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## **Some Old Truths Revisited\***

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\* Presidential address, 36th Annual Conference of the Australian Agricultural Economics Society, Canberra, 10-12 February, 1992.

## ABSTRACT

There are two objectives in this paper. The primary objective is to 'promote' the use of equilibrium displacement modelling, or comparative static analyses of general function models, as a research tool in agricultural price and policy analyses. This is by no means a new tool, but it does seem to be used much less in Australia than it is in the US where it has been the basis of several important journal papers in recent times. The paper includes applications to: (a) reproduce important results obtained by Buse (1958) regarding total elasticities; and (b) examine some arguments advanced in favour of single-desk selling arrangements. The latter is the secondary objective in the paper. Whilst equilibrium displacement modelling has its shortcomings, it is a research tool that can provide 'rich' results with few assumptions. It can be a substitute for, or an adjunct to, econometric modelling. The applications re-confirm the doubts that many analysts have expressed about single-desk selling.

## Introduction

Several important papers (including journal-article prize winners) in the area of agricultural price and policy analysis published over the last decade or so have been based on results derived from comparative static analyses of general function models<sup>1</sup>. The general features of this type of analysis are: (a) a particular market situation is characterised by a set of supply and demand (and maybe other) functions that are general in the sense that no particular functional forms are assumed; (b) the market is disturbed by a change in the value of some exogenous variable; and (c) the impacts of the disturbance are *approximated* by functions which are linear in elasticities. The procedures involved are also termed 'equilibrium displacement modelling' and sometimes 'Muth modelling', these being the procedures used in the important Muth (1964) paper. The procedures are certainly not new.

Despite the ability to produce useful analytical results, this type of work seems to be less common on the part of members of the Australian agricultural economics profession than on the part of colleagues in the United States. The primary purpose in this paper is to encourage colleagues toward greater use of this type of work. This is attempted by four simple applications of equilibrium displacement modelling: the first entails a re-examination of the results obtained in the important Buse (1958) paper, while the remaining applications all relate to an issue of contemporary debate, namely, the efficacy of single-desk selling arrangements in the marketing of Australian agricultural products. The evaluation, albeit partial, of some arguments advanced in favour of single-desk selling is a subsidiary objective in the paper.

It should be emphasised that the applications of equilibrium displacement modelling that have appeared in the professional literature are generally more sophisticated than the applications that are presented in this paper. For example, several of the applications in the literature involve modelling vertical market relationships, such as the distribution of research benefits among participants at different market levels (see, for example, Alston 1991), whereas the applications in this paper are all to do with simple horizontal market

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<sup>1</sup> Examples include Gardner (1975), Gardner (1979), Perrin (1980), Perrin and Scobie (1981), Mullen, Wohlgemant and Farris (1988), Holloway (1989), Hertel (1989), Mullen, Alston and Wohlgemant (1989), Wohlgemant and Haidacher (1989), Thurman and Wohlgemant (1989), Alston (1991), Hertel (1991) and Holloway (1991).

relationships involving two commodities that are related in demand and supply. However, even these simple applications should suffice to demonstrate the usefulness of equilibrium displacement modelling, and that adjustments from one market equilibrium situation to another involve complex relationships.

In the next section the Buse (1958) model is examined. Thence follows applications of equilibrium displacement modelling to evaluate three of the arguments advanced by proponents of single-desk selling: the price premium argument, the countervailing power argument and the generic promotion argument. There is then a discussion of some strengths and weaknesses of the procedures involved. The paper is ended with a summary and some conclusions.

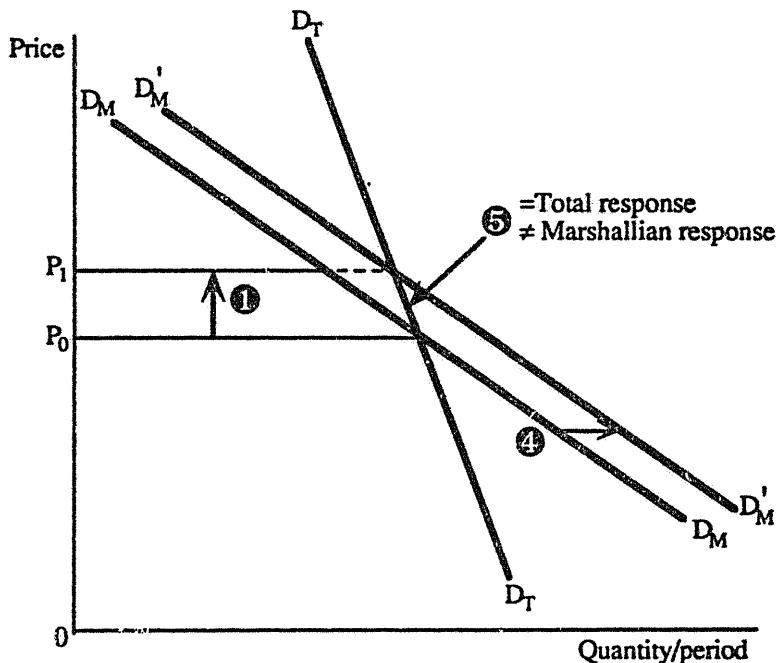
### Buse Revisited

The aim in the Buse (1958) paper was clear: to demonstrate that the predicted change in the quantity supplied and demanded of a commodity in response to a change in its exogenously - determined price will be different when account is taken of general - equilibrium effects than in the case where the prediction is based on Marshallian (i.e. *ceteris paribus* or partial) elasticities. He derived what he called 'total' demand and supply elasticities that take into account general equilibrium effects and showed how they were related to Marshallian elasticities (see Figures 1 and 2).

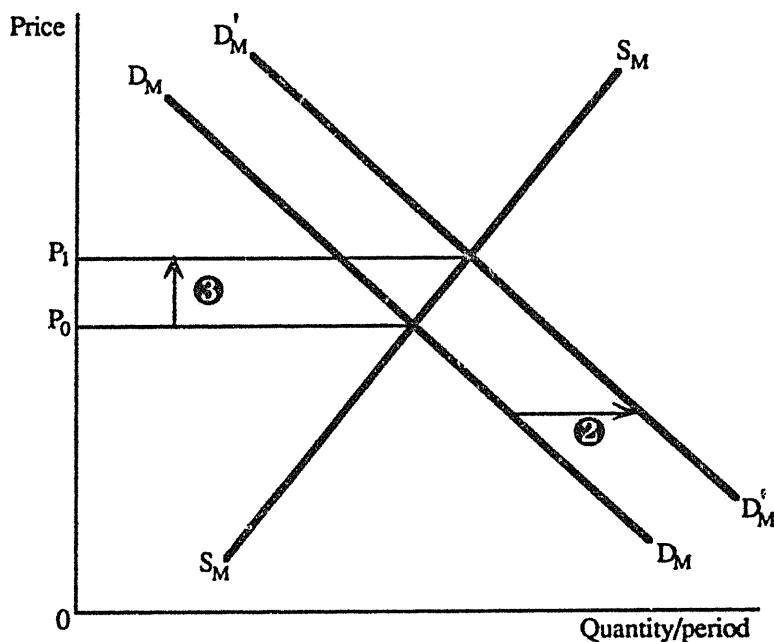
The general equilibrium effects referred to are those which are due to relatedness of commodity demands and/or supplies that is due, in turn, to substitution and complementarity. There is plenty of empirical evidence that indicates relatedness in agricultural commodity markets. In the case of Australia, a leading example on the supply side is provided by competitive resource allocation among broad-area agricultural enterprises, with wool, meats and grains generally being competitive (or substitutes) in supply (see Johnson, Powell and Dixon 1990 for estimates of own-and-cross-price elasticities) and, on the demand side, by substitution among meats (see MacAulay, Niksic and Wright 1990 for a summary of the empirical evidence). In the case of developing countries, one often finds that basic food commodities such as rice, corn, cassava and groundnuts are related in both demand and supply.

*Figure 1*  
Deriving total demand response for pork

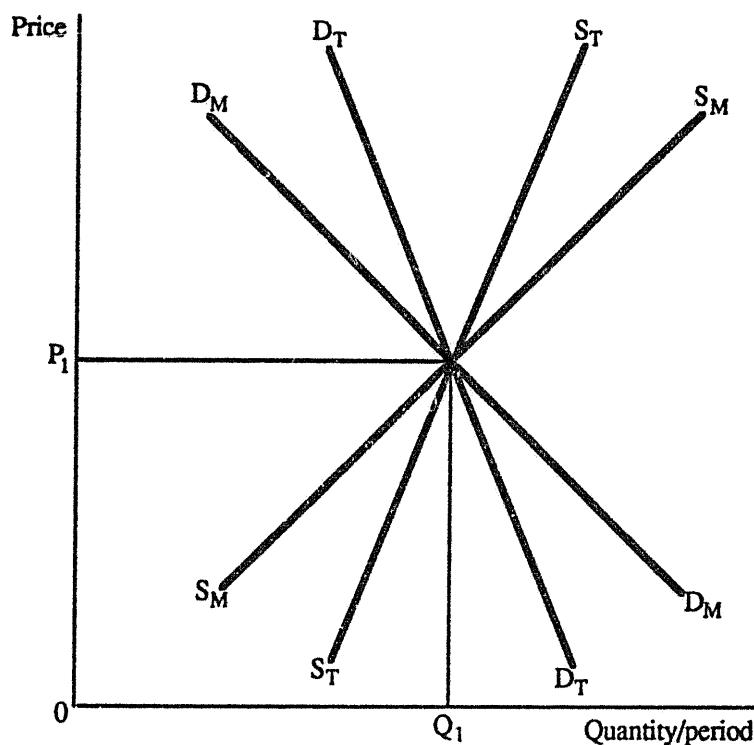
**Pork**



**Beef**



*Figure 2*  
Configuration of Marshallian (M) and Total (T)  
demand and supply response functions



Buse's results have considerable conceptual significance; for example, the Marshallian own-price elasticity coefficient can be in the relatively elastic range and the total elasticity in the relatively inelastic range. One would reach different conclusions as to the directional movement in total revenue following a price change depending on which elasticity was used for prediction purposes. Some would argue that the practical significance of his results are not so great because the elasticities which are estimated from econometric models are not likely to be Marshallian elasticities since it is difficult to isolate partial effects in a *mutatis mutandis* world. The estimated elasticities may be some mixture of Marshallian and total elasticities. Nevertheless, the conceptual difference is real.

Buse (1958) derived his results by manipulating an explicit simultaneous system of demand and supply functions for two commodities. The system was explicit in that the functions were assumed to be linear in logarithms. An alternative way of deriving Buse's results is through the use of an equilibrium displacement model with no assumptions about functional forms. In general functional form, Buse's model can be written as:

$$\begin{aligned}
 D_1 &= D_1(P_1, P_2, W) & \dots 1(a) \\
 S_1 &= S_1(P_1, P_2, X) & \dots 1(b) \\
 D_2 &= D_2(P_1, P_2, Y) & \dots 1(c) \\
 S_2 &= S_2(P_1, P_2, Z) & \dots 1(d) \\
 D_2 &= S_2 = Q_2 & \dots 1(e)
 \end{aligned}$$

where

$$\begin{aligned}
 P &= \text{price;} \\
 D &= \text{quantity demanded} \\
 S &= \text{quantity supplied;} \\
 Q &= \text{equilibrium quantity;} \\
 W, X, Y, Z &= \text{exogenous shift variables; and} \\
 1, 2 &= \text{subscripts denoting commodities 1 and 2.}
 \end{aligned}$$

The endogenous variables are  $D_1$ ,  $S_1$ ,  $Q_2$  and  $P_2$  ( $P_1$  being determined by government and enforced through stock control).

Buse was particularly interested in the impact of a change in  $P_1$  on the equilibrium values of  $D_1$  and  $S_1$  (and their difference which represents excess supply). These impacts

are conveniently represented by total elasticities. As shown in Appendix 1, a set of general equilibrium elasticities (one for each endogenous variable) is obtained as the solution to the matrix equation:

$$\begin{bmatrix} -1 & 0 & 0 & \eta_{12} \\ 0 & -1 & 0 & \varepsilon_{12} \\ 0 & 0 & -1 & \eta_{22} \\ 0 & 0 & -1 & \varepsilon_{22} \end{bmatrix} \begin{bmatrix} G(D_1, P_1) \\ G(S_1, P_1) \\ G(Q_2, P_1) \\ G(P_2, P_1) \end{bmatrix} = \begin{bmatrix} -\eta_{11} \\ -\varepsilon_{11} \\ -\eta_{21} \\ -\varepsilon_{21} \end{bmatrix} \dots S(I)$$

where

$\eta_{ij}$  ( $\varepsilon_{ij}$ ) = the Marshallian price elasticity of demand (supply) of commodity i with respect to the price of commodity j ( $i, j = 1, 2$ ); and

$G(v, P_1)$  = the general equilibrium (or total) elasticity of endogenous variable  $v$  ( $v = D_1, S_1, Q_2, P_2$ ) with respect to  $P_1$ .

Buse's total elasticities correspond to  $G(D_1, P_1)$  and  $G(S_1, P_1)$  which, by application of Cramer's rule, are given by:

$$G(D_1, P_1) = \eta_{11} + \eta_{12} G(P_2, P_1) \dots 2(a)$$

$$\text{and } G(S_1, P_1) = \varepsilon_{11} + \varepsilon_{12} G(P_2, P_1) \dots 2(b)$$

where

$$G(P_2, P_1) = (\varepsilon_{21} - \eta_{21}) / (\eta_{22} - \varepsilon_{22}). \dots 2(c)$$

These results generalise to the case of several commodities related in demand and/or supply.

As explained by Buse, if the two commodities are substitutes in both supply and demand,  $G(P_2, P_1)$  is positive and, with cross elasticities less than own elasticities, it would be less than one. Hence,  $G(D_1, P_1)$  and  $G(S_1, P_1)$  would be less elastic than, and

of the same sign as, their Marshallian counterparts. The same would be true if the two commodities were complements on both sides of the markets, although  $G(P_2, P_1)$  would be negative. It is not possible to sign  $G(P_2, P_1)$  in the case where commodities are substitutes on one side of the market and complements on the other unless the numerical values of the cross elasticities are known.

Clearly, ignoring cross-market effects is of more consequence the larger are the cross-price elasticities relative to the own-price elasticities. However, one would expect the absolute size of cross-price elasticities and own-price elasticities to be positively related.

Whilst Buse was not concerned with the total response of the equilibrium quantity of commodity 2 to a change in the price of commodity 1, this could be of interest in some problem settings (e.g. if there is a change in the exogenously-determined price of fluid milk, what is the impact on the equilibrium quantity of manufacturing milk?). It is given by

$$\begin{aligned} G(Q_2, P_1) &= \eta_{21} + \eta_{22} G(P_2, P_1) & \dots 3(a) \\ &= \varepsilon_{21} + \varepsilon_{22} G(P_2, P_1) & \dots 3(b) \\ &= (\varepsilon_{21} \eta_{22} - \varepsilon_{22} \eta_{21}) / (\eta_{22} - \varepsilon_{22}). & \dots 3(c) \end{aligned}$$

For clarity, one could refer to  $G(Q_2, P_1)$  as the total *cross-price* elasticity of demand (from 3(a)) and supply (from 3(b)) of commodity 2 with respect to the price of commodity 1. Buse's total elasticities  $G(D_1, P_1)$  and  $G(S_1, P_1)$  would then be referred to as the total *own-price* elasticities of demand and supply, respectively, for commodity 1.

What can be said about the sign of  $G(Q_2, P_1)$ ? If the commodities are substitutes (or complements) on both sides of the market, the sign is indeterminant a priori (the logic is that the Marshallian demand and supply functions for commodity 2 shift in different directions in response to a change in  $P_1$ ). If the commodities are substitutes in demand and complements in supply,  $G(Q_2, P_1)$  is positive (Marshallian supply and demand functions for commodity 2 both shift to the right in response to an increase in  $P_1$ ), and vice-versa if the commodities are complements in demand and substitutes in supply.

As shown in Appendix 1, the equilibrium displacement model can be used to derive general equilibrium elasticities for each endogenous variable with respect to any exogenous variable. It is worth noting that, when the Buse model is altered to make  $P_1$  endogenous (i.e. the model becomes one in which demand and supply for each commodity determine

their prices), general-equilibrium elasticities for the quantities traded of each commodity can be expressed as functions of Marshallian own and cross-price elasticities and the general-equilibrium price elasticities. For example,

$$G(Q_1, W) = \epsilon_{11} G(P_1, W) + \epsilon_{12} G(P_2, W) \quad \dots 4(a)$$

or

$$G(Q_1, W)/G(P_1, W) = \epsilon_{11} + \epsilon_{12} [G(P_2, W)/G(P_1, W)] \quad \dots 4(b)$$

where  $Q_1$  is the equilibrium quantity traded of commodity 1. Note the similarity between 5(b) and 2(b).

General equilibrium elasticities for other variables of interest that are not included explicitly in the model, in particular, the revenue earned from each commodity and excess supply (or additions to stocks) for commodity 1, can be derived readily from the general-equilibrium elasticities obtained from the solution to S(1):

$$G(R_1, P_1) = p + G(Q_1, P_1) \quad \dots 5(a)$$

$$\begin{aligned} G(R_2, P_1) &= G(P_2, P_1) + G(Q_2, P_1) \\ &= \epsilon_{22} + G(P_2, P_1) [1 + \epsilon_{21}] \end{aligned} \quad \dots 5(b)$$

$$G(K, P_1) = G(S_1, P_1)[S_1/K] - G(D_1, P_1)[D_1/K] \quad \dots 5(c)$$

where

$p$  = percentage increase in  $P_1$ ;

$R_i$  = revenue from market  $i$ ; and

$K$  =  $S_1 - D_1$ .

As acknowledged by Buse (1958), important analytical results governing multi-market equilibria have been known for some time, the basic relationships having been outlined by Hicks (1939). Notwithstanding this, Buse's paper (itself a prize-winner) was, in the author's view, an important contribution in that it highlighted in precise fashion how the own- and cross-price elasticities interact, with the application being to agricultural commodity markets where there are clearly some strong cross-market relationships.

## Single-Desk Selling

A contemporary issue in debate about Australia's agricultural marketing arrangements is the efficacy of single-desk selling arrangements, especially in relation to export selling. The issue has been addressed, for example, in Industries Assistance Commission (now Industry Commission) enquiries into the rice industry (Industries Assistance Commission 1987), the wheat industry (Industries Assistance Commission 1988), the dried vine fruits industry (Industries Assistance Commission 1989) and statutory marketing arrangements (Industry Commission 1991). Primary Industries and Energy Minister Crean, in an address to the Victorian Rural Press Club, claimed that he was challenging the Australian Wheat Board to demonstrate why its single-desk seller status was necessary (Primary Industry Survey September 1991) and Secretary Miller has made reference to 'the old days when growers still believed in single-desk selling' in a recent keynote address (Miller 1991).

Proponents of single-desk selling arrangements try to justify them on one or more of several grounds. They include, for example, the opportunity to extract price premia in some markets, the need to counteract buying power, the need to undertake product promotion, the preference of some centralised importing agencies to deal with a statutory authority and the need to assure quality. These arguments have been questioned in debate on the issue and the potential dangers of granting single-seller status have been emphasised. For example, it has been argued that supposed 'price premia' may be nothing more than a return to cover the costs of certain services 'packaged' into a particular sale and that granting single-seller status to an organisation removes some of the discipline of competition in ensuring efficient marketing activity and it may stifle innovative marketing initiatives.

The aim here is to demonstrate how some multi-market commodity analysis of the kind outlined in Appendix 1 can be used to provide some insights useful to the evaluation of three arguments advanced for single-desk selling: the price premia argument, the need for countervailing power and the need for product promotion.

### *The Price Premia Argument*

The essence of the price premia argument for single-desk selling arrangements is that, through controlling the flow of exports to a particular market by having a single

Australian seller into those markets, higher prices can be obtained than those obtained in the absence of a single-seller arrangement. Underpinning the argument is the view that Australia has 'market power' in the markets concerned. Evaluation of the argument based on experience is difficult for three reasons. First, where a statutory body enjoyed single-seller status for a long time as in the case of wheat and rice, there is no basis for comparisons with a situation of multiple Australian sellers. Second, the type of data one would wish to have would be regarded as being commercially confidential. Third, there is the problem of disentangling price effects due solely to market power from those which are due to other considerations such as quality and any special conditions associated with a sale (e.g. credit arrangements). Nevertheless, it is important to evaluate the argument (as well as other arguments advanced for single-desk selling) because there are real dangers associated with having such an arrangement, including lack of competitive discipline in the provision of the selling function.

In its report on statutory marketing arrangements, the Industry Commission (1991, pp. 48-9) concluded as follows:

'There are doubts about whether Australian agricultural commodities fulfil the necessary requirements which allow export controls to achieve market power premiums on overseas markets. Notwithstanding these doubts, to the extent that any increased return to producers from export sales could be achieved through controlling export sales, it would benefit Australia's domestic economy. From Australia's viewpoint, the market power premium would involve income transfers from overseas consumers to the domestic economy.'

However, export licensing or single-desk selling themselves can impose costs, since they limit market entry and can prevent competitive pressures from ensuring that sales into premium markets are undertaken at least cost. Administering and policing export controls also are not costless. Thus the objective of capturing a market power premium on export markets through controls on competitive access would only be sound if any extra costs imposed by those controls were less than the extra income obtained'.

The recent spate of debate about market power and single-desk selling arrangements is certainly not the first time it has emerged. Earlier Australian studies relevant to the issue

include, for example, Freebairn and Gruen (1977) and Smith (1977), both of which contain reservations about the market power-based gains to be had from single-desk selling into export markets. In contrast, Rae (1988) is of the view that the single-desk selling arrangement for New Zealand apples and pears helped that industry out-perform its Australian counterpart during the 1970s and 1980s, partly because of market-power considerations.

What can the results from a simple equilibrium displacement model contribute to the debate? It does seem clear that evaluation of market power and the benefits it offers to Australian exporters has to be evaluated on a case-by-case basis. While generally Australia might have limited power in export markets, there may be particular markets where it does. However, the characteristics of the market setting, such as whether there is an alternative source of supply other than Australian product and the existence and strengths of cross-relationships in demand involving the Australian product, are likely to vary across export markets. Hence, there is not a single multi-market commodity model which will be universally applicable to the analysis of market power and the gains from single-desk selling.

The following model characterises one of many plausible scenarios. It represents the demand and supply situation for two commodities, 1 and 2, in the Republic of Allaru. While Allaru has adopted a self-sufficiency policy for commodity 2 (its domestic price fluctuates so as to balance domestic demand and domestic supply), it imports the balance of its commodity 1 requirements only from Australia, perhaps because of transport cost considerations. In algebraic form, the model is:

$$\begin{aligned}
 D_1 &= D_1 (P_1, P_2, W) & \dots 6(a) \\
 S_1 &= S_1 (P_1, P_2, X) & \dots 6(b) \\
 D_2 &= D_2 (P_1, P_2, Y) & \dots 6(c) \\
 S_2 &= S_2 (P_1, P_2, Z) & \dots 6(d) \\
 M_1 &= D_1 - S_1 & \dots 6(e) \\
 D_2 &= S_2 = Q_2 & \dots 6(f)
 \end{aligned}$$

where the notation is as previously defined, with  $M_1$  added to denote imports.

A critical assumption is that  $M_1$  is controlled by an Australian exporting agency, either through acting as a single-desk seller or allocating export licenses. An implication of

this assumption is that the Australian exporting agency can influence the price of wheat in Allaru (by varying  $M_1$ ). But this is the essence of one of the arguments advanced by proponents of single-desk selling.

How much market power does Australia have in this case? The answer can be found through applying the procedures outlined in Appendix 1. What is required is a measure of the sensitivity of  $P_1$  to changes in  $M_1$ . However, it will be useful for our purposes to examine the sensitivity of all the endogenous variables in the multi-market model with respect to  $M_1$ . That information can be obtained as the solution to the matrix equation:

$$\begin{bmatrix} 1 & 0 & -\eta_{11} & \eta_{12} \\ D_1 & 0 & -\varepsilon_{11}S_1 & -\varepsilon_{12}S_1 \\ 0 & 1 & -\eta_{21} & -\eta_{22} \\ 0 & 1 & -\varepsilon_{21} & -\varepsilon_{22} \end{bmatrix} \begin{bmatrix} G(D_1, M_1) \\ G(Q_2, M_1) \\ G(P_1, M_1) \\ G(P_2, M_1) \end{bmatrix} = \begin{bmatrix} 0 \\ M_1 \\ 0 \\ 0 \end{bmatrix} \dots S(2)$$

where the notation is as previously defined.

The key result which gives an indication of market power is the value of  $G(P_1, M_1)$ , which we shall call the total price flexibility of  $P_1$  with respect to  $M_1$ . It measures the percentage change in  $P_1$  following a one per cent change in imports after allowing for general equilibrium effects. Using Cramer's rule, its value is given by

$$G(P_1, M_1) = (\varepsilon_{22} - \eta_{22})/\Delta_1 \dots 7(a)$$

where

$$\Delta_1 = [\varepsilon_{21} - \eta_{21}] [(r-1) \varepsilon_{12} - r \eta_{12}] - [\varepsilon_{22} - \eta_{22}] [(r-1) \varepsilon_{11} - r \eta_{11}] \dots 7(b)$$

and  $r = D_1/M_1$

One thing that is clear is that, when trying to gauge the impact on price of Australia's exports to Allaru, account needs to be taken not only of the demand elasticity for the product within Allaru (i.e.  $\eta_{11}$ ), but also of cross-demand elasticities, own-and cross-price supply

elasticities as well as the ratio of demand to imports. It could be said that all this is intuitively obvious. But the advantage of approaching the issue of market power in the manner we have is that it allows us to see more precisely how different parameters affect the degree of influence Australian exports have on price.

The signs of the partial derivatives of  $G(P_1, M_1)$  for the cases where commodities 1 and 2 are substitutes in both demand and supply are shown in Table 1. The economic logic underlying the signs of the partial derivatives becomes apparent if one bears in mind that, in examining the equilibrium displacement effects of changes in imports, we are working with general-equilibrium supply and demand functions. The presence of substitution relationships makes these functions more inelastic than their Marshallian counterparts. The stronger the substitution relationships, the more inelastic are the general equilibrium price effects of a given change in imports. This is shown in Figure 3.

The importance of the strength of the substitution relationships is also verified by thinking of the adjustment to a change in imports in a sequential fashion. When the level of imports changes, the price of commodity 1 changes and this, in turn, causes the price of commodity 2 to change. This leads to further change in the price of commodity 1. It can be shown from our equilibrium displacement model that the degree of 'price transmission' from commodity 1 to commodity 2 is given by:

$$G(P_2, M_1)/G(P_1, M_1) = (\varepsilon_{21} - \eta_{21})/(\eta_{22} - \varepsilon_{22}), \quad \dots 8$$

as was the case in the Buse model.

The logic of the positive sign of the derivative with respect to  $r$  ( $=D_1/M_1$ ) is that, *ceteris paribus*, a higher value for  $r$  means that Australia is satisfying a smaller proportion of Allaru's demand requirements for commodity 1 and, hence, Allaru's (excess) demand for Australian exports is more elastic. A given change in imports from Australia will, therefore, have a smaller impact on price (i.e. the real value of  $G(P_1, M_1)$  is greater).

Values of  $G(P_1, M_1)$  corresponding to various combinations of values of its arguments are shown in Table 2. Note that our measure of market power is inversely related to the Marshallian elasticities and the ratio of demand to imports. Too, the implications of ignoring general equilibrium effects are significant in percentage terms, with the degree of market power being underestimated by about 30 per cent.

Table 1

Signs of partial derivatives of  $G(P_1, M_1)$ 

Partial with respect to	Sign
$\eta_{11}$	-ve
$\eta_{12}$	-ve
$\eta_{22}$	-ve
$\eta_{21}$	-ve
$\varepsilon_{11}$	+ve
$\varepsilon_{12}$	+ve
$\varepsilon_{22}$	+ve
$\varepsilon_{21}$	+ve
$r$	+ve

**Note:** The sign of  $G(P_1, M_1)$  is negative. It is assumed that commodities 1 and 2 are substitutes in demand and supply. Consider, for example, the negative partial derivatives of  $G(P_1, M_1)$  with respect to  $\eta_{11}$  and  $\eta_{21}$ . An *increase* in  $\eta_{11}$  (which is negative) means a less elastic Marshallian demand and a less elastic general equilibrium demand. Hence  $G(P_1, M_1)$  becomes larger in absolute terms or *smaller* in real terms. An increase in  $\eta_{12}$  (which is positive) means a greater cross-price elasticity and hence a more inelastic general equilibrium demand function and a *smaller* (in real terms) value of  $G(P_1, M_1)$ .

*Figure 3*  
Price impacts of a given reduction in imports:  
Total vs Marshallian demand and supply response

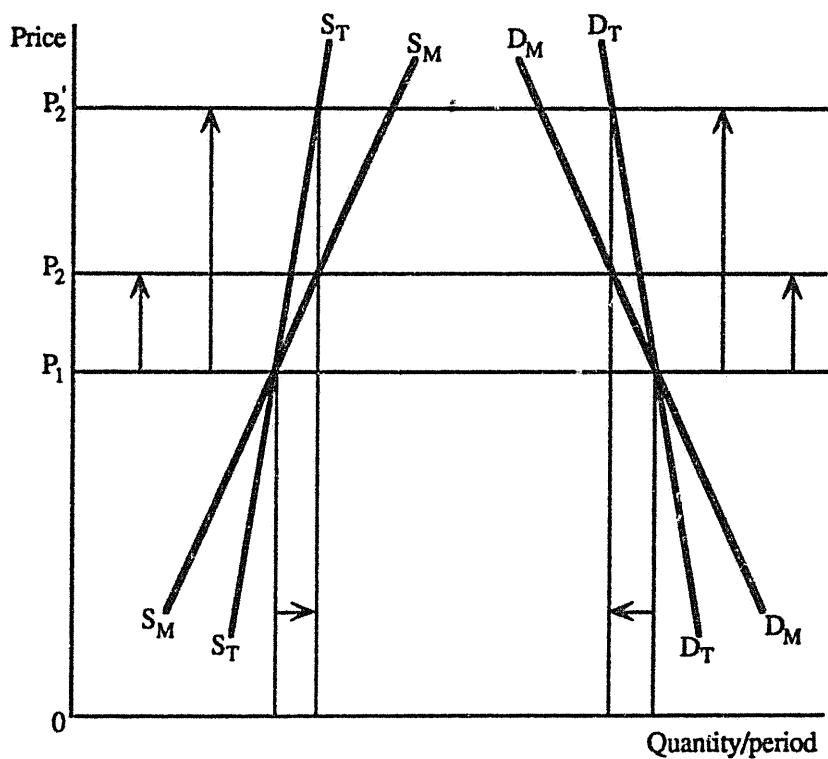


Table 2

Percentage increase in price of commodity 1 associated with a one per cent reduction in imports of commodity 1 for different parameter combinations

Supply elasticities	Demand elasticities			
	Base	Base x2	Base x3	Base x4
.... $r = 1.333$ ....				
Base	1.45 (1.03)	0.81	0.57	0.43
Base x2	1.21	0.73	0.52	0.41
Base x3	1.04	0.66	0.48	0.38
Base x4	0.91	0.60	0.45	0.36 (0.26)
.... $r = 2.0$ ....				
Base	0.82 (0.59)	0.49	0.35	0.27
Base x2	0.62	0.41	0.31	0.25
Base x3	0.50	0.35	0.27	0.22
Base x4	0.42	0.31	0.25	0.21 (0.15)
.... $r = 4.0$ ....				
Base	0.36 (0.26)	0.23	0.17	0.13
Base x2	0.25	0.18	0.14	0.11
Base x3	0.19	0.15	0.12	0.10
Base x4	0.16	0.13	0.10	0.09 (0.06)

**Note:** Base demand elasticities are  $\eta_{11} = -0.6$ ,  $\eta_{12} = 0.4$ ,  $\eta_{22} = -0.4$  and  $\eta_{21} = 0.2$ ; base supply elasticities are  $\varepsilon_{11} = 0.5$ ,  $\varepsilon_{12} = -0.3$ ,  $\varepsilon_{22} = 0.4$  and  $\varepsilon_{21} = -0.15$ ; the demand and supply elasticities are parameterised by multiplying all the base values by 2, 3 and 4;  $r = D_1/M_1$ ; the numbers in parentheses are the percentage price changes when general equilibrium effects are ignored.

Notwithstanding this under estimation, the general picture that emerges from the sensitivity analysis report in Table 2 is that the price in Allaru is relatively inflexible with respect to Australian exports (i.e. market power is weak) and that the extent of market power is highly sensitive to Australia's relative share of the Allaru market for commodity 1. We should keep in mind that Australia's market share will fluctuate through time in response to shifts in Allaru's Marshallian demand and supply functions for *both* commodities 1 and 2.

As a next step we can investigate how ability to influence the price in Allaru translates into ability to increase the revenue obtained from a given quantity of Australian exports. To do this assume that the demand for Australian exports of commodity 1 in all other markets is perfectly elastic at some price level  $P_w$ .

Then,

$$R = P_1 M_1 + P_w Q^* - P_w M_1 \quad \dots 9(a)$$

where

$R$  = total export revenue earned from commodity 1; and  
 $Q^*$  = total available for export.

Differentiating 9(a) with respect of  $M_1$  and converting to elasticities yields:

$$G(R_1, M_1) = [(P_1 M_1/R)] [1 + G(P_1, M_1)] - [P_w M_1/R] \quad \dots 9(b)$$

$=$  general-equilibrium elasticity of  $R$  with respect to  $M_1$ .

Suppose, initially, that  $P_1 = P_w$  (i.e. Australia does not try to exercise market power in its sales to Allaru). Then:

$$G(R_1, M_1) = (M_1/Q^*) G(P_1, M_1). \quad \dots 9(c)$$

For example, if sales to Allaru accounted for 20 per cent of exports and  $G(P_1, M_1) = -1.5$ , then  $G(R_1, M_1) = -0.3$ . A one per cent reduction in exports to Allaru, compared to the situation where Australia does not exploit market power, would cause export receipts to increase by 0.3 per cent.

Suppose there are  $n$  markets where Australia has some market power, that these markets cannot be arbitrated by other traders and that Australia faces a perfectly elastic demand in all other markets at price  $P_w$ . It can be shown that, compared with the situation where the price in all markets initially equals  $P_w$ , the revenue impact of reductions in exports is:

$$E(R) = \sum_i w_i E(M_i) G(P_i, M_i) \quad \dots 10$$

where

$$E(R) = dR/R;$$

$w_i$  = proportion of total exports going to market  $i$ ;

$$E(M_i) = dM_i/M_i;$$

$G(P_i, M_i)$  = total price flexibility in market  $i$  with respect to Australian exports; and  
 $i = 1, \dots, n$ .

Percentage increases in export revenue for the situation where Australia has market power in two export markets that, together, account for 20 per cent of Australian exports are shown in Table 3. Of course, it is not known how important 'premium' markets are in terms of their percentage share of Australian exports, but a figure of 20 per cent would, in the author's view, be an overestimate. Too, values of  $G(P_i, M_i)$  used in the calculation of Table 3 (-0.5 to -1.5) may well overstate actual market power.

In panel (i) of Table 3, the percentage decreases in exports to both markets have been set at five. The thing to note is that, even when the prices received are quite sensitive to imports from Australia, the percentage increase in overall export revenue is minuscule. In panels (ii) and (iii), the percentage reductions in exports to each market differs. The point to note from those figures is that, not only is the percentage increase in overall export revenue generally small, it is sensitive to the *pattern of reduction* in exports across different markets.

The percentage increases in export revenue would be greater for larger reductions in exports to the two markets but the results in Table 3 suggest that the increases would still be small. Too, while the revenue increases represent a straight transfer from overseas consumers to Australia, they have to be compared with any increases in costs incurred by Australia from having a single-desk selling arrangement in place.

Table 3

**Percentage increase in total export revenue from reducing exports to two markets accounting for 20 per cent of Australian exports**

$G(P_b, M_b)$	$G(P_a, M_a)$		
	-0.5	-1.0	-1.5
....(i) 5% reduction in $M_a$ and $M_b$ ....			
-0.5	0.50	0.87	1.25
-1.0	0.63	1.00	1.38
-1.5	0.75	1.13	1.50
....(ii) 5% reduction in $M_a$ ; 1% reduction in $M_b$ ....			
-0.5	0.40	0.78	1.15
-1.0	0.43	0.80	1.18
-1.5	0.45	0.83	1.20
....(iii) 1% reduction in $M_a$ ; 5% reduction in $M_b$ ...			
-0.5	0.20	0.28	0.35
-1.0	0.33	0.40	0.48
-1.5	0.45	0.53	0.60

**Note:** It is assumed that Australia faces a perfectly elastic demand in all other markets, that market 'a' accounts for 15 per cent of Australian exports and that market 'b' accounts for 5 per cent of Australia exports. The percentage increases are calculated using revenue under competitive pricing as the base.

A point also worth making is that our revenue comparisons have been made against a base of competitive pricing, that is, the case where exports to the two markets are those which would occur when the prices in those markets equalled the 'world price'. This may not be the appropriate comparison. If a single-desk selling arrangement was not in place, shrewd private traders might be able to take advantage of the market power which exists. If they are doing this, then the further revenue increases from switching to a single-desk selling arrangement will be less (or, indeed, negative if the private traders, perhaps through better market intelligence, can judge the elasticities better than the single-desk seller). Of course, proponents of single-desk selling argue that private traders would simply erode the price premiums which can be obtained by over-supplying the markets. But the price premia and associated transfers to Australian producers could be protected through auctioning the rights to export to the premium markets. Such an arrangement has, of course, been advocated previously (see, for example, Freebairn and Gruen 1977).

There is another potentially important point which is made clear by the use of the equilibrium displacement model. The model used was one in which Allaru did not trade in commodity 2 because of a self-sufficiency policy. When exports of commodity 1 from Australia are *restricted*, the solution to the equilibrium displacement model showed that

$$G(Q_2, M_1) = -M_1 (\epsilon_{22}\eta_{21} - \epsilon_{21}\eta_{22})/\Delta_1 \quad \dots 11(a)$$

$$\text{and } G(P_2, M_1) = M_1 (\epsilon_{21} - \eta_{21})/\Delta_1. \quad \dots 11(b)$$

The sign of  $G(P_1, M_1)$  is unambiguously positive, assuming commodities 1 and 2 are substitutes. Self-sufficiency in commodity 2 is achieved at a higher price level. The impact of the reduction in exports of commodity 1 on the price of commodity 2 in Allaru will be greater the stronger the cross-price effects. An issue which could be of importance is whether the government of Allaru would be content with allowing its consumers to pay a higher price for commodity 2. If it is not, then it may retaliate against its reduced access to imports of commodity 1 from Australia in a manner which erodes Australia's market power. This it could do, for example, by introducing policies to shift the supply curve for commodity 2 to the right or opening up its borders to imports of commodity 2. It is worth noting, too, that if Allaru adopted a policy of stabilising the price of commodity 2 in the face of fluctuations in the availability of imports of commodity 1, the general equilibrium effects which work to enhance Australia's ability to influence the price of commodity 1 would be eliminated.

While our discussion of the price premium argument has been concentrated on export marketing, the analysis is just as relevant to domestic marketing where, for example, a state marketing board can influence flows of a commodity to different outlets. In some of those outlets it might have market power while in others it might face a perfectly elasticity demand. Cross-commodity effects are likely to be important. The revenue impacts are likely to be greater because 'premium' markets are likely to account for a greater proportion of total sales.

### ***Collusive Buying***

Another argument advanced by proponents of single-desk selling is that such an arrangement is necessary when there is concentration among buyers. This, of course, is an old argument used to justify statutory marketing arrangements. Central to the argument is the association between concentration and collusive buying behaviour. However, while collusive buying behaviour might be easier when there is a high degree of concentration among buyers, the *incentive* for collusive buying may be lacking. Given that collusive behaviour entails some costs to those who participate in it, it is unlikely to be undertaken when the potential gains from doing so are slight.

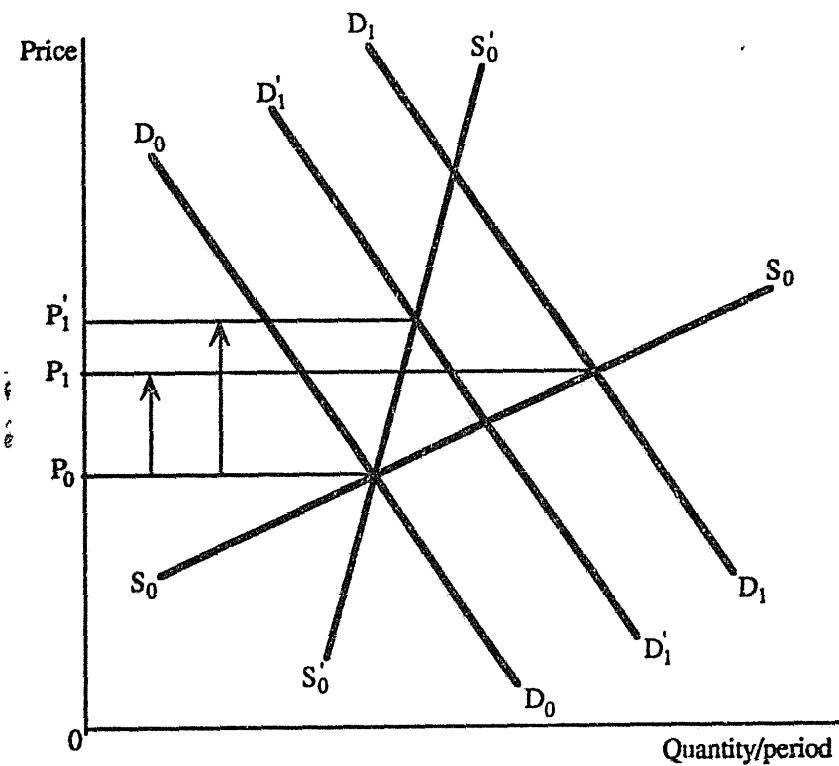
One would expect the incentive for collusive buying behaviour to be directly related to the potential impact on price of an expansion in demand. That impact, in turn, is inversely related to the price elasticity of the supply of the commodity being purchased. Hence, the price elasticity of supply is a relevant consideration in assessing the incentive toward collusive buying behaviour (see Figure 4).

Again, this basic point is nothing new to price analysts. For example, it was an important consideration in an early study by Helmberger and Hoos (1965) to do with the gains from co-operative bargaining in agriculture. They state (Helmberger and Hoos 1965, pp 129-30) that:

Greater elasticity in the supply function tends to decrease the difference between average and marginal resource cost and facilitates independent conduct in the sense that output variation on the part of any one firm will tend to have a correspondingly smaller impact on price.

The argument also surfaced in the recent review by NSW Agriculture and Fisheries of the rationale for marketing boards (Bruce 1990).

*Figure 4*  
**Price impacts of demand increases: large vs small buyers**



Depending on the elasticity of supply, a 10% increase in demand on the part of a very large buyer which shifts market demand from  $D_0$  to  $D_1$  can cause a smaller increase in price than a 10% increase in demand on the part of several small buyers which shifts market demand from  $D_0$  to  $D_1'$ .

The relationships involved can be analysed readily using an equilibrium displacement model. Suppose that the markets for two commodities, 1 and 2, which are substitutes in demand and supply, can be characterised as follows:

$$\begin{aligned}
 D_1^a &= D_1^a(P_1, P_2, W_1) & \dots 12(a) \\
 D_1^b &= D_1^b(P_1, P_2, W_2) & \dots 12(b) \\
 S_1 &= S_1(P_1, P_2, X) & \dots 12(c) \\
 D_2 &= D_2(P_1, P_2, Y) & \dots 12(d) \\
 S_2 &= S_2(P_1, P_2, Z) & \dots 12(e) \\
 D_1^a + D_1^b &= S_1 = Q_1 & \dots 12(f) \\
 D_2 &= S_2 = Q_2. & \dots 12(g)
 \end{aligned}$$

The notation is as previously defined except that the demand for commodity 1 has been decomposed into two sources, 'a' and 'b'. Source 'a' is the demand from a single large buyer (or a few large buyers) while source 'b' is the demand emanating from all other buyers, each of whom is assumed to be 'small'.

The larger is the demand from source 'a' relative to the demand from source 'b', the more concentrated is the buying side of the market. Price levels for each commodity are determined by supply/demand balance.

Our interest is in the impact of an increase in demand from source 'a' on the price of commodity 1, allowing for general equilibrium effects to occur. After undertaking the usual steps entailed in deriving general equilibrium elasticities, one obtains the following relationship:

$$\begin{bmatrix}
 1 & 0 & 0 & -\eta_{11}^a & -\eta_{12}^a \\
 -k_1 & 1 & 0 & -\eta_{11}^b k_2 & -\eta_{12}^b k_2 \\
 0 & 1 & 0 & -\epsilon_{11} & -\epsilon_{12} \\
 0 & 0 & 1 & -\eta_{21} & -\eta_{22} \\
 0 & 0 & 1 & -\epsilon_{21} & -\epsilon_{22}
 \end{bmatrix} \begin{bmatrix}
 G(D_1^a, X_1) \\
 G(Q_1, X_1) \\
 G(Q_2, X_1) \\
 G(P_1, X_1) \\
 G(P_2, X_1)
 \end{bmatrix} = \begin{bmatrix}
 N_{1,a,x_1} \\
 0 \\
 0 \\
 0 \\
 0
 \end{bmatrix} \dots S(3)$$

where

$k_1 = D_{1a}/Q_1$   
 $=$  share of source 'a' in the total demand for commodity 1;  
 $k_2 = 1 - k_1;$   
 $\eta_{1a,x_1} =$  Marshallian elasticity of demand source 'a' with respect to  $X_1$ .

The remaining notation is as previously defined. Using Cramer's rule, the general equilibrium elasticity of  $P_1$  with respect to  $X_1$  is given by

$$G(P_1, X_1) = k_1 \eta_{1a,x_1} (\eta_{22} - \varepsilon_{22}) / \Delta_2 \quad \dots 13(a)$$

where

$$\Delta_2 = (\varepsilon_{12} - k_1 \eta_{12a} - k_2 \eta_{12b}) (\varepsilon_{21} - \eta_{21}) - (\varepsilon_{22} - \eta_{22}) (\varepsilon_{11} - k_1 \eta_{11a} - k_2 \eta_{11b}) \dots 13(b)$$

Values for  $G(P_1, X_1)$  corresponding to various combinations of Marshallian elasticities and  $k_1$  are reported in Table 4.

Clearly,  $G(P_1, X_1)$  is positively related to  $k_1$ , negatively related to the Marshallian supply elasticities and positively related to the degree of inelasticity of the Marshallian demand functions. Importantly, one should not conclude that, because there is a high degree of concentration among buyers, those buyers will act collusively. The degree of concentration is only one of the parameters affecting the incentive to collude if that incentive is measured in terms of the increase in price that accompanies potential demand increases.

#### *Generic Promotion*

Single-desk selling has been advocated on the grounds that, in its absence, private traders would not engage in an adequate level of product promotion because they cannot internalise all the benefits of any promotion expenditure they undertake. The Industry Commission (1991, p. 65) has argued that, where free-rider problems are evident, some form of statutory arrangement might be sound in order to stimulate demand, but points out that it need not be single-desk selling. For example, in relation to wheat promotion, the Industry Assistance Commission (1988, p. 120) pointed out that a compulsory levy could be used to finance promotional activities (as occurs in the US wheat industry).

Table 4

Percentage increases in price following a one per cent  
increase in demand by a large buyer

Supply <sup>b</sup> elasticity	Market share <sup>a</sup>			
	.8	.6	.4	.2
....(i) Demand elasticities at base <sup>c</sup> ....				
Base	2.90	2.29	1.61	0.85
Base x2	2.31	1.81	1.26	0.66
Base x3	1.92	1.49	1.03	0.53
Base x4	1.65	1.27	0.87	0.45
....(ii) Demand elasticities at base <sup>c</sup> x 0.5 ....				
Base	4.62	3.61	2.52	1.32
Base x2	3.29	2.54	1.75	0.90
Base x3	2.56	1.96	1.34	0.68
Base x4	2.09	1.60	1.08	0.55

- a Measures the proportion of output purchased by a single large buyer (or a few large buyers) at initial equilibrium.
- b Base supply elasticities are  $\varepsilon_{11} = 1.0$ ,  $\varepsilon_{12} = -0.6$ ,  $\varepsilon_{22} = 0.8$  and  $\varepsilon_{21} = -0.4$ .
- c Base demand elasticities are  $\eta_{11}^a = -1.5$ ,  $\eta_{12}^a = 0.8$ ,  $\eta_{11}^b = -1.0$ ,  $\eta_{12}^b = 0.5$ ,  $\eta_{22} = -1.2$ ,  $\eta_{21} = 0.6$ .

A more fundamental argument in relation to setting up a single-desk seller to undertake generic promotion is whether there is much to be gained from generic promotion, whether it be undertaken by a single-desk seller or some other form of statutory arrangement, and the possibility that any benefits that do exist may be spread unevenly across the producers who provide the finance. If the generic product group (e.g. red meat or fruit) contains individual products that are substitutes in demand (or both demand and supply), generic promotion may well advantage one product more than another, especially if consumers allocate a reasonably fixed proportion of their budget to the product group.

It is relatively easy to demonstrate, through the use of a simple equilibrium displacement model, why there are concerns about the efficacy of generic promotion. Consider the following model which characterises the demand and supply conditions for two commodities which form a generic group:

$D_1$	$=$	$D_1(P_1, P_2, A)$	...14(a)
$S_1$	$=$	$S_1(P_1, P_2, W)$	...14(b)
$D_2$	$=$	$D_2(P_1, P_2, A)$	...14(c)
$S_2$	$=$	$S_2(P_1, P_2, X)$	...14(d)
$D_1$	$=$	$S_1 = Q_1$	...14(e)
$D_2$	$=$	$S_2 = Q_2$	...14(f)

where

$A$  = a dollar measure of generic promotional expenditure; and  
 $X_1, X_2$  = exogenous supply shifters.

The remaining notation is as previously defined.

Assume that the two commodities are substitutes in demand and in supply. This assumption certainly seems valid for the demand side (e.g. different red meats and different fruits are substitutes) and it may well be true on the supply side in some cases although, for comparable lengths of run, substitution on the supply side might be weaker than substitution on the demand side.

With this model one can investigate readily some of the impacts of an *increment* in generic promotional expenditure, as opposed to the impact of the *general level* of promotional expenditure (thus making for only a very partial analysis). A set of general equilibrium elasticities showing the impact of a change in promotional expenditure on each endogenous variable is obtained as the solution to the following system:

$$\begin{bmatrix} 1 & 0 & -\eta_{11} & -\eta_{12} \\ 1 & 0 & -\varepsilon_{11} & -\varepsilon_{12} \\ 0 & 1 & -\eta_{21} & -\eta_{22} \\ 0 & 1 & -\varepsilon_{21} & -\varepsilon_{22} \end{bmatrix} \begin{bmatrix} G(Q_1, A) \\ G(Q_2, A) \\ G(P_1, X_1) \\ G(P_2, A) \end{bmatrix} = \begin{bmatrix} \eta_{1A} \\ 0 \\ \eta_{2A} \\ 0 \end{bmatrix} \quad \dots S(4)$$

where  $\eta_{1A}$  and  $\eta_{2A}$  are the partial elasticities of demand with respect to promotional expenditure for commodities 1 and 2, respectively, and the remaining notation is as previously defined.

Through the application of Cramer's rule one obtains the following results:

$$G(P_1, A) = [\eta_{1A}(\eta_{22} - \varepsilon_{22}) - \eta_{2A}(\eta_{12} - \varepsilon_{12})]/\Delta_3 \quad \dots 15(a)$$

$$G(P_2, A) = [\eta_{2A}(\eta_{11} - \varepsilon_{11}) - \eta_{1A}(\eta_{21} - \varepsilon_{21})]/\Delta_3 \quad \dots 15(b)$$

$$G(Q_1, A) = \varepsilon_{11}G(P_1, A) + \varepsilon_{12}G(P_2, A); \text{ and} \quad \dots 15(c)$$

$$G(Q_2, A) = \varepsilon_{22}G(P_2, A) + \varepsilon_{21}G(P_1, A) \quad \dots 15(d)$$

where  $\Delta_3$  is the determinant of the LHS matrix containing partial demand and supply elasticities.

From these results one can obtain general equilibrium elasticities (with respect to A) for the gross revenues earned from each commodity. That is:

$$\begin{aligned} G(R_1, A) &= G(P_1, A) + G(Q_1, A, \\ &= [(1 + \varepsilon_{11}) [G(P_1, A)] + \varepsilon_{12}G(P_2, A); \text{ and} \end{aligned} \quad \dots 15(e)$$

$$\begin{aligned} G(R_2, A) &= G(P_2, A) + G(Q_2, A) \\ &= [(1 + \varepsilon_{22}) [G(P_2, A)] + \varepsilon_{21}G(P_1, A). \end{aligned} \quad \dots 15(f)$$

One measure of the distribution of promotional impacts is given by the ratio of the two revenue general equilibrium elasticities. Values for this ratio [ $G(R_1, A)/G(R_2, A)$ ] are given in Table 5 for various combinations of values for the arguments determining the value of the ratio. For any one pair of values for  $\eta_{1A}$  and  $\eta_{2A}$ , there is not much variation in the ratio as the partial demand and supply elasticities with respect to price are varied (a result attributed in part to varying these elasticities proportionally) but the values of  $\eta_{1A}$  and  $\eta_{2A}$  are crucial. As one would expect, producers of commodity 1 gain more relative to the producers of commodity 2 the greater is  $\eta_{1A}$  relative to  $\eta_{2A}$ . Clearly, an agency responsible for generic promotion should not be optimistic about inducing equal percentage revenue increases across the two producer groups when there is divergence between  $\eta_{1A}$  and  $\eta_{2A}$ . (Although not shown in Table 5, even when  $\eta_{1A}$  and  $\eta_{2A}$  are equal, increasing the divergence between the demand price elasticities for the two commodities, and/or the divergence between the supply price elasticities for the two commodities, results in a less even distribution of the revenue benefits.)

What is less obvious from intuition is that generic promotion may have little impact on revenue, or a negative impact, even when there are positive responses in demand to increases in promotional expenditure. Such a result is possible because of cross-commodity impacts. When generic promotion disturbs the equilibrium for, say, commodity 1 (2) by causing its demand curve to shift rightward, this in itself will disturb the equilibrium for commodity 2 (1) by causing its demand curve to shift rightward (in response to a higher price for commodity 1) and its supply curve to shift leftward (assuming substitution in demand and supply). There is an unambiguous upward pressure on the price of commodity 2 (1) but the pressures on the quantity traded of commodity 2 (1) are a mixture of positive and negative. Such cross-commodity impacts have to be added to the direct impacts of generic promotion on commodity 2(1) in order to obtain net effects.

The conditions under which generic promotion has a zero or negative impact on revenue are obtained readily from the equilibrium displacement model. Consider, for example, the impact on the revenue earned from commodity 1. It can be shown that:

$$\begin{aligned}
 G(R_1, A) &= 0 \\
 \text{if} \\
 \eta_{1A}/\eta_{2A} &= r = \frac{[\varepsilon_{12}(\eta_{11} - \varepsilon_{11}) - (1 + \varepsilon_{11})(\eta_{12} - \varepsilon_{12})]}{[\varepsilon_{12}(\eta_{21} - \varepsilon_{21}) - (1 + \varepsilon_{21})(\eta_{22} - \varepsilon_{22})]}.
 \end{aligned} \quad \dots 16$$

Table 5

**Ratio of percentage revenue gains in two markets  
from generic promotion**

Supply elasticities	Demand elasticities		
	Base	Base x2	Base x4
....(i) $\eta_{1A} = 1; \eta_{2A} = 3....$			
Base	0.696	0.699	0.701
Base x2	0.630	0.633	0.636
Base x4	0.551	0.554	0.557
.... (ii) $\eta_{1A} = 1.5; \eta_{2A} = 1.5 ....$			
Base	1.006	0.989	0.977
Base x2	1.006	0.986	0.967
Base x4	1.006	0.986	0.962
.... (iii) $\eta_{1A} = 3; \eta_{2A} = 1....$			
Base	1.574	1.517	1.475
Base x2	1.748	1.670	1.600
Base x4	1.991	1.902	1.802

**Note:** Base demand elasticities are  $\eta_{11} = -0.6, \eta_{12} = 0.4, \eta_{22} = -0.4$  and  $\eta_{21} = 0.2$ . Base supply elasticities are  $\epsilon_{11} = 0.5, \epsilon_{12} = -0.3, \epsilon_{22} = 0.4$  and  $\epsilon_{21} = -0.15$ . The ratio is calculated as the percentage revenue gain in market 1 divided by the percentage revenue gain in market 2.

Values of  $r$  for various combinations of values of partial demand and supply elasticities are shown in Table 6. Focus, for example, on the case where the supply elasticities are at their base values and the demand elasticities are four times their base values. Then the value of  $r$  at which  $G(R_1, A)$  is zero is -0.73. It is important to note that  $GR_1$  would be zero irrespective of whether it is  $\eta_{1A}$  or  $\eta_{2A}$  that is negative. A negative value for  $\eta_{2A}$ , together with cross-commodity effects, can mean that there is a negative impact on revenue from commodity 1 despite its having a positive direct (i.e. own partial) response to advertising expenditure.

Can the impact of promotion on the revenue earned from commodity 1 be negative when both  $\eta_{1A}$  and  $\eta_{2A}$  are positive? The answer is 'yes' and it can be verified by deriving the critical value of  $\eta_{1A}$  (denote it  $\eta_{1A}^*$ ) at which  $G(R_1, A) = 0$ , assuming  $\eta_{2A}$  is positive, and then deriving the conditions under which  $\eta_{1A}^* > 0$ . The result is that:

$$\eta_{1A}^* > 0 \text{ if } \eta_{11} > [\eta_{12}(1 + \varepsilon_{11})/\varepsilon_{12}] - 1. \quad \dots 17$$

For example, if  $\eta_{12} = 0.4$ ,  $\varepsilon_{11} = .5$  and  $\varepsilon_{12} = -0.3$ , then  $\eta_{11}$  needs to be greater than 3.0 in absolute value. This does seem to be an unlikely combination of elasticities (i.e.  $\eta_{11}$  is quite elastic and  $\eta_{12}$  is quite inelastic) but it would be possible (according to the homogeneity condition of demand theory) if the income elasticity of demand for commodity 1 was sufficiently large and positive.

These results are sufficient to show that a positive direct response of the demand for a commodity with respect to promotional expenditure is insufficient reason for concluding that the revenue earned from that commodity will increase if promotional expenditure is increased. Too, generic promotion may result in quite uneven revenue impacts depending on underlying elasticity relationships.

### Some Strengths and Weaknesses of Equilibrium Displacement Modelling

As for any procedure used in analytical work in economics, equilibrium displacement modelling has strengths and weaknesses and the fact that I set one of the objectives in this paper as encouraging greater use of the procedure reflects my belief about the balance of strengths and weaknesses.

Table 6

**Ratios of partial demand responses to generic promotion  
that result in zero revenue increase in market 1**

Supply elasticities	Demand elasticities			
	Base	Base x2	Base x3	Base x4
Base	-0.66	-0.70	-0.72	-0.73
Base x2	-0.50	-0.53	-0.55	-0.57
Base x3	-0.40	-0.43	-0.45	-0.47
Base x4	-0.33	-0.35	-0.38	-0.39

**Note:** Base demand elasticities are  $\eta_{11} = -0.6$ ,  $\eta_{12} = 0.4$ ,  $\eta_{22} = -0.4$  and  $\eta_{21} = 0.2$  Base supply elasticities are  $\epsilon_{11} = 0.5$ ,  $\epsilon_{12} = -0.3$ ,  $\epsilon_{22} = 0.4$  and  $\epsilon_{21} = -0.15$ .

I believe there are two important strengths. The first is that headway can be made in measuring displacement effects in situations where there is neither the time nor research resources available to engage in econometric modelling. One can still make informal assessments of the effects provided one is prepared to make assumptions about elasticity values, perhaps undertaking sensitivity analysis in addition. The latter can be based on previous econometric work, constraints from economic theory, or both. Too, it needs to be remembered that even when there are sufficient time and resources to undertake econometric modelling, there will still be assumptions involved (including, importantly, assumptions about functional forms). This advantage of equilibrium displacement modelling would seem particularly relevant in the case of some developing countries where data for econometric modelling may be either unavailable or are not to be believed.

The second important strength is that one can readily determine the economic forces that determine the size of equilibrium displacements. For this reason equilibrium displacement modelling can be a useful adjunct to econometric modelling in that it can reveal the important parameters that need to be estimated. Without wishing to be too critical, I suspect that econometric modelling is sometimes undertaken too hastily in the sense that the researcher does not think through all the parameters that are required to address a specific policy issue.

One could ask, with respect to the particular applications given in this paper, how much better off we are from having worked through the analytics of the displacements. Most of the results produced were probably intuitively obvious (hence the choice of title for the paper) and certainly reinforced what has already been argued by policy analysts. Despite this, I believe it is always consoling to work through the analytics involved to prove the intuition is correct.

Although attention in this paper was concentrated on investigating the equilibrium displacement effects of a change in a single exogenous variable, changes in two or more exogenous variables can be modelled using the same procedures, with the proportionate change in each endogenous variable being the sum of products of elasticities and proportionate changes. For example, we could have analysed the revenue impacts of a simultaneous decline in imports and a shift in the demand and/or supply of commodity 2 using the equilibrium displacement model for Allaru.

Regarding the weaknesses, it has to be acknowledged that the results from equilibrium displacement modelling are approximations to changes in endogenous variables. The approximation will be more accurate the smaller are the percentage shifts in demand and supply being considered (see Alston and Wohlgenant 1990 for a report on testing the accuracy of the approximations). Of course, results from the use of an econometric model to study displacement effects are also approximations.

Because the procedures really amount to comparative static analysis, they suffer from the usual criticism that paths of adjustment are ignored. This could be overcome to some extent by repeated applications of the procedures for different lengths of run. Too, paths of adjustment are also ignored in much econometric modelling.

### **Summary and Conclusions**

There were two objectives in this paper. The first was to advocate the greater use of equilibrium displacement modelling in analytical work in the area of price and policy analysis. This was because quite 'rich' results can be obtained with a minimum of effort. Cross-market effects are readily accommodated and these can be important in many problem settings.

The procedures involved were demonstrated by reproducing some important results obtained by Buse (1958) and investigating, in a partial way, an issue important in contemporary debate about Australia's agricultural marketing arrangements, namely single-desk selling. That investigation reinforced the view that the benefits from single-desk selling may well be less than its costs.

## APPENDIX 1

Equilibrium conditions for the Buse model (see main text, page no. to go in later) require that

$$D_1(P_1, P_2, W) - D_1 = 0$$

$$S_1(P_1, P_2, X) - S_1 = 0$$

$$D_2(P_1, P_2, Y) - Q_2 = 0$$

$$S_2(P_1, P_2, Z) - Q_2 = 0$$

where the endogenous variables ( $P_2$ ,  $D_1$ ,  $S_1$  and  $Q_2$ ) are measured at their equilibrium values.

To investigate the equilibrium displacement effects of a change in  $P_1$ , totally differentiate with respect to  $P_1$  and rearrange to obtain:

$$(\partial D_1 / \partial P_2) dP_2 - dD_1 = -(\partial D_1 / \partial P_1) dP_1$$

$$(\partial S_1 / \partial P_2) dP_2 - dS_1 = -(\partial S_1 / \partial P_1) dP_1$$

$$(\partial D_2 / \partial P_2) dP_2 - dQ_2 = -(\partial D_2 / \partial P_1) dP_1$$

$$(\partial S_2 / \partial P_2) dP_2 - dQ_2 = -(\partial S_2 / \partial P_1) dP_1.$$

Replace  $dP_1$  with  $P_1 d \ln P_1$  etc. and divide the first of the resulting equations by  $D_1$ , the second by  $S_1$  and the third and fourth by  $Q_2$  to obtain:

$$\eta_{12} d \ln P_2 - d \ln D_1 = -\eta_{11} d \ln P_1$$

$$\varepsilon_{12} d \ln P_2 - d \ln S_1 = -\varepsilon_{11} d \ln P_1$$

$$\eta_{22} d \ln P_2 - d \ln Q_2 = -\eta_{21} d \ln P_1$$

$$\varepsilon_{22} d \ln P_2 - d \ln Q_2 = -\varepsilon_{21} d \ln P_1$$

where  $\eta_{ij}$  ( $\varepsilon_{ij}$ ) is the Marshallian price elasticity of demand (supply) of commodity  $i$  with respect to the price of commodity  $j$ .

Finally, divide throughout by  $d \ln P_1$  to obtain:

$$\eta_{12} G(P_2, P_1) - G(D_1, P_1) = -\eta_{11}$$

$$\varepsilon_{12} G(P_2, P_1) - G(S_1, P_1) = -\varepsilon_{11}$$

$$\eta_{22} G(P_2, P_1) - G(Q_2, P_1) = -\eta_{21}$$

$$\varepsilon_{22} G(P_2, P_1) - G(Q_2, P_1) = -\varepsilon_{21}$$

where (for example):

$$\begin{aligned}
 G(P_2, P_1) &= \frac{d \ln P_2}{d \ln P_1} \\
 &= (dP_2/P_2)/(dP_1/P_1) \\
 &= \text{general equilibrium point elasticity of } P_2 \text{ with respect to } P_1.
 \end{aligned}$$

We now have a system of four linear equations that can be solved for the four general equilibrium elasticities  $G(D_1, P_1)$ ,  $G(S_1, P_1)$ ,  $G(Q_2, P_1)$  and  $G(P_2, P_1)$ .

In matrix form the system is:

$$\begin{bmatrix} -1 & 0 & 0 & \eta_{12} \\ 0 & -1 & 0 & \varepsilon_{12} \\ 0 & 0 & -1 & \eta_{22} \\ 0 & 0 & -1 & \varepsilon_{22} \end{bmatrix} \begin{bmatrix} G(D_1, P_1) \\ G(S_1, P_1) \\ G(Q_2, P_1) \\ G(P_2, P_1) \end{bmatrix} = \begin{bmatrix} -\eta_{11} \\ -\varepsilon_{11} \\ -\eta_{21} \\ -\varepsilon_{21} \end{bmatrix} \dots S(1)$$

and the solutions for the general equilibrium elasticities can be found by successive application of Cramer's rule.

Buse was interested in  $G(D_1, P_1)$  and  $G(S_1, P_1)$  which he termed the total elasticities of demand and supply, respectively. The solutions to these are

$$G(D_1, P_1) = \eta_{11} + \eta_{12} (\varepsilon_{21} - \eta_{21}) / (\eta_{22} - \varepsilon_{22})$$

and

$$G(S_1, P_1) = \varepsilon_{11} + \varepsilon_{12} (\varepsilon_{21} - \eta_{21}) / (\eta_{22} - \varepsilon_{22}).$$

However, it is also the case that

$$G(P_2, P_1) = (\varepsilon_{21} - \eta_{21}) / (\eta_{22} - \varepsilon_{22})$$

and, hence, alternative expressions for the total elasticities of demand and supply are

$$G(D_1, P_1) = \eta_{11} + \eta_{12} G(P_2, P_1)$$

and

$$G(S_1, P_1) = \varepsilon_{11} + \varepsilon_{12} G(P_2, P_1). \quad \dots A(1)$$

These results are identical to those obtained by Buse using his explicit log-linear model. As indicated by Buse, the results extend to models involving more than two commodities.

A further result not covered by Buse is that

$$\begin{aligned} G(Q_2, P_1) &= (\varepsilon_{21} \eta_{22} - \varepsilon_{22} \eta_{21}) / (\eta_{22} - \varepsilon_{22}) \\ &= [(\varepsilon_{21} (\eta_{22} - \varepsilon_{22}) + \varepsilon_{22} (\varepsilon_{21} - \eta_{21})) / (\eta_{22} - \varepsilon_{22})] \\ &= \varepsilon_{21} + \varepsilon_{22} G(P_2, P_1). \end{aligned} \quad \dots A(2)$$

Alternatively,

$$\begin{aligned} G(Q_2, P_1) &= (\varepsilon_{21} \eta_{22} - \varepsilon_{22} \eta_{21}) / (\eta_{22} - \varepsilon_{22}) \\ &= [(\eta_{22} (-\varepsilon_{22} + \eta_{22}) + \eta_{22} (\varepsilon_{21} - \eta_{21})) / (\eta_{22} - \varepsilon_{22})] \\ &= \eta_{21} + \eta_{22} G(P_2, P_1). \end{aligned} \quad \dots A(3)$$

Using similar procedures, one can derive general equilibrium elasticities for each of the endogenous variables with respect to any of the exogenous variables. Rather than doing this for the Buse model where  $P_1$  is exogenous, it is useful to consider the case where both prices are endogenous. The matrix equation containing general equilibrium elasticities with respect to  $W$  (the demand shifter for commodity 1) is

$$\begin{bmatrix} -1 & 0 & \eta_{11} & \eta_{12} \\ -1 & 0 & \varepsilon_{11} & \varepsilon_{12} \\ 0 & -1 & \eta_{21} & \eta_{22} \\ 0 & -1 & \varepsilon_{21} & \varepsilon_{22} \end{bmatrix} \begin{bmatrix} G(Q_1, W) \\ G(Q_2, W) \\ G(P_1, W) \\ G(P_2, W) \end{bmatrix} = \begin{bmatrix} -\eta_{11} \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

where  $\eta_{11}$  is the partial elasticity of demand for commodity 1 with respect to  $W$ .

The solutions are

$$\begin{aligned} G(P_1, W) &= N_{1w} (\eta_{22} - \varepsilon_{22}) / \Delta 5 \\ G(P_2, W) &= N_{1w} (\varepsilon_{21} - \eta_{21}) / \Delta 5 \\ G(Q_1, W) &= N_{1w} [(\varepsilon_{11} \eta_{22} - \varepsilon_{12} \eta_{21}) - (\varepsilon_{11} \varepsilon_{22} - \varepsilon_{12} \varepsilon_{21})] / \Delta 5 \\ G(Q_2, W) &= N_{1w} (\varepsilon_{21} \eta_{22} - \varepsilon_{22} \eta_{21}) / \Delta 5 \end{aligned}$$

where  $\Delta 5$  is the determinant of the LHS matrix containing Marshallian elasticities.

The expression for  $G(Q_1, W)$  can be manipulated to show that

$$G(Q_1, W) = \varepsilon_{11} G(P_1, W) + \varepsilon_{12} G(P_2, W)$$

and, hence,

$$G(Q_1, W)/G(P_1, W) = \varepsilon_{11} + \varepsilon_{12} [G(P_2, W)/G(P_1, W)]. \quad \dots A(4)$$

Also the expression for  $G(Q_2, W)$  can be manipulated to obtain

$$G(Q_2, W) = \varepsilon_{22} G(P_2, W) + \varepsilon_{21} G(P_1, W)$$

and hence,

$$G(Q_2, W)/G(P_1, W) = \varepsilon_{21} + \varepsilon_{22} [G(P_2, W)/G(P_1, W)]. \quad \dots A(5)$$

Alternatively, it can be shown that

$$G(Q_2, W) = \eta_{22} G(P_2, W) + \eta_{21} G(P_1, W)$$

and hence,

$$G(Q_2, W)/G(P_1, W) = \eta_{21} + \eta_{22} [G(P_2, W)/G(P_1, W)]. \quad \dots A(6)$$

A point to note is the similarity between A(1) which is the Buse total supply elasticity for commodity 1 and A(4) which, in a sense, can be interpreted as a supply elasticity one step removed so-to-speak from the initial source of change. In the case of A(1), the change in the price of  $P_1$  is exogenous, whereas in A(4),  $P_1$  changes because  $W$  changes. The same comparisons can be made between A(2) and A(5), and between A(3) and A(6).

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