
432	-2.549	8.733	6.184	9.754	13.229	0.289
430	-1.724	8.683	6.959	9.892	10.378	0.295
428	-1.337	8.998	7.660	10.345	8.683	0.308
426	-1.034	9.250	8.215	10.658	7.280	0.316
424	-0.801	9.812	9.011	11.385	5.916	0.331
422	-0.554	9.612	9.058	11.203	5.165	0.333
420	-0.330	9.680	9.350	11.334	4.253	0.337
418	-0.238	9.965	9.726	11.643	3.492	0.346
416	-0.146	10.143	9.997	11.879	2.902	0.353
414	-0.058	10.333	10.358	12.148	2.490	0.358
412	-0.039	10.397	10.436	12.282	2.138	0.361
410	0.106	10.458	10.564	12.389	1.776	0.362
408	0.141	10.569	10.709	12.537	1.492	0.364
406	0.159	10.673	10.832	12.669	1.274	0.367
404	0.174	10.774	10.947	12.772	1.052	0.369
402	0.195	10.799	10.994	12.829	0.885	0.370
400	0.216	10.835	11.050	12.895	0.760	0.371
398	0.222	10.905	11.127	12.995	0.648	0.372
396	0.225	10.985	11.209	13.103	0.552	0.374
394	0.220	11.104	11.323	13.247	0.471	0.377
392	0.204	11.459	11.459	13.414	0.393	0.380

TABLE 4

## Simulations of Various Price Underwriting Rules with Supply Side Shocks

1	2	3	4	5	6	7
Floor price bandwidth lower bound	Buffer stocks surplus	Change in Producer revenue	Column 2 + Column 3	Change in consumer expenditure	Average stocks	Coefficient of variation
	\$m	\$m	\$m	\$m	kt	
448	-9.729	4.442	-5.287	1.860	37.692	0.073
446	-6.689	4.543	-2.146	2.178	26.701	0.10
444	-5.082	4.552	-0.531	2.591	21.092	0.139
442	-3.243	5.250	2.007	3.621	14.162	0.188
440	-2.883	4.966	2.080	3.232	13.362	0.187
438	-2.080	4.972	2.892	3.439	10.774	0.201
436	-1.423	5.138	3.715	3.771	8.324	0.218
434	-1.126	5.351	4.224	4.129	7.161	0.234
432	-0.736	5.364	4.629	4.284	5.980	0.242
430	-0.557	5.543	4.985	4.552	5.298	0.253
428	-0.439	5.818	5.380	4.926	4.800	0.265
426	-0.301	6.034	5.732	5.231	4.234	0.275
424	-0.196	6.286	6.089	5.530	3.730	0.287
422	-0.105	6.512	6.407	5.842	3.340	0.297
420	-0.003	6.665	6.661	6.103	2.999	0.304
418	-0.058	6.868	6.926	6.387	2.705	0.312
416	0.112	7.040	7.151	6.628	2.389	0.319
414	0.161	7.249	7.410	6.903	2.089	0.327
412	0.211	7.389	7.600	7.099	1.831	0.331
410	0.231	7.576	7.807	7.324	1.598	0.336
408	0.262	7.706	7.968	7.522	1.397	0.341
406	0.276	7.880	8.157	7.752	1.230	0.347
404	0.280	8.080	8.360	7.983	1.066	0.353
402	0.271	8.275	8.546	8.231	0.929	0.358
400	0.252	8.487	8.739	8.470	0.811	0.364
398	0.237	8.648	8.885	8.683	0.693	0.368
396	0.228	8.802	9.030	8.858	0.590	0.371
394	0.210	8.976	9.186	9.055	0.499	0.375
392	0.188	9.116	9.304	9.236	0.421	0.378

tended to offset each other. Consumers again lost from the policy, but the losses were small compared to the value of total expenditures.

When the simulation was re-run using supply side shocks in place of demand side shocks the results were very similar, indicating that the sources of variation in the model were not important (Table 4). Consumers again lost from the scheme and producers made gains in revenue terms. However, in both cases the level of transfers was relatively low.

### Changing the Elasticities

#### Bandwidth rule

All of the results reported above were calculated using unit elasticities of demand and supply and a cross-price elasticity of -0.5. In Table 5 results

TABLE 5

Bandwidth Outcomes with Different Elasticities with Demand Side  
Shocks with Floor Price at 440c/kg

Elasticity	1 Buffer stock profit	2 Change in producer revenue	3 Column 2 + Column 3	4 Change in consumer expenditure	5 Average stocks	6 Coefficient of variation
	\$m	\$m	\$m	\$m	kt	
Elasticity of demand -1.5	-335.02	0.28	-334.74	5.58	1 266.56	0.14
Elasticity of supply 0.5	-90.56	-6.48	-97.04	2.85	345.14	0.14
Cross-price elasticity	-187.39	-4.43	-191.82	4.11	708.70	0.14

TABLE 6

Bandwidth Outcomes with Different Elasticities with Supply Side  
Shocks with Floor Price at 440c/kg

Elasticity	1 Surplus	2 Producer revenue	3 Column 2 + Column 3	4 Consumer expenditure	5 Average stocks	6 Coefficient of variation
	\$m	\$m	\$m	\$m	kt	
Elasticity of demand -1.5	-111.82	-2.06	-113.88	14.93	434.21	0.16
Elasticity of supply 0.5	-94.67	-5.38	-100.05	8.37	363.59	0.15
Cross-price elasticity	-102.23	-4.53	-106.76	10.90	393.29	0.15

are reported for the bandwidth rule under alternative assumptions about elasticities and with demand side shocks.

The simulations were re-run using a bandwidth of 440-462c/kg. In the first run, the short term elasticity of demand was increased to -1.5 and the model recalibrated so that the coefficient of variation of prices (CV) was at 0.40 (as before) without stabilisation. The effect of the change in elasticity was to increase the costs of stabilisation while reducing the revenue effects on producers and consumers. In general, increasing the elasticity of demand makes the policy less effective and more expensive to producers and less expensive to consumers. The same general results were obtained from increasing the elasticity of demand to -1.5 when supply shocks were the source of disturbance. However, average stock levels increased dramatically. These results are reported in Table 6.

TABLE 7

Underwriting Outcomes with Different Elasticities with Demand Side Shocks with Floor Price at 440c/kg

Elasticity	1	2	3	4	5	6
	Surplus	Producer revenue	Column 2 + Column 3	Consumer expenditure	Average stocks	Coefficient of variation
	\$m	\$m	\$m	\$m	kt	
Elasticity of demand 1.5	-16.63	12.45	-4.17	16.02	70.04	0.23
Elasticity of supply 0.5	-13.44	19.37	-4.07	10.92	55.14	0.24
Cross-price elasticity	-13.78	10.29	-3.50	12.68	57.20	0.23

TABLE 8

Underwriting Outcomes with Different Elasticities with Supply Side Shocks with Floor Price at 440c/kg

Elasticity	1	2	3	4	5	6
	Surplus	Producer revenue	Column 2 + Column 3	Consumer expenditure	Average stocks	Coefficient of variation
	\$m	\$m	\$m	\$m	kt	
Elasticity of demand 1.5	-8.76	9.39	0.64	9.41	39.00	0.21
Elasticity of supply 0.5	-4.65	5.68	1.03	4.39	21.01	0.21
Cross-price elasticity	-5.35	7.11	1.76	7.28	23.97	0.22

To test for the sensitivity of the results to changes in assumptions about supply responsiveness the elasticity of supply was reduced from 1.0 to 0.5. This had little effect on revenue transfers in absolute terms. However, the proportional increase in consumer expenditure was high, especially when the source of price instability was demand.

The cross-price elasticity was reduced from 0.5 to 0.25, the equivalent of reducing the substitutability of Australian wools with foreign wools. With demand side shocks causing price instability this reduced consumer expenditures and increased producer revenue. It did not increase the 'profitability' or trading surplus of the buffer stock to any significant extent. When supply side shocks predominated, the buffer stock trading surplus actually fell significantly as Australian wool became less substitutable and consumer expenditures rose, leaving consumers worse off.

### Underwriting rule

The same exercise was conducted using the underwriting rule in place of the bandwidth rule. The results, reported in Tables 7 and 8, indicate much the same results. That is, the signs were unaffected except for the net producer position where the absolute value of the change was relatively small. Except for the profitability of the buffer stock, the magnitudes of the revenue transfers did not change significantly in absolute terms. Again, the same changes in elasticities caused the average level of stocks to rise and subsequently profits fell. Consumers were worse off under both higher demand elasticities, and under low supply elasticities regardless of the source of price shocks. They benefited from reduced substitutability when the source of price shocks was supply and were worse off when it was demand. Producers benefited from increased demand elasticity and gained from reductions in the elasticity of supply for both simulations. They benefited when substitutability was decreased and supply was the source of price shocks.

### Conclusions

The purpose of this paper was to obtain estimates of the revenue transfers and trading surpluses that would result from a hypothetical buffer stock operating under two different price rules in the Australian wool market. A number of general conclusions can be drawn from the empirical tests that were undertaken:

- The size of transfers between consumers and producers is small in relation to total revenues. The transfers would be of the order of 1 to 2 per cent.
- The sources of price shocks are not important in determining the direction or size of transfers between consumers and producers. However, the type of stabilisation rule adopted is important.
- The magnitude of the supply and demand elasticities will influence the size of revenue transfers between consumers and producers, but the absolute level of change in transfers associated with changes in elasticities will be small.
- Consumers generally lose from the revenue transfers associated with price stabilisation, regardless of whether an underwriting or a bandwidth rule applies, while producers gain in revenue terms with an underwriting rule but lose from a bandwidth rule. In either case the gains and losses are small.



- A higher level of stocks will be held when supply is the predominant source of shocks under a bandwidth rule and the opposite will be true if an underwriting rule is employed.
- A buffer stock in the Australian wool market can be expected to make a trading loss under either of the bandwidth or underwriting rules of the form examined in this paper. However, it is possible that trading rules could exist that would result in a trading profit, especially if this was the objective of the stabilisation authority. While the role bufferstocks play as instruments of market power is an extremely interesting issue and a logical follow-up to a study such as this, it is outside the scope of the study.
- The expected trading surplus, or profit, of a buffer stock will diminish dramatically as demand becomes more elastic.

All of these points support the general conclusion that 'hidden gains and losses' are unlikely to be of major significance in the evaluation of price stabilisation in the Australian wool market. As discussed in most textbooks on price stabilisation, the theory of 'hidden gains and losses' is dependent on a linear model and perfect stabilisation. The results show that when these assumptions are relaxed qualitative conclusions from the theory break down.

Finally, the analysis is an attempt to measure the revenue transfers and expected trading surplus of a buffer stock in the Australian wool market under different price rules. It does not include the efficiency gains that result from stabilisation, which have been discussed in the recent literature in the area, and because these effects are excluded from the analysis, it is not possible to obtain any useful measure of the potential overall benefits and costs of price stabilisation in the wool market.

Further, it is not possible to infer anything from the analysis about the trading losses or gains that have been achieved historically by the Australian Wool Corporation because the stabilisation rules that have been applied by the Corporation are more complex, and most importantly, have greater flexibility, than those used in the simulation.

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