SIMULTANEITY IN THE DETERMINATION OF ASSISTANCE TO AGRICULTURE: REVISITED

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ABSTRACT

Earlier attempts to test the relationship between the level of assistance and industry variables as hypothesized by Anderson have been inconclusive with the exception of a strong apparent link between industry value added and the level of assistance. While this finding might be criticized as a tautology , a thorough review of the logic of the argument provides the basis for refutation of this proposition. The paper reports upon testing of the Anderson hypothesis using econometric techniques. Interesting empirical results are shown with two stage least squares estimation of a non-linear simultaneous system of equations using cross-sectional data and simultaneous equations representing assistance and industry value added.

Introduction

The goal of this research is to investigate the economic factors associated with different levels of assistance to Australian agricultural industries. Its focus has its origin in the work of Anderson (1978) which has led to two previous conference papers by MacAulay, et al. (1985 and 1988). In the first paper, using data prepared in part by the Industries Assistance Commission (1983) on assistance to agriculture, MacAulay, Musgrave, Thomas and Burge (1985) attempted to apply ordinary least squares regression analysis in an effort to test the hypotheses proposed by Anderson. A linear equation was estimated which gave some support to Anderson's work. MacAulay, Thomas and Musgrave returned to econometric estimation of government assistance to agriculture in 1988. An attempt was made to model the simultaneity between assistance given to industries and the value added by these industries. Problems were evident in attempting to estimate the non-linear and simultaneous model based on time-series cross-sectional data. Thus, the approach adopted was to present pooled regressions without consideration of the simultaneity. A major concern was the possibility that the strong apparent link between industry value added and the level of assistance was the consequence of an arithmetic artifact. In this third paper a revision of that work is reported, the nature of the functional form is re-examined, and the simultaneity of the relationship between assistance and the value added is taken into account.[1]

Background

To economists, topics such as markets and individual utility functions are basic to the discipline. It is not surprising that they use these concepts in trying to explain better policy making and its implementation. Anderson (1979) and others have suggested that policy outcomes depend on a bargaining process within which interest groups and politicians attempt to maximize their individual utility functions. Empirical verification of this proposition remains uncertain, however. As noted in MacAulay et al. (1985) '... there appears to be very few studies that have attempted to examine the factors that generate or lead to different levels of assistance to the various industries in agriculture.' Quiggin (1987) contends that no empirical studies have been conclusive regarding this point.

Anderson (1978) provides a conceptual framework which can be used empirically to test this proposition. As noted in MacAulay et al. (1988), these hypotheses imply that more assistance will be provided for an industry:

1. the more labour intensive the industry, especially the more farm-family labour intensive;
2. the smaller the value-added share of output;

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[1] The assistance of Bill Griffiths in guidance on the development of the econometric estimates for this paper is gratefully acknowledged.

3. the more lobbying support the industry gets from associated industries and State governments;

4. the fewer farmers in the industry;

5. the more positively skewed the distribution of the output among farms,

6. the more the industry is organised for reasons other than lobbying;

7. the more the industry is declining;

8. the more covert and the less government outlay is involved in the assistance instrument available; and

9. the more marginal the electorates in which the industry is located

Attempts in MacAulay et al. (1985) to verify these hypotheses have led to the following observation: '...as with all econometric estimation it is very difficult to be sure that the rationale proposed for a certain set of results is in any sense unique to those results. All that can be said is that the results obtained do not imply rejection of any of the hypotheses tested. Systematic patterns can be observed and the suggested economic reasons found to support some of the differences in effective assistance.'

In MacAulay et al. (1988) the conclusion was reached that, with the exception of one factor, nothing conclusive could be found in empirically testing Anderson's hypotheses using basic data calculated by the Industries Assistance Commission. A significant point was reached, however, using graphic analysis and ordinary least squares estimation. It appeared that '... differences in the value added share of output between industries provides a major explanation as to why different rates of assistance are provided to different industries' (MacAulay et al. 1988).

Relationship Between Assistance and Value Added Share of Output

Anderson (1978) has mathematically shown that the smaller the value added share of output the larger will be a change in net income following a given change in product or input prices. Thus, he argued, that the smaller the value added share of output the higher would be the assistance to an industry because of the proportionally greater benefit and therefore the greater the incentive for an industry to seek assistance. This implies that industries with small value added shares of output receive a share of government assistance well beyond their relative contribution to the economy and will attract resources that might be more efficiently allocated to lower or non-assisted industries in the absence of assistance (Haynes 1985). In this section of the paper, a more thorough definition of the interrelationship between assistance and value added share of output will be developed.

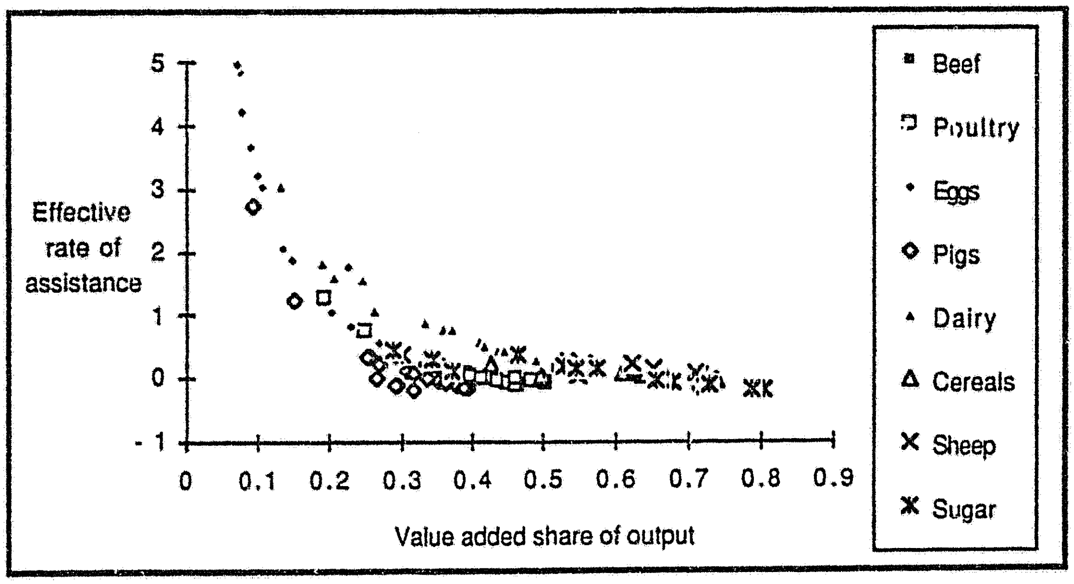
Assistance is commonly measured by the effective rate of assistance. It is defined as:

$$(1) \qquad g_i = \frac{AVA_i - UVA_i}{UVA_i}$$

where

g_i = effective rate of assistance for industry i,
AVA_i = assisted value added of industry i, and
UVA_i = unassisted value added of industry i.

Using graphic analysis it is apparent that assistance and the value added share of output are inversely related (Figure 1) and by taking the reciprocal of the value added share of output a linear relationship is obtained (Figure 2).



Source: An updated version of Figure 1 in MacAulay et al. (1988).
Figure 1. Effective assistance versus value added share of output for eight industries over the period 1970/71 to 1986/7.

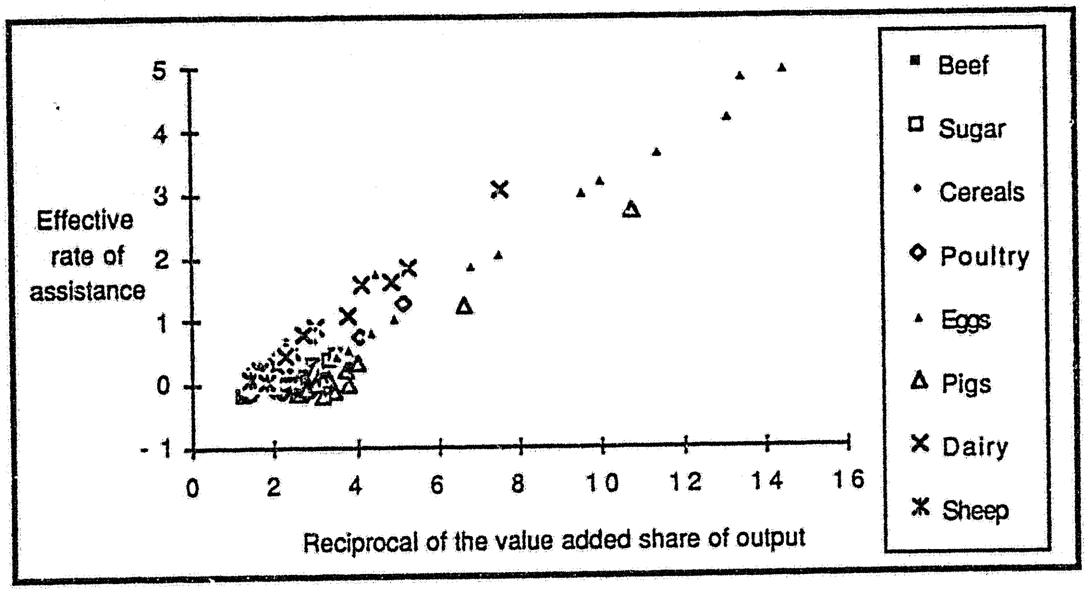


Figure 2. Effective assistance versus the reciprocal of the value added share of output for eight industries over the period 1970/71 to 1986/7.

The curvilinear nature of the relationship indicates that a reciprocal or quadratic form might be the appropriate functional form of the relationship. Further, if the reciprocal of the value added share of output (that is VO_i / UVA_i) is used an apparent linear relationship is observed.
Thus, based on this analysis the functional relationship between the effective rate of assistance and the value added share of output can be written as follows:

$$(2) \quad g_i^* = f^*\left(\frac{1}{\frac{UVA_i}{VO_i}}\right) = f^*\left(\frac{VO_i}{UVA_i}\right).$$

If a linear relationship is specified then

$$(3) \quad g_i^* = \alpha_i + \beta_i\left(\frac{VO_i}{UVA_i}\right),$$

where

g_i^* = effective rate of assistance (graphical relationship),

VO_i = value of output,

UVA_i = unassisted value added, and

α_i and β_i are parameters representing the intercept and slope for industry i.

What is obvious from equation (1) is that value added is included in the definition of the effective rate of assistance. As has been suggested, the above relationship could be the result of the way in which the effective rate of assistance is calculated. Empirical use of such a relationship may be questioned if one of these variables were regressed against the other because one is apparently a component of the other. In fact the relationship might be said to be a tautology.

The method of calculating unassisted value added in agriculture used by the Industries Assistance Commission has been to obtain estimates of the value of agricultural output at the farm gate for a range of agricultural commodities and deduct material inputs, depreciation, assistance to output and inputs and add tariffs on inputs (Table 1). Thus the unassisted value added was essentially calculated using the following relationship:

$$(4) \qquad UVA_i = VO_i - \left(\frac{\sum_{k=1}^{n} VI_{koi}}{VO_{oi}} \right) VO_i$$

$$(5) \qquad \qquad = VO_i \left(1 - \sum_{k=1}^{n} x_{koi}\right)$$

where industry i uses k different inputs with value VI_{ki} and a ratio of $\sum_{k=1}^{n} x_{koi}$ to total output in the base year (subscript o refers to the base year). Thus, in essence, the unassisted value added was based on a fixed ratio of inputs in relation to the value of output. Such ratios were used to calculate the value of material inputs and depreciation. Further, the value of output and inputs includes elements of assistance (output -- domestic price arrangements, export incentives and export inspection; input -- fertiliser subsidies, tariffs on materials and capital) were also deducted. Tariffs on inputs used in agriculture were matched to the tariff assistance given to the various industrial sectors supplying those inputs and the tariff assistance calculated accordingly. Assistance to output and assistance to inputs were based on the nature of the support given to various industries. Both, however, might be expected to be closely related to the value of outputs and inputs although only in a statistical sense not in a direct mathematical way. For the sake of this mathematical analysis, the assistance to output and assistance to inputs and also assistance from tariffs has been ignored.

Table 1

Illustrative Calculation of Effective Rate of Assistance for Wheat, 1986-87

Item	Value $m
Value of output (VO_i)	2,090.4
- Material inputs ($= x_i\ VO_i$) $x_i = 0.2949$	616.4
- Depreciation ($= d_i\ VO_i$) $d_i = 0.1680$	351.2
- Services ($= s_i\ V0_i$) $s_i = 0.0500$	104.5
- Assistance to output	249.7
- Assistance to inputs	0.0
+ Tariffs on inputs	62.8
= Unassisted value added (UVA_i)	831.2
+ Assistance to value adding factors	57.4
+ Assistance to output	249.7
+ Assistance to inputs	0.0
- Tariffs on inputs	62.8
= Assisted value added (AVA_i)	1075.5
Effective rate of assistance ($g_i = (AVA_i - UVA_i)/UVA_i$)	0.3

Source: Industries Assistance Commission, 1988, unpublished data.

Substituting equation (5) into equation (1) then:

$$(6) \qquad g_i = \frac{AVA_i - UVA_i}{VO_i \, (1 - \sum_{k=1}^{n} x_{koi})}$$

$$(7) \qquad = \frac{AS_i}{VO_i \, (1 - \sum_{k=1}^{n} x_{koi})}$$

$$(8) \qquad = f\left(\frac{AS_i}{VO_i}\right)$$

where

AS_i = assistance provided to industry i.

Now let assistance, AS_i, be *assumed to be* a linear function of the value of output so that:

$$(9) \qquad AS_i = \alpha'_i + \beta'_i \, VO_i \, ,$$

and substitute into (1) where assistance AS_i is the difference AVA_i - UVA_i, so that

$$(10) \qquad g_i = \frac{\alpha'_i}{UVA_i} + \beta'_i \left(\frac{VO_i}{UVA_i}\right),$$

Thus the calculated form of assistance will only be equivalent to the observed graphical relationship if assistance is a linear function of the value of output and the intercept α_i is equal to α'_i / UVA_i. It is easy to show graphically that equation (9) does not hold in relation to the observed data (Figure 3) and would not *a priori* be expected to hold because assistance is made up of a variety of components which are based on a wide variety of mechanisms which determine the level of assistance.

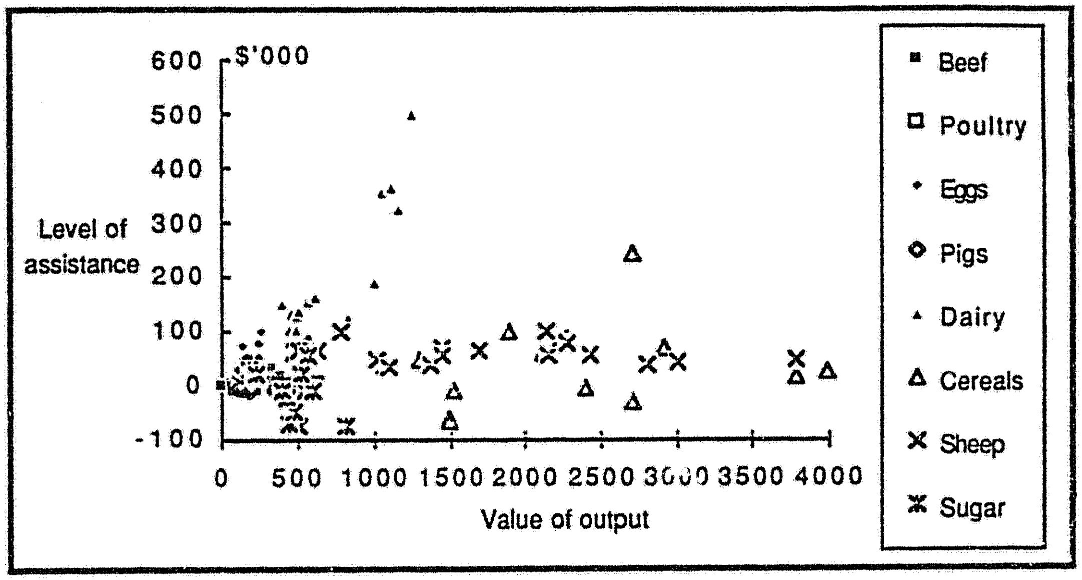


Figure 3 Level of assistance related to the value of output for eight industries over the period 1970/71 to 1986/7.

Thus, based on the definition of the effective rate of assistance and the method of calculation, then g_i (equation 8) is not functionally equivalent to g_i^* (equation 2). That is, the effective rate of assistance, as calculated, is not directly related to the value added share of output merely because of the way it is calculated. In fact, the relationship observed in Figure 1 and represented by equation (2) would seem to be a consequence of the gains to be had from assistance being greater the smaller the relative size of the value added contributed by the industry.

In the following section the parameters of the relationship between effective rate of assistance and the value added share of output will be estimated in the context of a simultaneous relationship between assistance and the unassisted value of output.

Econometric Model[2]

Based on the hypotheses of Anderson (1978) and the graphical and econometric analysis reported in MacAulay et al (1985) a simultaneous equation model was specified in MacAulay et al. (1988). The general context of this model is an attempt to explain why different industries have different rates of assistance. The behavioural assumption underlying the model is that of private vested interest groups demanding assistance for the various industries and of a supply of assistance

[2] The data section as presented was adopted almost entirely from MacAulay, Thomas and Musgrave (1988) p.3.

provided by government through regulations and various other devices (see Martin (1989) for a review of public choice theory). For this paper the model is reestimated using revised econometric methods in part to over come the problems of simultaneous estimation that were evident in the 1988 conference paper.

The model used follows from equation (2) where the effective rate of assistance for a particular industry is a reciprocal function of the value-added share of output and a set of industry shifter variables. The simultaneous nature of the model derives from the fact that production decisions will be made to adjust to changes in the level of assistance. These decisions are assumed to impact on the value of output from an industry. The unassisted value added for an industry is closely related to the value of output as indicated in equation (5) and will change in response to the level of assistance given the definition of unassisted value added. As assistance is increased it can be expected that the value added contribution of an industry will fall as the assistance will encourage the purchase of material inputs but will also impute additional value to the primary factors of production. Then, at the same time, a fall in the unassisted value added share of output will lead to increased incentives for interest groups to bargain for assistance. It is further hypothesized that the unassisted value added is also, in part, determined by the factor and product prices for the industry. In a simplified form the model is as follows with *a priori* sign information indicated in brackets:

$$(10) \quad EFFAST_i = f(\,(+)VO_i \,/\, UVA_i,\, Z_{ik}\,) + e_{ij}\,,$$

$$(11) \quad VO_i = f(\,(-)EFFAST_i,\, (-)PI_i,\, (+)PO_i,\, Y_{ik}\,) + v_{ij}\,.$$

$$(12) \quad UVA_i = f(\,(+)VO_i,\, (-)AS_i\,) + u_{ij}$$

$$(13) \quad AS = EFFAST_i * UVA_i$$

where

AS_i is the level of assistance for industry i;
$EFFAST_i$ is the effective rate of assistance for industry i;
VO_i is the value of output for industry i;
UVA_i is the unassisted value added for industry i;
Z_{ik} and Y_{ik} are the k-th other exogenous variables for indust y i;
PI_i is the input pnce for industry i;
PO_i is the output price for industry i; and,

e_{ij} and v_{ij} a set of normally distributed error terms.

The effective rate of assistance g_i may be re-written as:

$$EFFAST_i = (AVA_i - UVA_i)/UVA_i$$

The data used in this modelling effort represented time-series of the 17 years period, 1970/71 to 1986/87, and cross sections over eight industries. Data on assistance to was provided by the Industries Assistance Commission (1983, 1987, 1990) on the industries of sheep, beef, dairy, pigs, eggs, poultry, cereals and sugar. Data were available on industry output, material inputs, assisted value added, and unassisted value added. Data on value of agricultural output, farm costs and income, and various price indices were obtained from the Australian Bureau of Agricultural and Resource Economics (1989). A critical evaluation of the assumptions and problems in collecting the assistance data is provided by the Industries Assistance Commission (1983). Details of the derivation of the data used for this study are provided in MacAulay et al. (1985) and in Appendix A.

Given that the available data were a series of eight industry cross-sections over 17 years and that the graphic observations suggested common slopes for each of the industries on the value-added share of output variable, pooling the data and applying standard time-series, cross-sectional techniques appeared worthwhile (testing of slopes indicated this also). Subject to suitable data being available an attempt was made to match the Z variables with some of the hypotheses of Anderson (1978). An intercept dummy variable was included for each industry. The other shifter variables were: a measure of the skewness of the distribution of the value of output from firms in each of the eight industries and an approximate measure of labour intensity (employment in the industry divided by output).

In the case of equation (11) the input price variables used were common to each industry, thus slope dummy variables were needed. Industry specific output prices were used and also required slope dummy variable. Testing of the intercept variables indicated that they were not significantly different from zero so the intercept variables were discarded.

Generalised least squares was used for estimation. It was assumed that there would be correlations between the residual sets for each cross section because of the many common factors which affect the various agricultural industries. Further, it was assumed that there was a strong likelihood of heteroskedasticity within each cross-section because of the general growth in the size of the various agricultural industries. Because of the relatively short time period of 17 years, it was assumed that any estimates of autocorrelation within each time series would be too unreliable to make estimates of autocorrelation worthwhile. Thus generalised least squares was applied to the model with corrections for heteroskedasticity and correlation between the residuals of the cross-sections (Kmenta 1986).

The form of the model given above is simultaneous and non-linear in the endogenous variables. To deal with the simultaneous nature of the model the method of Kelejian (1971) was applied (also Amemyia 1974). This involved a modified two-stage least squares procedure. Kelejian was able to show that if the functional forms of the reduced form are not known, they may be approximated by polynomials. However, he also pointed out that the polynomials in the reduced forms had to be of the same degree if the two-stage least squares estimates were to be consistent. The second stage of the estimation was then to apply generalised least squares to time-series, cross-sectional data. However, in applying a two-stage least squares approach estimates of the variances were based on errors derived in the second stage using the actual values of the endogenous variables rather than the estimated values. Thus, the second stage of the process was to carry out second-stage estimates, using the instrumental variables estimates from the first stage, for each cross-section and then to use the errors from these estimates to obtain a variance-covariance matrix to be used in a final generalised least squares estimate using the estimated values for the right-hand-side endogenous variables.

The steps in the process were:

1) Estimate polynomial approximations for the reduced form equations (third order polynomials were used).

2a) Using the $\hat{Y}$ values from the reduced form estimates estimate the structural form for each of the eight cross-sections using 17 observations for each cross-section.

2b) Use the residuals derived from 2a) coefficients and actual Y values to derive a variance-covariance matrix (136 x 136).

2c) Apply generalised least squares to the structural form equations of the model using the variance-covariance matrix from 2b) and the $\hat{Y}$ values for the endogenous variables.

The equations were estimated using SHAZAM version 6.1 (White, Haun, Horsman and Wong 1988).

Results

The estimated results are presented in Table 2 and provide a very clear indication of the significance of the value-added share of output as a determinant of the effective rate of assistance. The strength of the relationship and the fact that few other variables appeared to be significant is surprising, but not inconsistent with the graphical evidence. In addition, the skewness and labour intensity variables gave signs consistent with the arguments of Anderson. The number of establishments variable was not significant and therefore deleted.

In the case of the estimated form of equation (2), the notion that increased assistance is consistent with lowering the value added for an industry, was also observed. This then provides some rather tentative evidence to suggest that there is a simultaneous interaction between assistance and the unassisted value added contributed by an industry.

Conclusions

The econometric work presented in this paper is a revision of the work in the 1988 paper of MacAulay et al. Because of estimation difficulties in the earlier paper, the simultaneou model was reformulated and reestimated. The extended non-linear system of equations would appear to give a satisfactory representation of the relationships between assistance and the value added share of output.

The relationship between value-added share of output and the effective rate of assistance to an industry can be quantitatively measured. Thus, in the political bargaining process, industries that have a low value added contribution to the economy receive relatively greater rat of assistance thus potentially diverting resources away from industries that contribute a larger value added share. While this follows from Anderson's (1978) work, it is also evident that other variables suggested by Anderson cannot be tested because of data limitations. It follows then, as indicated in MacAulay et al. (1988), that 'If the major part of the assistance provided to an industry goes to the purchase of more and/or higher priced inputs then the value-added share of output for that industry will be reduced. In facing a reduced share of the value added a sector finds it even more worthwhile to seek and lobby for assistance for the sector since each dollar of assistance gained contributes more significantly to the assisted value added of the industry.' This might be referred to as the assistance spiral or the assistance trap. To break out of this spiral, assistance needs to be provided in such a way that the value added share of output is increased rather than diminished with assistance. This might be achieved in a number of ways but encouragement of investment in value adding processes would seem to be an obvious path.

Table 2

Estimated Regression Results for Eight Industries and 1970/71 to 1986/87

Variable	Coefficient	Standard error error
Effective rate of assistance--EFFAST		
CONSTANT (sheep)	-0.29	0.069*
VO/UVA	0.24	0.037*
SKEW	-0.027	0.032
LABINT	0.0000021	0.00001
DUM2 (beef)	-0.043	0.061
DUM3 (dairy)	0.50	0.11*
DUM4 (pigs)	-0.37	1.77
DUM5 (eggs)	0.49	1.36
DUM6 (poultry)	-0.20	0.38
DUM7 (cereals)	-0.048	0.038
DUM8 (sugar)	-0.091	0.081
DEGGS	-2.03	5.38
R^2 adjusted (Buse) & SEE[a]	0.77	0.81
Value of output--VO		
CONSTANT	-213.44	38.81*
EFFAST	54.75	25.36*
PRICE (sheep)	8.52	0.63*
INDEXPI	1.62	0.49*
DPO2 (beef)	2.06	2.37
DPO3 (dairy)	-8.00	0.64*
DPO4 (pigs)	-6.41	0.77*
DPO5 (eggs)	-7.81	0.66*
DPO6 (poultry)	-6.63	0.55*
DPO7 (cereals)	5.89	3.15
DPO8 (sugar)	-6.04	0.60*
DEGGS	462.34	178.82*
R^2 adjusted (Buse) & SEE[a]	0.94	0.77
Unassisted value of output--UVA		
CONSTANT	25.26	15.39
OUTPUT	0.61	0.036*
ASSIST	-1.27	0.14*
DVO2 (beef)	-0.029	0.054
DVO3 (dairy)	-0.0069	0.049
DVO4 (pigs)	-0.56	0.047*
DVO5 (eggs)	-0.44	0.10*
DVO6 (poultry)	-0.59	0.14*
DVO7 (cereals)	-0.052	0.046
DVO8 (sugar)	-0.27	0.039*
DEGGS	-41.80	52.40
R^2 adjusted (Buse) & SEE[a]	0.96	0.54

[a]Buse R^2 is a weighted coefficient on the transformed values.

Note: A * is used to indicate that the coefficient is greater than twice the standard error.

If, as has been indicated in this paper, aspects of the policy process related to the assistance to agricultural industries can be represented in a mathematical way then this opens up the way of building in such processes into models to be used both for forecasting purposes and for assessing policy outcomes. Rausser (1987) indicated this possibility clearly in his analysis of the policy process.

References

Amemyia, T. (1974), 'The nonlinear two-stage least squares estimator', *Journal of Econometrics* 2(2), 105-110.

Anderson, K. (1978), 'On why rates of assistance differ between Australia's rural industries', *Australian Journal of Agricultural Economics* 22(2 and 3), 99-114.

Australian Bureau of Agricultural and Resource Economics (1989), *Commodity Statistical Bulletin*, Australian Government Publishing Service, Canberra.

Australian Bureau of Statistics (various issues), *Agricultural Sector: Structure of Operating Units*, Cat No 7102.0, Australian Government Publishing Service, Canberra.

Industries Assistance Commission (1983), *Assistance to Australian Agriculture*, Australian Government Publishing Service, Canberra.

______ (1987), *Assistance to Agricultural and Manufacturing Industries*, Australian Government Publishing Service, Canberra.

______ (1990), unpublished data.

Haynes, J. E., 'Rural assistance levels: the influence of policies and world price changes', *Australian Journal of Agricultural Economics* 29(1), 32-48.

Kelejian, H.H. (1971), 'Two-stage least squares and econometric systems linear in the parameters but nonlinear in the endogenous variables', *Journal of the American Statistical Association* 66(334), 373-374.

Kmenta, J. (1986), *Elements of Econometrics*, (2nd edn),Macmillan, New York.

MacAulay, T. G., Musgrave, W. F., Thomas, W. C. and Burge, B. T. (1985), 'Factors related to effective assistance to Australian agriculture in the context of an endogenous policy process', Paper presented to the Australian Agricultural Economics Society Conference, Armidale.

______, (1988), 'Simultaneity in the determination of assistance to agriculture', Paper presented to the Australian Agricultural Economics Society Conference, Melbourne.

Martin, W.J. (1989), Public choice theory and agricultural policy reform, Australian National University, unpublished manuscript.

Quiggin, J. (1987), 'Egoistic rationality and public choice: a critical review of theory and evidence', *Economic Record* 63(180),10-21.

Rausser, G.C. (1987), Political failure and reform of agricultural policy, Paper presented to the Australian Agricultural Economics Society Conference, Adelaide.

Sokal, R. and Rohlf, F. (1969), *Biometry*, Freeman, San Francisco.

White, K. J., Haun, S. A., Horsman, N. G., and Wong, S. D. (1988), *SHAZAM: The Econometrics Computer Program, User's Reference Manual, Version 6.1*, McGraw-Hill Book Company, New York.

Appendix A

Definitions of Variables and Data Sources

The information reported here applies to eight agricultural industries (sheep, beef cattle, dairy cattle, pigs, eggs, poultry meat, cereals and sugar for the period 1970-71 to 1986-87.

EFFAST = is the effective rate of assistance (Industries Assistance Commission 1983, 1987 and 1990).

INDEXPO = is index of agriculture product prices 1980-81=100 (Australian Bureau of Agricultural and Resource Economics 1989).

INDEXPI = is the index of farm price inputs, 1980-81=100 (Australian Bureau of Agricultural and Resource Economics 1989).

LABINT = is the ratio of employment to the value of output divided by the index of prices paid by farmers (Australian Bureau of Agricultural and Resource Economics 1989).

SKEW = is the skewness of the distribution of the value of output of agricultural establishments (Australian Bureau of Statistics, *Agricultural Sector: Structure of Operating Units*) and Sokal and Rohlf (1969) for the method of calculating the skewness of a categorised distribution.

V0/UVA = is the ratio of value of output to unassisted value added (Industries Assistance Commission 1983, 1987 and 1990).