SOME VARIANCE EFFECTS OF A FLOOR PRICE SCHEME FOR WOOL: A TWO-PERIOD ANALYSIS*

J. H. DULOY
University of New England

During recent years, and especially since the Australian Wool Board recommended a floor price for wool, there has been considerable interest in the effects upon commodity prices and revenues of a system of buffer stocks.[1] Powell and Campbell's analysis of so-called "hidden losses" and "hidden gains" has indicated that a scheme such as that proposed for wool can be expected to lead to large revenue effects.[2] However, there seems no reason to believe that the net effects upon growers' revenues will be either positive or negative. Indeed, most of the proponents of the scheme do not claim favourable revenue effects, averaged over a number of periods. The "respectable" arguments in favour of the scheme then depend upon its variance effects—the reduction of price variability through the buying-in of wool by an authority when prices are low and the subsequent re-selling of wool when prices are high. Such an argument has apparently been important in the decision to recommend a reserve price scheme for wool.[3] The Board's recommendation was for a conservative floor price, to be financed to the extent of some £20 million by the woolgrowers and some £60 million by the banks, under Commonwealth Government guarantee.

To the extent that a floor price scheme was successful, there is little doubt that it would reduce to some extent the variance of both the price of wool and of woolgrowers' incomes, taken as a whole. This is so because, as the scheme is envisaged, all the wool produced by growers is sold, either to commercial buyers or to the reserve price authority. Thus, so far as growers are concerned, there is no effect by the scheme upon the quantity sold and paid for; and the revenue and price effects are identical. However, this is not true of the effects upon the balance of trade, because the quantity of wool exported is affected by the scheme.

Consider the situation when demand is such that the market price is below the reserve. Such a situation appears in Fig. 1, where it is assumed

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[1] Since this article was written, an analysis of the effect of buffer-stock schemes on total foreign exchange earnings has appeared. See H. G. Grubel, "Foreign Exchange Earnings and Price Stabilization Schemes", *American Economic Review,* Vol. LIV, No. 4 part I, (June, 1964), pp. 378-385.

[2] A. A. Powell and K. O. Campbell, "Revenue Implications of a Buffer Stock Scheme with an Uncertain Demand Schedule", *The Economic Record,* Vol. 38, No. 83, (September, 1962), pp. 373-385.

[3] This point constituted the first argument listed by the Wool Board in support of its decision to recommend a floor price scheme. See the Australian Wool Board, *Report and Recommendations on Wool Marketing,* Canberra, July, 1964, p. ii.

that the short-run supply of wool is fully inelastic. From the point of view of growers, a quantity, *GI,* is sold at a price *IC* (or at the reserve price leading to an increase in price from P_o to P_R, and an identical percentage increase in revenue (abstracting from the costs of the scheme), from *GDFI* to *GACI.* However, a quantity, *HI,* is purchased by the authority, leaving *GH* purchased and exported (ignoring the small quantity of raw wool consumed in Australia) by commercial buyers. Thus, the change in overseas receipts from wool sales are from *GDFI* to *GABH.* The net effect clearly depends upon the elasticity of demand for Australian wool. If demand is elastic, overseas revenue is reduced when wool is purchased by the authority, and is increased when subsequently sold. Opposite effects hold for an inelastic demand schedule.

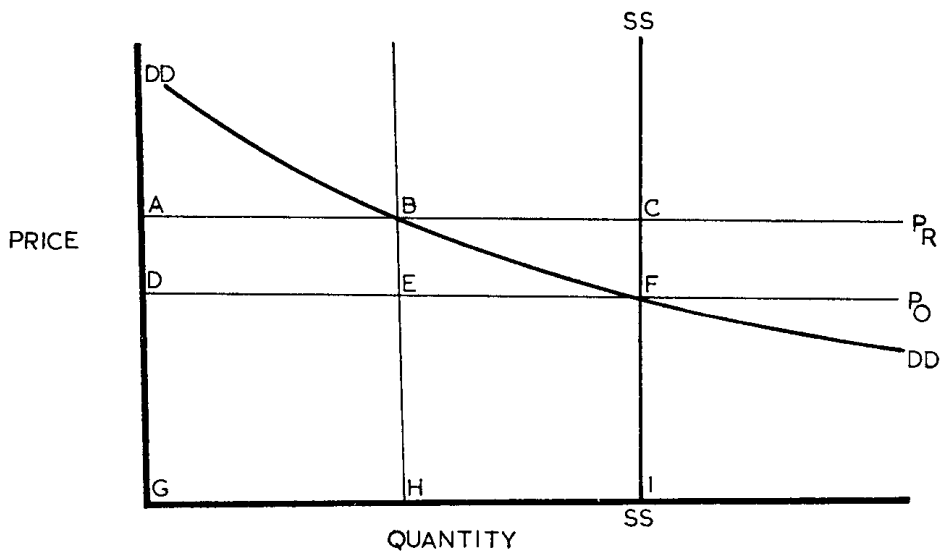

FIG. 1

For Australian wool, the evidence suggests that demand is elastic. Horner concluded, on the basis of estimates using pre-war data, that the elasticity of demand for Australian wool lay in the range —1·59 to 2·15;[4] demand is likely to be more elastic since the advent of synthetics.

An elastic demand schedule for Australian wool suggests that a reserve price scheme will have a perverse effect upon overseas receipts. When demand is weak, leading to low prices and receipts, the effect of the authority's purchases is for an increase in prices, but a net decrease in the receipts from wool exported, because of the effect of the reduction in the quantity sold to commercial buyers. Similarly, under conditions of strong demand, when the authority sells wool, a reduction in price is likely to be accompanied by an increase in the overseas receipts from wool.

The likely effects of the scheme, then, are to reduce the variances of

[4] F. B. Horner, "Elasticity of Demand for the Exports of a Single Country", *Review of Economics and Statistics,* Vol. 34, (November, 1952), p. 335.

prices and revenue to growers, but to increase the variance of wool revenues on external account.[5]

These effects are here evaluated in a two-period analysis, which, however, provides information only on the magnitude of the changes in revenue and receipts in one buying and one selling period. Some evaluation of the impact upon the variances *per se* will be available later from the results of a multi-period simulation study now in progress.

The analysis is based upon a number of assumptions, the most important of which are listed below:[6]

(a) The short-run elasticity of supply of Australian wool is zero, and Australian production in each year is taken to be 1,600 million pounds greasy.

(b) A homogeneous product is assumed.

(c) No operating costs, either for its administrative functions or for interest, handling, and storage costs for purchased wool are charged against the authority. Nor does the authority follow a selling policy designed to yield trading profits of any specific magnitude on its operations.[7]

(d) The parameters of the demand curve are assumed to be constant throughout a period, which is taken to be one year. Thus the analysis is concerned with annual effects and abstracts from intra-seasonal changes.

(e) Many of the results here presented concern the impact of the scheme upon commercial sales. To translate these effects into effects upon overseas earnings, it is reasonable to assume that some 90 per cent of Australian wool is normally exported.

The analysis was concerned with a constant floor price, taken to be 54d. per lb.,[8] and considered a range of values of the free market price, P_o, in the buying period, and a range of increases in price from the buying to the selling period, $\triangle P$. Thus, the price in the selling period was defined as $P_1 = P_o + \triangle P$. Two forms of the demand function were considered—the first linear in the logarithms; the second linear. Given the output of wool of 1,600 m. lbs., the constant term in the logarithmic demand curve was determined by the free market price

[5] The secondary effects upon the balance of trade are also likely to be perverse. As wool sales account for some 50 per cent of overseas trade revenue, these effects could be of some importance. Thus, when wool prices tend to be low, such that the authority purchases wool and reduces export revenue from this source, it simultaneously injects additional purchasing power into the economy via wool producers, leading to a demand for imports greater than would otherwise have been the case.

[6] Many of these assumptions are similar to those adopted by Powell and Campbell in their study of "hidden" gains and losses. See A. A. Powell and K. O. Campbell, *op. cit., passim.*

[7] A later study by the author indicates that the pursuit of trading profits by the authority increases the effect of its operations on the variances of growers' incomes and of export incomes.

[8] There is no significance attached to the choice of a reserve price of 54d., although it was the figure suggested, as an example only, in the Wool Board's report. In a two-period analysis, it is necessary to set some number as the reserve price as a basis for calculations.

prevailing in the period concerned and the elasticity of demand (also allowed to vary between periods).[9]

The quantities varied in the study were thus the price in the buying period, P_0; the increase in price obtained in the selling period, ΔP; the elasticity of demand in the buying period, η_0; and the change in elasticity from buying to selling period, $\Delta\eta$. The values over which these parameters were varied are set out in Table 1. The range of parameter values considered meant that results for 800 combinations of the parameters were potentially available—or twice that, considering the two algebraic forms of the demand function.[10] Only a selection of results and their general tendencies can be presented here.

TABLE 1

Values of Parameters

Parameter	Values							
P_0 (d./lb.)	35	40	45	50				
ΔP (d./lb.)	5	10	15	20	30			
η_0	−1·00	−1·5	−2·0	−2·5	−3·0			
$\Delta\eta$	+0·00	−0·25	−0·50	−0·75	−1·00	+0·25	+0·50	+0·75

For each period in which the authority engaged in transactions the following measures of its performance were computed: the "hidden" gain or loss, the change in the value of wool sold to commercial buyers, and the stocks of wool held at the end of the period. When both buying and selling operations occurred, also computed were the sums of the changes in woolgrowers' revenues and of commercial sales, and the quantity of wool held by the authority at the end of the period. For buying periods only, the proportion of the clip acquired was computed, as also was a quantity which may be termed the "borrowing proportion".

It will be recalled that, given an elastic demand schedule, the value of commercial purchases of wool (most of which are exported) is reduced during a period when the authority purchases wool. As against this, stocks of wool are accumulated in Australia. If an overseas lender can be found to lend against these stocks, then adverse effects upon the balance of payments may be averted.[11] The borrowing proportion, then, is the proportion of the reserve price at which such a lender would need to value the stocks to offset fully the change in the value of commercial purchases.

The reader is now referred to Table 2. It can be seen that the reduction in commercial sales brought about by the buying operations of the scheme can be substantial. To support the market to a reserve price of 54d., given that the free market price would have been 45d., could lead to a reduction in the value of commercial receipts of some

[9] For the linear demand function, a similar procedure was adopted, except that the values of the parameters were constrained to yield an elasticity, evaluated at the market price, identical with that of the non-linear function. On most criteria investigated, the logarithmic-linear form of the demand function showed a floor price scheme more favourably than did the linear form. Results derived using logarithmic demand function only are presented in this paper.

[10] Fewer results than 1,600 were actually obtained because there were no sales of wool for some parameter combinations.

[11] This point was brought to my attention by Professor F. Gruen.

£50 millions, for the likely elasticity value of —2·0. Such a reduction would occur in a period when receipts from commercial sales would already have been low, with a price of 45d. This effect rapidly increases with larger differences between the floor price and the free market price and with assumptions of a more elastic demand.

TABLE 2

Reduction in Commercial Sales Brought About by Buying Operations of a Floor Price Scheme (£ '000,000)

Elasticity (η_0)	Free market price in Buying Period (P_0)			
	35	40	45	50
—1·0	0	0	0	0
—1·5	45	37	26	13
—2·0	82	69	50	25
—2·5	112	96	72	36
—3·0	135	120	92	47

The borrowing proportions required to offset the adverse external effects appear in Table 3. They do not appear unduly high. If the reserve price were not set at an excessively high level, these borrowing proportions would appear to provide a reasonable level of security for all but the most conservative of lenders. There is, however, no certainty that overseas lenders could be found to advance and liquidate loans in accordance with the buying and selling operations of the scheme to offset the potential variance-increasing effects upon export receipts.

TABLE 3

Borrowing Proportion Required to Offset Adverse External Effects in Buying Periods

η_0	35	40	45	50
—1·0	0·00	0·00	0·00	0·00
—1·5	0·23	0·25	0·27	0·29
—2·0	0·35	0·39	0·41	0·43
—2·5	0·42	0·46	0·49	0·52
—3·0	0·47	0·50	0·54	0·58

The preceding results refer only to buying periods. In selling periods, increases in commercial sales are obtainable when the demand function is elastic. To examine changes in the selling period effectively, it is necessary that the cycle be completed; that is, that all stocks acquired when buying, are sold. With the elasticity constant for buying and selling periods, the cycle is completed for all values of the elasticity considered, with an initial price of 40d. and an increase of 30d.; for an initial price of 45d. and an increase of 20d.; and for an initial price of 50d. and an increase of 10d. (in all cases given a constant floor price of 54d.). The last of these has been taken because it is a range of price variation not uncommon during the post-war period, and it is for this range only that results are presented.

From Table 4, it will be noticed that the increase in commercial sales in the selling period slightly exceeds the decrease in the buying,

leading to a small net increase over the complete cycle. In relation to the value of commercial sales under the auction system of £333 millions in the buying period and £400 million in the selling, this net increase is not significant. However, the effect in increasing the variance of external receipts could be more substantial, as may be concluded from the size of the changes in particular periods.

TABLE 4

Changes in Commercial Sales Over a Complete Cycle in £ Million With Constant Elasticities in Buying and Selling Periods:
$P_0 = 50d. \quad \triangle P = 10d.$

Elasticity	Buying Period	Selling Period	Net Change
−1·0	0·0	0·0	0·0
−1·5	−12·6	+14·0	+1·5
−2·0	−24·7	+27·6	+2·9
−2·5	−36·3	+40·6	+4·3
−3·0	−47·6	+53·2	+5·7

So far, an elasticity constant over the cycle has been assumed. Allowing the elasticity to vary between buying and selling periods does not greatly affect the results. This may be seen from a perusal of Table 5, where the elasticity in the selling period is allowed to vary ±0·5 about the elasticity in the buying period. Only net changes over the cycle are included. Otherwise, the assumptions are the same as those for Table 4. It will be noticed that the results are asymmetric, and tending towards positive net changes at the higher elasticities. For comparative purposes, the net changes in woolgrowers' incomes are also presented in this table. These are the sums of "hidden gains and losses". It will be noted that they follow a similar trend with the elasticities as do net changes in commercial sales. The net changes in growers' incomes are similarly small in relation to the totals involved. (It is perhaps worth noting that, for price increases greater than the 10d. assumed in the

TABLE 5

Net Changes in Commercial Sales (Upper Diagonal) and in Growers' Incomes (Lower Diagonal) Over a Complete Cycle in £ Million:
$P_0 = 50d. \quad \triangle P = 10d.$

Elasticity in Selling Period	Elasticity in Buying Period				
	−1·0	−1·5	−2·0	−2·5	−3·0
−1·0	0·0 −0·9	−12·6 −12·7			
−1·5	+9·6 +8·1	+ 1·5 0·0	−6·5 −7·4		
−2·0		+ 8·7 + 6·5	+2·9 +0·9	−2·7 −4·3	
−2·5			+8·6 +5·9	+4·3 +1·7	+0·6 −2·2
−3·0				+9·1 +5·7	+5·7 +2·4

table, the net increases in commercial sales tend to be larger, and the net increases in growers' incomes smaller.)

Thus far, it has been seen that the net effects of a floor price scheme on both commercial sales and growers' incomes are likely to be small, but that, based on the absolute values of the changes in particular periods, the variance effects upon commercial sales may be more substantial. Because the main argument put forward in favour of the scheme depends upon its reducing the variances of growers' incomes, it is worth examining the magnitude of the changes in growers' incomes in buying and selling periods. This is done in Table 6, which is directly comparable with Table 4.

TABLE 6

Changes in Woolgrowers' Incomes Over a Complete Cycle in £ Million With Constant Elasticities in Buying and Selling Periods: $P_0 = 50d.$ $\triangle P = 10d.$

Elasticity	Buying Period	Selling Period	Net Change
−1·0	+26·7	−27·6	−0·9
−1·5	+26·7	−26·7	−0·0
−2·0	+26·7	−25·8	+0·9
−2·5	+26·7	−25·0	+1·7
−3·0	+26·7	−24·2	+2·4

Comparing the entries in Tables 4 and 6, it may be concluded that, if the elasticity of demand is —2·0, the reduction in variance of growers' incomes is likely to be accompanied by a similar increase in the variance of receipts from commercial sales; for a demand less elastic than —2·0, the reduction in the variance of growers' incomes is likely to exceed the increase in the variance of commercial receipts; above it, the converse tends to hold.

Conclusion

From this two-period analysis, it is concluded that, for complete cycles, a floor price scheme cannot be expected to have any significant effect upon the mean level of either growers' incomes or of receipts from commercial sales of wool. Because of the absolute magnitude of changes in both buying and selling periods, a scheme may be expected to have a more substantial impact upon the variance of both growers' incomes (in the aggregate) and of receipts from commercial sales. These changes can be expected to be of opposite sign. Hence, any reduction in the variance of the wool-cheque which a scheme produces, may be expected to be accompanied by an increase in the variance of commercial sales. Because the variance of the incomes of *individual* woolgrowers is likely to be greatly influenced by changes in local conditions leading to changes in output and by cost changes, any reduction in the variance of the aggregate is likely to be far less important at the individual farm level. Any increase in the variance of receipts from commercial sales, and hence of export receipts for wool sold, is likely to lead to an intensification of the severity of periodic balance of payments crises. For the income stream of the individual woolgrower the impact of the external effect may predominate, so that the net effect may be destabilizing, and *a fortiori* for the rest of the economy.