# ADDING INPUT DEMANDS TO
# PARTIAL EQUILIBRIUM AGRICULTURAL
# TRADE MODELS

by

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*The views expressed in this paper do not necessarily reflect those of the Industries Assistance Commission.

## 1. INTRODUCTION[1]

There has been a recent proliferation of partial equilibrium multi commodity multi country agricultural commodity trade models (OECD [ 8 ] Tyers and Anderson [ 11 ], and the USDA [ 12 ]). On the production side, these models explain output responses as a function of the prices of outputs and at most a couple of variable input prices. No explicit production technology is specified. Rather output price elasticities with respect to output prices are cobbled together from available sources. These are then taken to provide a local approximation to the underlying output side of the production technology.

Because the models do not attempt to explain the demand for all variable inputs they are deficient from a policy perspective as they can not provide all the information of relevance to the policy debate. There is also the possibility that they may provide misleading insights on policy issues although this prospect seems slight.

In addition to the trade, world price, production and consumption information normally generated from partial equilibrium trade models, information is also required on the impact of policy changes on:

- national farm income;
- labour demand;
- partial equilibrium estimates of economic welfare;
- the budgetary cost of policies; and
- the unit price of fixed and quasi-fixed inputs, eg owner-operator "wage rates" and land prices.

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1 The theoretical work involved in this note was undertaken at the Agricultural Directorate, OECD, Paris. The application reported in this note was undertaken at the Industries Assistance Commission, Australia. This work has benefitted significantly through valuable contributions and suggestions made by Thomas Hertel. Susan Capalbo, Louis Mahe and Matt Harley. Paul Thomassin of Agriculture Canada provided data in a timely and helpful fashion.

For a model to generate this sort of information a knowledge of the response of variable input demand to price changes is required. In this note a methodology is proposed which enables this sort of information to be added to partial equilibrium trade models at very little additional cost.[2]

In the following section the proposed methodology is outlined while Section 3 provides a worked example of the methodology.

## 2. THE METHODOLOGY

A local approximation to the profit maximising opportunities available to a producer who produces (m) outputs jointly using (n) variable inputs can be represented by a $(m+n)^2$ matrix of price elasticities of variable commodity supply/demand with respect to variable commodity prices. These elasticities can be split into 4 quadrants as depicted in Figure 1.

**FIGURE 1 : GROSS MATRIX OF PRICE ELASTICITIES OF VARIABLE COMMODITY SUPPLY/DEMAND WITH RESPECT TO VARIABLE COMMODITY PRICES**

| | m Output prices | n Input prices |
|---|---|---|
| m Output levels | $\eta_{ik}$ (m x m) | $\theta_{i\ell}$ (m x n) |
| n Input levels | $\delta_{jk}$ (n x m) | $\beta_{j\ell}$ (n x n) |

In the upper left hand quadrant the familiar own price elasticities of supply with respect to variable output prices are presented (ie the $\eta_{ik}$'s ). The majority of the supply elasticities contained in the partial equilibrium trade models are of this type.

2 Horridge and Pearce [13] modified Tyers and Anderson's model by including [illegible]-agricultural good. Unfortunately their interpretat[illegible] elasticities precludes the calculation of input effects of policy changes.

The upper right hand quadrant contains the elasticities $\theta_{i\ell}$ . These capture the impact on variable output level of movements in input prices. Typically, the existing partial equilibrium trade models contain a few of these elasticities - mainly livestock supply elasticities with respect to feed prices (OECD [ 8 ]).

Finally, the bottom two quadrants pick up the effects of output and input price movements on variable input demand, ie the matrices of elasticities $\delta_{jk}$ and $\beta_{j\ell}$ respectively.

When (m+n) is large and/or available data bases leave something to be desired, it is unlikely that econometric techniques could be used to isolate the required $(m+n)^2$ elasticities with any degree of precision. A methodology is therefore proposed which enables the $(m+n)^2$ elasticities to be constructed in a theoretically consistent manner using available information.

To derive the relevant formulae first denote the vector of (m + n) variable profit shares by;

$$\underset{(m \times 1)}{S_i} \quad \text{and} \quad \underset{(n \times 1)}{S_j}$$

where a typical element of $S_i$ is $P_i^p Q_i / \pi > 0$ and a typical element of $S_j$ is $W_j X_j / \pi < 0$ and where $\pi$ is variable profit.

Also denote the (n x m) matrix of compensated input demand elasticities with respect to output levels as $\lambda_{ji}$ , where a typical element of this matrix measures the percentage change in the compensated demand for input j with respect to a one per cent movement in the output of commodity i.

Denote the (n x n) matrix of elasticities of compensated input demand with respect to input prices as $\beta^{c}_{j\ell}$ , where a typical element of this matrix measures the percentage change in the compensated demand for input j with respect to a one per cent change in the price of input $\ell$ .

Following Hertel [2], the matrix of gross elasticities of input demand with respect to variable output prices is given by

$$\underset{(n \times m)}{\delta_{jk}} = \underset{(n \times m)}{\lambda_{jk}} \; \underset{(m \times m)}{\eta_{ik}} , \tag{1}$$

where $\lambda_{jk}$ is the matrix of elasticities of compensated demand for inputs with respect to output levels and is evaluated at optimal input levels.

Following Lau [ 5 ], output supply is assumed to be homogeneous of degree zero in variable commodity prices ie;

$$\underset{(m \times m)}{\eta_{ik}} \; \underset{(m \times 1)}{1_m} + \underset{(m \times n)}{\theta_{i\ell}} \; \underset{(n \times 1)}{1_n} = \underset{(m \times 1)}{0_m} , \tag{2}$$

where $1_m$ and $1_n$ are summing vectors and $0_m$ is a (m x 1) vector of zeros.

Next, assume that substitution possibilities between inputs and outputs are symmetric, ie:

$$\underset{(m \times n)}{\theta_{i\ell}} \; \text{diag} \; \underset{(n \times n)}{(S_j)^{-1}} = \text{diag} \; \underset{(m \times m)}{(S_i)^{-1}} \; \underset{(m \times n)}{\delta^{T}_{jk}} , \tag{3}$$

where diag $(S_i)^{-1}$ denotes the diagonal matrix with elements equal to the reciprocal of the elements in the $S_i$ vector and the superscript T denotes the transposition operation.

To derive the relevant formula, (1) is first substituted into the symmetry constraint (3), which gives:

$$\underset{(m \times n)}{\theta_{i\ell}} = \text{diag} \; \underset{(m \times m)}{(S_i)^{-1}} \; \underset{(m \times m)}{\eta^{T}_{ik}} \; \underset{(m \times n)}{\lambda^{T}_{jk}} \; \text{diag} \; \underset{(n \times n)}{S_j} . \tag{4}$$

Second, (4) is then substituted into the homogeneity constraint (2), which gives:

$$\underset{(m \times m)}{\eta_{ik}} \; \underset{(m \times 1)}{1_m} + \underset{(m \times m)}{\operatorname{diag}(S_i)^{-1}} \; \underset{(m \times m)}{\eta_{ik}^{T}} \; \underset{(m \times n)}{\lambda_{jk}^{T}} \; \underset{(n \times n)}{\operatorname{diag}(S_j)} \; \underset{(n \times 1)}{1_n} = \underset{(m \times 1)}{0_m} \; . \tag{5}$$

Equation set 5 contain m equations and can be solved for m unknowns. In this analysis the unknowns are chosen to be the own price elasticities of supply ie the diagonal elements of $\eta_{ik}$. This leaves $\frac{1}{2}(m^2-m)$ cross price elasticities to be specified; $(m + n)$ profit shares; and $(n \times m)$ compensated input demand elasticities with respect to output levels to be specified. Once these are specified, $\eta_{ik}$ can be fully determined by solving (5). Once $\eta_{ik}$ is determined, $\delta_{jk}$ follows from (1), $\theta_{i\ell}$ follows from (3), and $\beta_{j\ell}$ is determined (Hertel [3]) by:

$$\underset{(n \times n)}{\beta_{j\ell}} = \underset{(n \times n)}{\beta^{c}_{j\ell}} + \underset{(n \times m)}{\delta_{jk}} \; \underset{(m \times m)}{\eta_{ik}^{-1}} \; \underset{(m \times n)}{\theta_{i\ell}} \; . \tag{6}$$

In terms of the decomposition of the gross elasticities given in Figure 1, equation (6) enables the matrix of elasticities, $\beta_{j\ell}$, to be determined. The matrix of elasticities, $\delta_{jk}$, is determined by substituting (5) into equation (1), and $\theta_{i\ell}$ is determined by equation (3). Thus the equations that have been derived enable all of the $(m+n)^2$ elasticities given in Figure 1 to be derived in a theoretically consistent manner. In the following section this methodology is used to derive a set of elasticities for grain and livestock production in Canadian agriculture.

## 3. An Example

Canadian agriculture was assumed to consist of 3 industries - pig production, poultry production and a multi-product industry producing all other agricultural products. In this section the elasticities for the multi-product industry are calculated. This industry is assumed to produce 5 outputs using 10 inputs. Owner-operator labour is assumed to be the fixed factor of production. The outputs and variable inputs include:

| Outputs | Inputs |
| --- | --- |
| Milk | Compound Feed |
| Other Grazing Animals | Wheat |
| Grains | Coarse Grains |
| Sugar | Other Feed |
| Other | Fertilizer |
| | Other Materials |
| | Grazing Land |
| | Cropping Land |
| | Hired Labour |
| | Capital |

As outlined above, to implement the methodology the following information is required;

- $\frac{1}{2}(m^2-m)$ cross price elasticities of supply;
- $(n \times m)$ elasticities of compensated input demand with respect to output levels;
- $\frac{1}{2}(n^2-n)$ price elasticities of input demand with respect to input prices; and
- $(m+n)$ variable profit shares.

This data and their source are detailed in Appendix 1. Applying the data given in Appendix 1 to the formulae derived above givs the gross elasticities given in Table 1. In assessing these elasticities, account needs to be taken of the fact that they are medium term, five-year elasticities, in which production is assumed to be constrained only by the availability of the farmer's labour. With few inputs fixed, Sakai's [ 9 ] restrictions on a "normal" technology should hold. In particular, as noted in Hertel [3, p.10], the following restrictions characterise a "normal" technology:

$$\frac{\partial X_j}{\partial W_k} < \underline{0} \text{ for any } j,\, k$$

$$\frac{\partial Q_i}{\partial P_s} > \underline{0} \text{ for any } i,\, s$$

Gross substitution among inputs and outputs is ruled out

$$\frac{\partial X_j}{\partial P_s} > \underline{0} \text{ for any } j,\, s$$

$$\frac{\partial Q_s}{\partial W_j} < \underline{0} \text{ for any } j,\, s\ .$$

Regressive relationships between inputs and outputs are ruled out.

To understand why these restrictions arise consider why joint production arises. Joint production comes about when the cost of producing one commodity is affected by the level of production of another commodity. These cost effects are sometimes described as "economies of scope". They arise from two sources. First, when production is constrained by the presence of a fixed factor of production (in the current study the fixed factor is owner-operator labour) expansion of one commodity will use more of the fixed factor. With less fixed factors available for the production of the other commodities, their production will only be maintained if more variable inputs are used. Hence per unit costs of production of the alternative commodities will rise. If these sorts of "economies of scope" predominate then outputs are more likely to be gross substitutes for one another, ie cross price elasticities of supply will be negative.

In contrast, the second kind of "economies of scope" give rise to gross complementarity between outputs. In the second case, the expansion of one output lowers the cost of producing other commodities. For example, an expansion of dairy production would increase effluent output and this could lead to lower costs for cropping activities as less fertilizer would be used because the effluent could be spread as a fertilizer substitute. When these sorts of economies of scope predominate outputs will be gross complements for one another, ie cross price elasticities of supply will be positive.

Examining the derived elasticities given in Table 1 it can be seen that there are some minor violations of Sakai's restrictions on a normal technology. Some regressive relationships exist between inputs and outputs while some inputs are gross substitutes with one another.

The regressive relationships between inputs and outputs arise because of the existence of gross substitution amongst several outputs. In deriving the output supply elasticities, it was difficult to obtain a relatively large own price elasticity for grain crops without making milk a gross substitute for grain crops. When gross substitution exists a price increase of one commodity will not increase the output of all other commodities. Consequently, the price increase will lead to a contraction of the substitute outputs. The decline in these outputs will cause input use to fall. If this fall outweighs the input expansion caused by the own output increase, regressive relationships between inputs and outputs will arise. This is the case with price increases for milk and extensive grazing which lead to less cropping land being used because less crops are produced (Table 1). Similarly, a grain crop price rise reduces the output of milk and extensive grazing. This reduces the demand for land, some feeds, labour and capital.

Examining the input price elasticities with respect to input prices it can be seen that Sakai's restrictions on a normal technology are also violated in some cases. Here it can be seen from Table 3.6 that some inputs are gross substitutes for one another. This is particularly the case for feed inputs. To understand why this result occurs refer back to equation (6) in Section 2. This equation splits the gross elasticities of input demand into two components. The first term on the right hand side of equation (6) picks up the substitution effects between inputs while the second term on the right hand side of equation (6) picks up the expansion effect of moving input prices. In the case of feed the expansion effects are dominated by the substitution effects so that overall gross substitution prevails. Given the high substitution possibilities between feeds these violations of the restrictions are considered to be valid.

TABLE 1 GROSS PRICE ELASTICITIES OF SUPPLY AND INPUT DEMAND WITH RESPECT TO VARIABLE COMMODITY PRICES

(PRICES)

| | MILK | EXT/GRZ | GR/CROP | RICE | SUGAR | OTHER | COM/FD | WHT | C/G | OTH/FD | FERT | OTH/MA | LAND 1 | LAND 2 | LABOUR | CAPITAL | SUM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.4331 | 0.1032 | -0.3558 | 0.0000 | 0.0001 | 0.0064 | -0.0799 | 0.0010 | 0.0328 | -0.0837 | 0.0089 | -0.0241 | -0.0296 | 0.0325 | -0.0289 | 0.0141 | 0.0000 |
| GRZ | 0.0995 | 0.7619 | -0.1779 | 0.0000 | 0.0001 | 0.0064 | -0.1344 | 0.0001 | -0.0748 | -0.1297 | -0.0267 | -0.2056 | -0.0499 | 0.0160 | -0.0565 | -0.0986 | 0.0000 |
| ROP | -0.1930 | -0.1032 | 0.1709 | 0.0000 | -0.0005 | 0.0032 | 0.0450 | -0.0005 | -0.0009 | 0.0464 | -0.0023 | 0.0245 | 0.0169 | -0.0160 | 0.0151 | 0.0004 | 0.0000 |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| R | 0.0099 | 0.0103 | -0.0883 | 0.0000 | 0.4063 | 0.0635 | -0.0355 | 0.0002 | -0.0001 | -0.0355 | -0.0333 | -0.1034 | -0.0011 | -0.0317 | -0.1201 | -0.0405 | 0.0000 |
| R | 0.0099 | 0.0103 | 0.0089 | 0.0000 | 0.0010 | 1.6328 | -0.1291 | -0.0003 | -0.0048 | -0.1239 | -0.1058 | -0.4430 | -0.0011 | -0.1222 | -0.5257 | -0.2078 | 0.0000 |
| FD | 0.1914 | 0.3337 | -0.1928 | 0.0000 | 0.0008 | 0.1974 | -1.4010 | 0.0094 | 0.0616 | 0.5281 | -0.0448 | -0.0408 | 0.0428 | 0.1365 | -0.0893 | 0.2651 | 0.0000 |
| | -0.1846 | -0.0243 | 0.1496 | 0.0000 | -0.0003 | 0.0413 | 0.7221 | -1.8128 | 0.1070 | 0.4279 | -0.0324 | 0.0932 | 0.0842 | 0.1184 | 0.0020 | 0.3088 | 0.0000 |
| | -0.0743 | 0.1315 | 0.0425 | 0.0000 | 0.0000 | 0.0810 | 0.6785 | 0.0153 | -1.7212 | 0.3844 | -0.0376 | 0.0418 | 0.0691 | 0.1253 | -0.0262 | 0.2898 | 0.0000 |
| FD | 0.2238 | 0.3593 | -0.2215 | 0.0000 | 0.0009 | 0.2114 | 0.5892 | 0.0062 | 0.0389 | -1.4560 | -0.0457 | -0.0511 | 0.0395 | 0.1401 | -0.0970 | 0.2620 | 0.0000 |
| | -0.0314 | 0.0978 | 0.0145 | 0.0000 | 0.0011 | 0.2383 | -1.0660 | -0.0006 | -0.0050 | -0.0604 | -0.3632 | -0.0872 | 0.0687 | 0.1162 | -0.1887 | 0.2660 | 0.0000 |
| MA | 0.0240 | 0.2122 | -0.0437 | 0.0000 | 0.0010 | 0.2815 | -0.0170 | 0.0005 | 0.0016 | -0.0190 | -0.0246 | -0.8099 | 0.0590 | 0.1134 | -0.0377 | 0.2536 | 0.0000 |
| 1 | 0.2781 | 0.4859 | -0.2631 | 0.0000 | 0.0001 | 0.0069 | 0.1578 | 0.0043 | 0.0246 | 0.1389 | 0.1828 | 0.5565 | -0.4151 | -0.2937 | 0.0811 | -0.9349 | 0.0000 |
| 2 | -0.1640 | -0.0838 | 0.1447 | 0.0000 | 0.0016 | 0.3936 | 0.2916 | 0.0032 | 0.0240 | 0.2644 | 0.1660 | 0.5998 | -0.1578 | -0.5622 | 0.0143 | -0.9355 | 0.0000 |
| OR | 0.0833 | 0.1689 | -0.0777 | 0.0000 | 0.0034 | 0.9666 | -0.1074 | 0.0000 | -0.0029 | -0.1046 | -0.1540 | -0.1089 | 0.0249 | 0.0082 | -0.9211 | 0.2214 | 0.0000 |
| TAL | -0.0204 | 0.1474 | -0.0011 | 0.0000 | 0.0006 | 0.1906 | 0.1597 | 0.0024 | 0.0158 | 0.1415 | 0.1087 | 0.3676 | -0.1436 | -0.2675 | 0.1109 | -0.8126 | 0.0000 |

Turning to a discussion of the magnitude of the elasticities, the overall impression gained is that Canadian agriculture is generally not very responsive to variable price movements. Apart from "other agriculture", output supply elasticities are less than one. The elasticities are however significantly greater than those obtained from econometric techniques. Lopez [ 7 ], for example, obtained estimates of the own price elasticity of supply for crops and animal products of about .01 and .4 respectively.

Given the low value of the supply elasticities obtained in the current study it can be concluded that there are minimal economies of scope in Canadian agriculture. That is, few cost savings arise when one output is expanded. Thus, joint production in Canadian agriculture largely arises because outputs have to compete amongst each other for the limited supply of owner-operators labour.

In contrast to the other elasticities, input price elasticities with respect to input prices are far more price responsive. Feeds exhibit the strongest substitution between one another.

In terms of the production relationships among primary factors, the current study finds that land and capital are gross complements but land and labour and labour and capital are gross substitutes. As in the case of feed, these results are largely determined by the size of Capalbo's estimated substitution elasticities. They dominate the expansion effects implied by the assumed output supply elasticities and compensated input demand elasticities with respect to output levels.

In summary, the elasticities calculated in this study give rise to elasticities with similar overall properties to those obtained from econometric studies of Canadian agriculture. The elasticities imply production is relatively unresponsive to price movements and that there is very little interaction between outputs and inputs. Input use is however more price responsive to input price movements. The elasticities are constructed in a manner consistent with the belief that producers maximize profits. Under these circumstances it is concluded that the calculated elasticities provide a reasonable approximation of the profit maximizing opportunities available to farmers in the grains/grazing sector of Canadian agriculture.

## APPENDIX 1 : SOURCES OF DATA

To calculate the elasticities for the multi-product industry the following base data is required;

- $\frac{1}{2}(m^2-m)$ cross price elasticities of supply;
- $(n \times m)$ elasticities of compensated input demand with respect to output levels;
- $\frac{1}{2}(n^2-n)$ price elasticities of input demand with respect to input prices; and
- $(m+n)$ variable profit shares.

### - (m+n) Variable Profit Shares

The (m+n) profit shares were derived from the data base of an input/output model of Canadian agriculture [ 10 ]. Variable profit was defined as net income of farm operators plus net rental income. Input use valued at purchasers' prices was divided by variable profit to obtain the profit shares. Input shares are negative and the shares sum to one over both inputs and outputs.

### - (nxm) Elasticities of Compensated Input Demand with Respect to Output Levels

The database in Agricultural Canada's input/output model was used to obtain the (nxm) elasticities of compensated input demand with respect to output levels. Specifically these elasticities are approximated by:

$$\underset{(n \times m)}{\lambda_{jk}} = (\partial X_j^c / \partial Q_i)(Q_i / X_j) = \underset{(n \times m)}{\alpha X_{ji} / \sum_k X_{jk}} \qquad \begin{matrix} j=1, \ldots, n \\ i,k=1, \ldots, m \end{matrix} . \quad (7)$$

That is, the percentage change in the demand for the jth input due to a one per cent change in the output of the ith commodity is equal to a scalar, $\alpha$, times the share of the input consumed in the production of the ith commodity. The share data are scaled to incorporate in the elasticities diminishing returns to variable factors which should exist in the presence of a fixed factor. That is, in the presence of a fixed factor a proportional increase in all outputs should lead to a proportionately greater increase in variable input use. The scalars were obtained from the estimated profit function for the United States provided by Hertel [ 4 ]. They ranged from 1.08 for land up to 1.32 for labour and indicate that labour use intensifies as outputs are expanded, whereas the use of land declines relatively.

The elasticities of compensated input demand with respect to output levels are given in Table A1.

- ½ $(m^2-m)$ **Cross Price Elasticities of Supply**

The derivation of the ½ $(m^2-m)$ cross price elasticities of supply took account of the existing elasticities in the MTM model OECD [ 8 ] and available econometric evidence Lopez [7]. Initial values of the elasticities were chosen and these were altered having regard to the effects of the changes on the signs and magnitudes of the own price elasticities of supply. While there is obviously considerable scope to alter individual elasticities, the process of deriving the elasticities indicated there were definite bounds within which the elasticities had to be set if plausible elasticities were to be obtained. The elasticities finally settled upon are given in Table A2.

- ½ $(n^2-n)$ **Price Elasticities of Compensated Input Demand**

The ½ $(n^2-n)$ input price elasticities were derived by disaggregating the elasticities estimated by Capalbo [ 1 ]. Capalbo estimated various models for Canadian agriculture and the model chosen for this analysis was the specification which closely accords with that of the current study. This model provides estimates of the compensated input demand elasticities for 6 variable inputs with owner operator labour fixed. Her inputs include;

- feed
- fertilizer
- other materials
- land and building
- capital; and
- hired labour.

This input structure was disaggregated into the 10 available inputs specified in the MTM inputs model using the formula proposed by Fuss [ 2 ]. The disaggregated elasticities are giver in Table A3.

TABLE A 1 COMPENSATED INPUT DEMAND WITH RESPECT TO OUTPUTS

| | MILK | EXT/GRZ | GR/CRO | RICE | SUGAR | OTHER | SUM |
|---|---|---|---|---|---|---|---|
| COM/FD | 0.4379 | 0.4040 | 0.1992 | 0.0000 | 0.0018 | 0.1172 | 1.1600 |
| WHEAT | 0.0168 | 0.1032 | 1.0169 | 0.0000 | 0.0003 | 0.0228 | 1.1600 |
| C/G | 0.1101 | 0.2578 | 0.7446 | 0.0000 | 0.0008 | 0.0457 | 1.1600 |
| OTH/FD | 0.4772 | 0.4232 | 0.1321 | 0.0000 | 0.0019 | 0.1257 | 1.1600 |
| FERT | 0.1687 | 0.1884 | 0.6266 | 0.0000 | 0.0031 | 0.1432 | 1.1300 |
| OTH/MAT | 0.1981 | 0.3139 | 0.4761 | 0.0000 | 0.0025 | 0.1694 | 1.1600 |
| LAND 1 | 0.5116 | 0.5684 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0800 |
| LAND 2 | 0.0000 | 0.0000 | 0.8365 | 0.0000 | 0.0042 | 0.2392 | 1.0800 |
| LABOUR | 0.2486 | 0.2151 | 0.2599 | 0.0000 | 0.0071 | 0.5894 | 1.3200 |
| CAPITAL | 0.1758 | 0.2517 | 0.6169 | 0.0000 | 0.0018 | 0.1138 | 1.1600 |

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Source ; Ariculture Canada

A discription of all variables included in the tables is given in Table 3 .

TABLE A 2 ASSUMED CROSS PRICE ELASTICITIES OF SUPPLY AND CALCULATED OWN PRICE ELASTICITIES OF SUPPLY

| | MILK | EXT/GRZ | GR/CROP | RICE | SUGAR | OTHER |
|---|---|---|---|---|---|---|
| MILK | 0.4331 | 0.1032 | -0.3558 | 0.0000 | 0.0001 | 0.0064 |
| EXT/GRZ | 0.0995 | 0.7619 | -0.1779 | 0.0000 | 0.0001 | 0.0064 |
| GR/CROP | -0.1990 | -0.1032 | 0.1709 | 0.0000 | -0.0005 | 0.0032 |
| RICE | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| SUGAR | 0.0099 | 0.0103 | -0.0889 | 0.0000 | 0.4063 | 0.0635 |
| OTHER | 0.0099 | 0.0103 | 0.0089 | 0.0000 | 0.0016 | 1.6328 |

TABLE A 3 COMPENSATED PRICE ELASTICITIES OF INPUT DEMAND

| | COM/FD | WHEAT | C/G | OTH/FD | FERT | OTH/MAT | LAND 1 | LAND 2 | LABOUR | CAPITAL | SUM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COM/FD | -1.3055 | 0.0090 | 0.0630 | 0.6225 | -0.0250 | 0.1000 | 0.0727 | 0.1353 | 0.0050 | 0.3230 | 0.0000 |
| WHEAT | 0.6945 | -1.8123 | 0.1084 | 0.3984 | -0.0250 | 0.1000 | 0.0727 | 0.1353 | 0.0050 | 0.3230 | 0.0000 |
| C/G | 0.6945 | 0.0155 | -1.7194 | 0.3984 | -0.0250 | 0.1000 | 0.0727 | 0.1353 | 0.0050 | 0.3230 | 0.0000 |
| OTH/FD | 0.6945 | 0.0058 | 0.0403 | -1.3516 | -0.0250 | 0.1000 | 0.0727 | 0.1353 | 0.0050 | 0.3230 | 0.0000 |
| FERT | -0.0368 | -0.0005 | -0.0033 | -0.0330 | -0.3430 | 0.0040 | 0.0727 | 0.1353 | -0.1070 | 0.3117 | 0.0000 |
| OTH/MAT | 0.0416 | 0.0005 | 0.0038 | 0.0373 | 0.0011 | -0.6770 | 0.0727 | 0.1353 | 0.0680 | 0.3167 | 0.0000 |
| LAND 1 | 0.2850 | 0.0037 | 0.0259 | 0.2555 | 0.1934 | 0.6857 | -0.3716 | -0.3194 | 0.1280 | -0.8862 | 0.0000 |
| LAND 2 | 0.2850 | 0.0037 | 0.0259 | 0.2555 | 0.1934 | 0.6857 | -0.1716 | -0.5194 | 0.1280 | -0.8862 | 0.0000 |
| LABOUR | 0.0060 | 0.0001 | 0.0005 | 0.0054 | -0.0873 | 0.1967 | 0.0393 | 0.0731 | -0.5950 | 0.3612 | 0.0000 |
| CAPITAL | 0.1946 | 0.0025 | 0.0177 | 0.1744 | 0.1274 | 0.4590 | -0.1361 | -0.2534 | 0.1810 | -0.7670 | 0.0000 |

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COM/FD = Compound feed , WHEAT = Feed wheat ,C/G = Feed coarse grains , OTH/FD = All other feeds FERT =Fertilizer , OTH/MAT = All purchased materials excluding fertilizer and feeds , LAND 1 = Service flow from grazing land , LAND 2 = Service flow from cropping land , LABOUR = Hired labour , CAPITAL = Service flow from all capital items excluding land , SUM = Sum of elasticities across a row , MILK = All milk produced , EXT/GRZ = Production of beef & veal , wool and sheep meat , GR/CRO = Production of wheat , coarse grains , oilseeds and other grains , RICE = Rice production , SUGAR = Production of sugar , OTHER = Production of vegetables , fruit , tobacco and wine .

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(3) Hertel, Thomas W., "Applications of Duality and Flexible Functional Forms : The Case of the Multiproduct Firm", Research Bulletin 980, Purdue University, Agricultural Experiment Station, September 1984.

(4) Hertel, Thomas W., "An Aggregate Technology for Modelling U.S. Agricultural Policy", Purdue University, Mimeographed.

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(8) Organisation for Economic Cooperation and Development, "National Policies and Agricultural Trade", Paris 1987.

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(12) USDA, see, for example, Dixit, P., V. Ronnigan, J. Sullivan and J. Waino, (1987) Impact of Removal of Support to Agriculture in Developed Countries, International Trade Division, Economic Research Service USDA.

(13) Mark Horridge and David Pearce, "Modelling the Effects on Australia of Interventions in World Agricultural Trade", Impact Preliminary Working Paper OP-65, October 1988

# AUSTRALIAN AGRICULTURAL ECONOMICS SOCIETY
# 1989 ANNUAL CONFERENCE

Lincoln College
6-9 February 1989

Sponsored by Reserve Bank of New Zealand

## PROGRAMME

**TUESDAY 7 FEBRUARY**

| | |
|---|---|
| 8.30 - 9.00 pm | REGISTRATIONS |
| 9.00 - 10.30 am | OPENING PLENARY PAPER<br>Room 12<br>**Bruce Gardner**<br>University of Maryland<br>**"INTERNATIONAL CONSEQUENCES OF UNITED STATES AGRICULTURAL POLICIES"**<br><br>**Ivan Roberts**<br>Australian Bureau of Agricultural and Resource Economics<br><br>Discussion Opener |
| 10.30 - 10.45 am | Tea and Coffee |
| 10.45 - 12.30 pm | INVITED PAPERS (Two concurrent sessions)<br><br>(a) *Dairy Trade* - Room 1<br>**Steve Beare, Lora Domine and Murray Lembit**<br>Australian Bureau of Agricultural and Resource Economics<br>**"TRANS-TASMAN TRADE IN MANUFACTURED DAIRY PRODUCTS: A MATHEMATICAL PROGRAMMING MODEL OF IMPERFECT SECTORAL COMPETITION"**<br><br>**Gary Griffith, Ralph Lattimore and John Robbertson**<br>New South Wales Department of Agriculture, Lincoln College and Virginia Polytechnic and State University<br>**"CER AND AUSTRALIA-NEW ZEALAND DAIRY PRODUCTS TRADE"**<br><br>(b) *Stabilisation* - Room 2<br>**John Quiggin and Brian Fisher**<br>University of Sydney<br>**"GENERALISED UTILITY THEORIES - IMPLICATIONS FOR STABILISATION POLICY"**<br><br>**Rob Fraser, R.W.**<br>University of Western Australia<br>**"ON EVALUATING THE PRODUCER BENEFITS FROM PRICE STABILISATION"** |
| 12.30 - 1.30 pm | Lunch |
| 1.30 - 3.30 pm | CONTRIBUTED PAPERS A |
| 3.30 - 3.45 pm | Tea and Coffee |
| 3.45 - 5.00 pm | PRESIDENTIAL ADDRESS - Room 12 |
| 7.00 - 7.30 pm | Pre-Dinner Drinks, Oak Room |
| 7.30 pm | Conference Dinner, Lincoln Dining Room |

**WEDNESDAY 8 FEBRUARY**

| | |
|---|---|
| 8.30 - 10.30 am | CONTRIBUTED PAPERS B |
| 10.30 - 10.45 am | Tea and Coffee |
| 10.45 - 12.30 pm | PLENARY PAPERS<br>Room 12 |
| | **Tony Rayner**<br>Lincoln College<br>**"THE ROLE OF AGRICULTURAL POLICY IN NEW ZEALAND: PAST, PRESENT AND FUTURE"** |
| | **Will Martin**<br>Australian National University<br>**"RURAL POLICY: 1983 - 1988"** |
| | **Brian Easton**<br>Consultant<br>**"AGRICULTURAL POLICY: THE RATIONALE FOR ONE"** |
| 12.30 - 1.45 pm | Lunch |
| 1.45 - 3.30 pm | CONTRIBUTED PAPERS C |
| 3.30 - 4.00 pm | Tea and Coffee |
| 4.00 - 6.00 pm | ANNUAL GENERAL MEETING<br>Room 12 |
| 6.00 pm | Depart for Social Evening |

**THURSDAY 9 FEBRUARY**

| | |
|---|---|
| 8.30 - 10.30 am | CONTRIBUTED PAPERS D |
| 10.30 - 10.45 am | Tea and Coffee |
| 10.45 - 12.30 pm | INVITED PAPERS (Two concurrent sessions) |

(a) *Agricultural Research*
Room 1

**Jim Ryan and Jeff Davis**
Australian Centre for International Agricultural Research
**"ECONOMIC GROWTH, TECHNOLOGICAL CHANGE AND PRIORITY ASSESSMENT IN AGRICULTURAL RESEARCH"**

**Veronica Jardine**
Scobie Economic Research
**"CRISIS IN AGRICULTURAL R AND D IN NEW ZEALAND?"**

(b) *Macroeconomics*
Room 2

**Paul O'Mara**
Australian Bureau for Agricultural and Resource Economics
**"EXCHANGE RATES, INTEREST RATE AND AGRICULTURE: A MACROECONOMIC VIEW"**

**John Robertson and David Orden**
Virginia Polytechnic and State University
**"A VECTOR ERROR CORRECTION MODEL OF MONEY AND PRICE DYNAMICS IN NEW ZEALAND"**

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|---|---|
| 12.30 - 1.30 | Lunch |
| 1.30 - 3.15 pm | CLOSING PLENARY SESSION<br>Room 12 |

**Gordon Rausser and Foster W.E.**
University of California, Berkeley
**"POLITICAL PREFERENCE FUNCTIONS AND THE MARKET FOR PUBLIC POLICY REFORM"**

| | |
|---|---|
| 3.15 - 3.30 pm | CONFERENCE CLOSURE |
| 3.30 - 4.00 pm | Tea and Coffee |
| 4.00 - 6.00 pm | INCOMING COUNCIL MEETING |

## Selected and Contributed Papers, Session A
## Tuesday 7 February - 1.30 to 3.30 pm

### Session A-1, Room 1, Chairperson: Tony Zwart

Chiao, Y.S.
MAFCorp
and Scobie, G.M.
Scobie Economic Research

The Cost to Agriculture of Import Protection in New Zealand

Eveleens, W.M.; Reynolds, R.G. and Moore, W.
MAFCorp

Effects of Liberalisation on the Provision of Government Services to Agriculture

Sandrey, R. and Eveleens, W.
MAFCorp

New Livestock Industries: The Dynamics and Impacts of Government Policies

### Session A-2, Room 2, Chairperson: Carolyn Tanner

Hardaker, J. B.; Fleming, and Patten, H, Louise
University of New England

Issues in Food Policies in the South Pacific

Delforce, Julie
University of New England
University of Queensland

Expenditure Patterns of Smallholder Farm Households in Tonga: an Application of the Almost Ideal Demand System

Qian, Dong; Xiji, A; Drynan, R.G. and Longworth, John

Food Consumption Patterns of Urban Residents in China

### Session A-3, Room 3, Chairperson: Ralph Lattimore

McDougall, Robert and Sugden, Craig
Industries Assis. Comm.

Reforming Trans-Tasman Shipping: An International General Equilibrium Analysis

Dwyer, G.M. and Davidson, Brian
University of New England

A Trans-Tasman Trade in Market Milk - A Spatial Equilibrium Approach

Topp, V; Williamson, G.; Lembit, M. and Beare, S.
A.B.A.R.E. and Beare, S.

The Resource Costs of Blended Milk Pricing in Victoria

### Session A-4, Room 4, Chairperson: Anton Meister

Vidler, Peter
Duffy, ACT

An Analysis of Some Aspects of the Australian Domestic Raw Cotton Market, 1968-69 to 1985-86

Campbell, H. and Lindner, R.
University of Tas.

The Production of Fishing Effort and the Economic Performance of Licence Limitation Programs

Staniford, A.J.
Dept of Fisheries, S.A.

Licence Reduction and Gear Restriction Policies in Limited Entry Fisheries: A Bioeconomic Analysis

### Session A-5, Room 5, Chairperson: Roy Powell

Battese, George, E.; Colby, T.C. and Coelli, T.J.
University of New England

Estimation of Frontier Production Functions and the Technical Efficiencies of Indian Farms Using Panel Data from ICRISAT'S Village Level Studies

Belete, Abenet; Dillon, John, L. and Anderson, Frank, M.
University of New England

The Development of Agriculture in Ethiopia Following the 1975 Land Reform

Esparon, Nanette, M. and Sturgess, N.H.
University of Melbourne

Technical Efficiency of Rice Production in East and West Java, Indonesia

### Session A-6, Room 6, Chairperson: Gordon MacAulay

Brennan, D. and Lindner, R.
University of W.A.

The Long-term Peak Load Problem in Grain Storage: An Empirical Analysis

Pandey, Sushil
University of W.A.

Economics of Wild Oats Control: An Application of a Stochastic Dynamic Programming Model

Malcolm, W. and Edwards, R.
Melbourne University

Judging Crop Sequences for Crop Farm Management

## Selected and Contributed Papers, Session B
## Wednesday 8 February - 8.30 to 10.30 am

### Session B-1, Room 1, Chairperson: Basil Sharpe

| | | |
|---|---|---|
| Jakobsson, K.M. and Dragun, A.K.<br>La Trobe University | Hertzler, G.L; Lindner R.K. and Pandey, S.<br>University of W.A | Ghadim, Amir K., Abbadi and Pannell, D.J.<br>University of W.A. |
| The Economics of Species Preservation: Theory and Methodology | Public Policies for Pest Control: Toward an Analytical Framework | Weed Management in Crop-Pasture Rotations |

### Session B-2, Room 2, Chairperson: Ian Jarratt

| | | |
|---|---|---|
| Anaman, K.A.: Izac, A.M.N; and Fraser, K.I.<br>University of Queensland | Voon, T. and Edwards, G.<br>La Trobe University | Williams, Christine H; Longworth, John W. and Whan Ian F<br>University of Queensland |
| An Economic Evaluation of Dryland Pasture Improvement Strategies for Beef Cattle Production in Tropical Queensland | Returns to Research for Beef Carcase Quality Improvement in Australia | Pricing Efficiency at South East Queensland Cattle Auctions |

### Session B-3, Room 3, Chairperson: Sandra Martin

| | | |
|---|---|---|
| Connolly, G. and Guy, K.<br>ABARE | Griffith, G.R. and Duff, G.L.<br>N.S.W. Ag. & Fisheries | Negendank, O.<br>University of Otago |
| Tests of the Dynamics and Functional Form of Retail Demand for Clothing and Footwear in Western Europe | The Influence of Shortrun Price Variability on Sydney Pork Price Spreads: A Preliminary Analysis | Forecasting Systems for the Pork Industry - the Role of Producers |

### Session B-4, Room 4, Chairperson: Bob Townsley

| | | |
|---|---|---|
| Bennett, Jeff, W.<br>University of N.S.W. | Vidler, Peter<br>Duffy, ACT | Lawrence, Denis and Zeitsch, J.<br>Industries Assis. Com. |
| Wages Determination in the NSW Black Coal Industry | An Analysis of Trends in Queensland Raw Cotton Production, 1971-72 to 1985-87 | Production Flexibility Revisited |

### Session B-5, Room 5, Chairperson: Tim Yapp

| | |
|---|---|
| Wynen, Els and Kennedy, John<br>La Trobe University | Sappideen, B.<br>Soil Conservation Service, N.S.W. |
| Policy Options for Chemical Free Agriculture: an LP Approach Farmers | Economic Evaluation of the Yass Salinity Abatement Demonstration Project: A Methodological Framework |

### Session B-6, Room 6, Chairperson: John Longworth

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|---|---|---|
| Wright, Vic.<br>University of New England | Wan, Guang Hua; Griffiths, W.E. and Anderson, J.R.<br>University of New England | Woodford, Keith<br>Queensland Ag. College |
| Agribusiness Management and Farm Management: Some Parallels and Their Implications | Estimation of Marginal Risks With Seemingly Unrelated Regression and Panel Data | Risk Management in Farming and Some Implications for Agricultural Education |

## Selected and Contributed Papers, Session C
## Wednesday 8 February - 1.45 to 3.30 pm

### Session C-1, Room 1, Chairperson: John Mullen

| | | |
|---|---|---|
| Vidler, Peter and Davidson, Brian<br>Duffy, ACT | Kennedy, John and Godden, David<br>La Trobe University and NSW Dept of Agriculture | Godden, David<br>Dept. of Ag., N.S.W. |
| The Identification of Research Issues in the Australian Cotton Industry | The Value of Rights in New Plant Varieties | Induced Institutional Innovation: Plant Variety Rights, Patents, Genetic Engineering and All That |

### Session C-2, Room 2, Chairperson: Anthony Chisholm

| | | |
|---|---|---|
| Johnson, R.W.<br>Massey University | Anderson, K.<br>University of Adelaide | Vanzetti, David and Kennedy, John |
| The Real Rate of Exchange Revisited: Reflections on Policies Encouraging International Competitiveness | Rent Seeking and Price Distorting Policies in Rich and Poor Countries | Strategic Trade Policy With Competitive Storage |

### Session C-3, Room 3, Chairperson: Tony Rayner

| | | |
|---|---|---|
| Corra, G.; Dickson A. and Teal, F.<br>A.B.A.R.E. | Jarratt, Ian S. and Longworth, John<br>University of Queensland | SriRamaratnam, S.<br>MAFCorp |
| Why has the Supply of Beef in Japan Grown so Rapidly? | Premiums and Discounts for Brands of Imported Beef in Japan | Implications of Changes in Access to Japanese Beef Markets for New Zealand Trade |

### Session C-4, Room 4, Chairperson: Garry Griffith

| | | |
|---|---|---|
| Nuthall, P.L.<br>Lincoln College | Wheatstone, Margaret<br>Lincoln College | Chiao, Y.S. and Doyle, C.J.<br>MAFCorp and AFRC IGAP |
| Farm Management by Computer - Prospects and Possibilities | Microdynamics of Farm Adjustment | The Effects of Market Structure on the Distribution of Research Gains in the NZ Sheepmeat Industry |

### Session C-5, Room 5, Chairperson: Ron Sandrey

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|---|---|---|
| Zeitsch, John<br>Industries Assis. Comm. | Bouis, H.E.<br>Int. Food Policy Res. Inst. | Bewley, R. and Elliott, G.<br>University of Sydney |
| Adding Input Demands to partial Equilibrium Agricultural Trade Models | A Food Demand System Based on Demand for Characteristics: If There is Curvative in the Slutsky Matrix, What do the Curves Look Like and Why? | The Rejection of Homogeneity in Demand and Supply Analysis An Explanation and Solution |

### Session C-6, Room 6, Chairperson: Brian Hardaker

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|---|---|---|
| Soe, Tin and Fisher, Brian<br>University of Sydney | Chandra, S.<br>AIDAB | Enjiang, C.<br>University of Melbourne |
| Burmese Rice Price Policies: An Economic Analysis of Developments Since Independence | Australian Aid Experience in the Livestock Sector of the Less Developed Countries | Housing Expenditure and Chinese Rural Development - Preliminary Results of a Survey in Jiangsu Province |

## Selected and Contributed Papers, Session D
## Thursday 9 February - 9.30 to 10.30 am

**Session D-1, Room 1, Chairperson: Robin Johnson**

| | | |
|---|---|---|
| Powell, Roy<br>University of New England<br>Hite, James; Hendry, Mark<br>Clemson Uni. Sth Carolina | Reynolds, R.G.; Chiao, Y.S.<br>and Robinson, B.R.<br>MAFCorp | Chisholm, Tony<br>La Trobe University |
| Rural Regional Stabilisation: A Problem and Some Policy Options | Macroeconomic Policies and Agricultural Sector Responses | Capital Income and Capital Gains Taxation in Agriculture and Forestry |

**Session D-2, Room 2, Chairperson: Gerald Frengley**

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|---|---|---|
| Galapitage, D.C.<br>La Trobe University | Yapp, T.P. and Connell, L.J.<br>Soil Conservation Service, N.S.W. | Chewings, R.A.<br>Soil Conservation Service N.S.W. |
| Alternative Management Policies for Mountain Ash (Eucalyptus Regnans R Muell) in Victoria | A Review of Factors Influencing the Adoption of Conservation Tillage | Economic Evaluation of the Gobondery Soil Conservation Project |

**Session D-3, Room 3, Chairperson: Tony Zwart**

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|---|---|---|
| Angel, C.; Beare, S.<br>and Zwart, A.<br>ABARE and Lincoln College | Martin, W.<br>ABARE | Mullen, John D.<br>Dept. of Ag., N.S.W.<br>Alston, J.M.<br>University of California, Davis<br>and Wohlgenant, M.K.<br>N. Caroline State University |
| Product Characteristics and Arbitrage in the Australian and NZ Wool Market | Implications of China's Foreign Exchange System for the Wool Market | Demand Parameters in the Wool Processing Industry |

**Session D-4, Room 4, Chairperson: Peter Nuthall**

| | | |
|---|---|---|
| Vishwakarma, Keshav<br>La Trobe University | Wang, K.Mc.; Richmond, G.S.;<br>Hacker, R.B.; Hertzler, G.<br>and Lindner, B.K.<br>University of W.A. | Macaulay, T.G.;<br>Thomas, W.C. and<br>Musgrave, W.F.<br>University of New England<br>and University of Alaska |
| Optimization Over Time for Agriculture and Resource Management | Grazing Management Decision-making in the Pastoral Zone of Western Australia: an Application Using Control Theory | Policy Response Functions in Spatial Trading Systems |

**Session D-5, Room 5, Chairperson: Bob Lindner**

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|---|---|
| Deng, Gang<br>La Trobe University | Gyles, Amanda; Hardaker, Brian;<br>Kami Viliami and Speijer, Paul<br>University of New England |
| The Role of Books and Agricultural Development in Traditional China Classics | Keeping Research Relevant: Experiences with On-Farm Trials in Tonga |