SIMULTANEITY IN THE DETERMINATION OF ASSISTANCE TO AGRICULTURE

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ABSTRACT

An econometric model of the factors determining assistance to agriculture has been developed in previous work by the authors in which a number of the factors suggested by Anderson (1978) were shown to be significant when data on effective rates of assistance were used. In constructing the model the simultaneity between the assistance to agriculture and the level of income in agriculture was ignored. In this paper the original single equation model is substantially revised and a model devised to take account of the simultaneity between the assistance given to industries and the value added by these industries. In addition it was found that the value-added share of output was a highly significant factor in determining the level of assistance and that it had a reciprocal relationship to the level of assistance.

Introduction

Anderson (1978) posed the question: 'Why do some industries receive more assistance than others?' The basic thesis of his work was that economic factors could be used to explain the different levels of assistance but at that time there were not adequate data to support a detailed analysis of this question. He did attempt to use a limited number of observations to support his arguments. Subsequently data were prepared by the Industries Assistance Commission (1983) on assistance to agriculture and MacAulay, Musgrave, Thomas and Burge (1985) attempted to apply regression analysis to the data in an effort to test the hypotheses proposed by Anderson. In their paper a linear equation was estimated which gave some support to Anderson's hypotheses. In this paper a revision of this work is reported and the simultaneity between assistance and the value added for a sector taken into account. In addition the nature of the functional form previously used is re-examined.

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Anderson's Hypotheses

Underlying the work by Anderson is the proposition that a policy outcome depends on a bargaining process within which interest groups and politicians attempt to maximise their individual utility functions. This lead Anderson to consider both demand and supply factors which could affect the level of assistance to an industry.

On the demand side Anderson argued that by using a Jones-type trade model (Jones 1971, 1971, 1975) in which capital is industry specific and labour perfectly mobile in the short run, returns to labour and capital are raised more by a given increase in assistance the higher is labour's share of value added and the smaller is the value-added share of output. When capital is less mobile than labour the labour intensive industries gain more from assistance than the less labour intensive industries. Significant for the analysis in this paper is Anderson's hypothesis that assistance will be higher the lower the value-added share of output. This effect is due to the fact that the smaller is the value-added contribution of an industry to output then the larger will be the change in income from a given product or input price change. Similarly the effect of a given addition to the level of assistance will be greater the smaller the value-added share of output. A mathematical derivation of this result can be found in Anderson (1975, p. 114).

In addition, Anderson proposed a number of other demand-side factors as influencing the level of assistance given to an industry. The lobbying strength of input suppliers and output-using industries will affect the demand for assistance. However, there is a free-rider problem involved that affects the benefits and costs of lobbying. Thus, the smaller and more compact the industry the less the free-rider problem but the less the ability of an industry to collect funds for lobbying purposes. Another interacting factor proposed was the size of firm, with larger firms likely to gain more from a given level of assistance since they have a larger output. This would seem to imply that the more positively skewed is the distribution of firm sizes the larger the rate of assistance. The existence of an industry organisation was also proposed as likely to affect the cost of lobbying, particularly if the organisation was already in existence for another purpose.

On the supply side governments have the ability to change the rewards to economic activity by changes in laws, through taxes, and through providing subsidies, etc. For government to change the rewards of economic activity the benefits to the government in terms of gained votes and party contributions must exceed the losses. Thus, if an industry which contributed to campaign funds were allowed to decline economically, government will lose contributions to such funds so that assistance is likely to be provided to slow the decline of such an industry. A second factor on the supply side which was proposed by Anderson was whether or not assistance is overt or covert. In the case of tariffs there is no direct government expenditure incurred so that changes to the tariff structure are not seen as a government outlay but a government revenue. In this sense they are covert assistance for import-competing industries. For export industries the home

consumption price scheme provides a somewhat hidden means of assistance to the exporting industry, the cost of which is paid by domestic consumers. The marginality of electorates was also proposed by Anderson as a factor which influences assistance to industries.

To summarise, Anderson's hypotheses imply that more assistance will be provided for an industry as follows (MacAulay, et al. 1985):

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

Relationship Between Assistance and Other Variables

From the data on assistance to agricultural industries published by the Industries Assistance Commission (1983, 1987) the eight industries of sheep, beef, dairy, pigs, eggs, poultry, cereals and sugar were chosen. The choice was based on the availability of other supporting data for the analysis. The data represent time-series of cross-sections over the 14 years 1971/72 to 1984/85 and across the eight industries. The assistance data relate to industry output, material inputs, assisted value added, and unassisted value added. From these data the effective rate of assistance can be calculated. The effective rate of assistance measures the net assistance to an industry's value-adding activities. It is calculated as the assisted value added less the unassisted value added divided by the unassisted value added. A critical evaluation of the assumptions and problems of collecting the assistance data is provide by the Industries Assistance Commission (1983). Details of the derivation of the data used for this study are provided in MacAulay et al. (1985).

On occasion, graphical analysis of data can be insightful in gaining an understanding of the relationships involved in econometric studies. Presented in an appropriate way, and taking care not to ignore the possibility of multi-dimensional interactions, a graph can expose the dominant relationships in a set of data as well as the appropriate functional form.

The relationship between the effective rate of assistance and the value-added share of output is clearly shown in Figure 1. This supports Anderson's hypothesis of a negative relationship but what is surprising about this Figure is the curvature to the relationship. It is clear that different

industries have different relationships with a different curvature. Either a quadratic or reciprocal relationship between the effective rate of assistance and the value-added share of output would seem possible from this chart. The relationship would appear to be very strong, and as will become apparent later, dominates most of the other relationships.

In the hope of finding other graphical evidence to support Anderson's hypotheses, additional Figures were prepared. In general, from Figures 2 to 5 no other such clear-cut relationship is apparent. In Figure 2 there appears to be no relationship to the number of rural establishments (plotted on a logarithmic scale for visual purposes). The industries vary in their number of establishments but over time the numbers appear to change very little within an industry. The greater the skewness of an industry toward large output firms the greater the level of support was hypothesised by Andserson. In Figure 3 the skewness statistic (which is negative for a positive skewness) was calculated for the value of the output from agricultural enterprises. A difficulty with this data is that it is likely to be a poor proxy for management units. It is apparent that for some industries there is some variation of the rate of assistance with the skewness measure. The question of the degree of covertness of assistance was taken to be represented by the level of tariff protection on inputs which is 'negative' assistance for the agricultural industry concerned. Thus as the tariff protection for the input industry rises the level of assistance falls. Again, the graph in Figure 4 provides little in the way of a visual pattern for determining any relationship.

In Figure 5 the effective rate of assistance is plotted against employment per unit of output where output is measured in terms of an index derived by deflating the value of output by an output price. This becomes a very approximate measure of the intensity of labour use in an industry. From Figure 5 it is apparent that the egg industry has a considerable variation in its level of assistance but very little in its level of employment per unit of output while for other industries the reverse is true.

A number of other charts were examined in the process of the research for this paper but none provided any relationships as clear cut as that in Figure 1. It was therefore apparent that the value added-share of output was likely to play a very important role in explaining the rate of assistance provided to an industry.

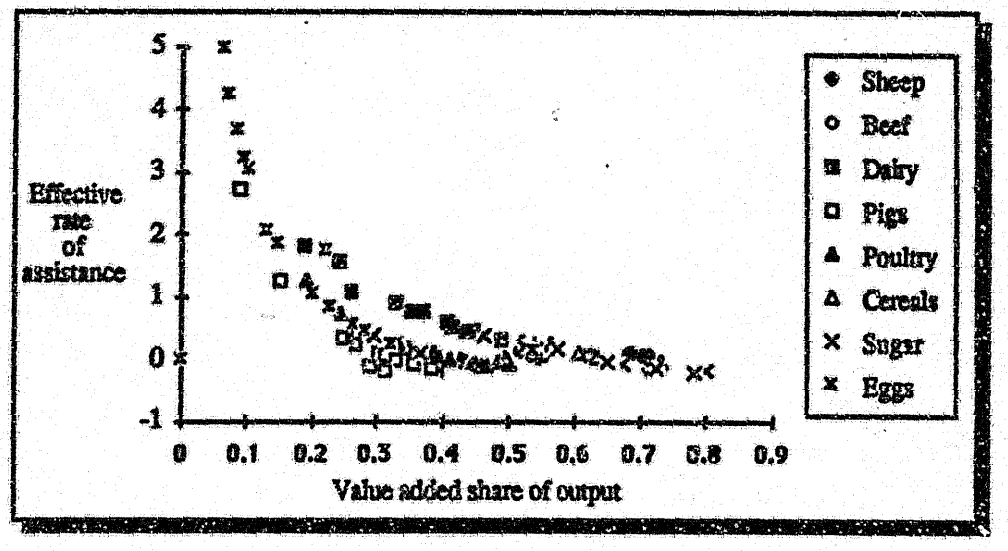

Figure 1. Effective assistance versus value added share of output for eight industries over the period 1970/71 to 1984/85.

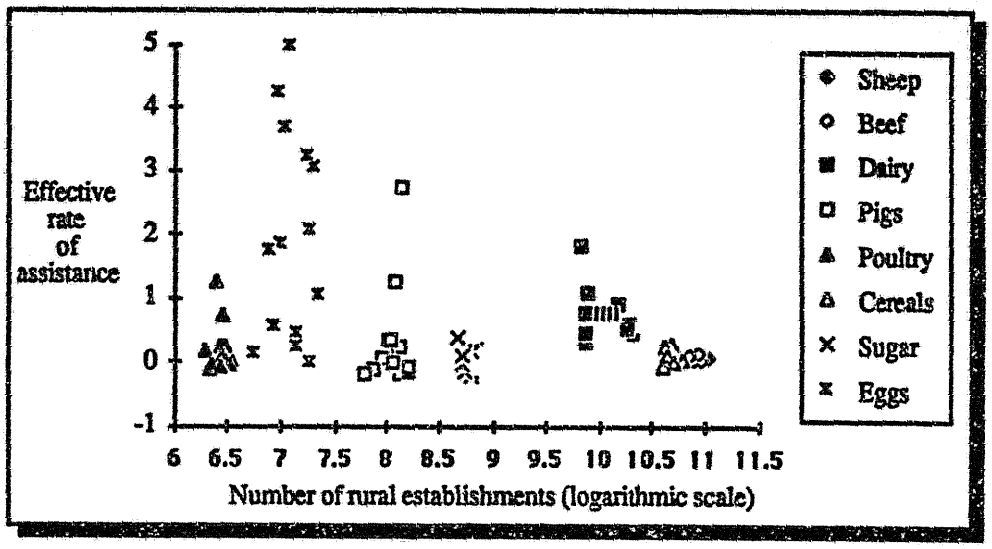

Figure 2 Effective rate of assistance versus the number of rural establishment over eight industries for the years 1971/72 to 1984/85.

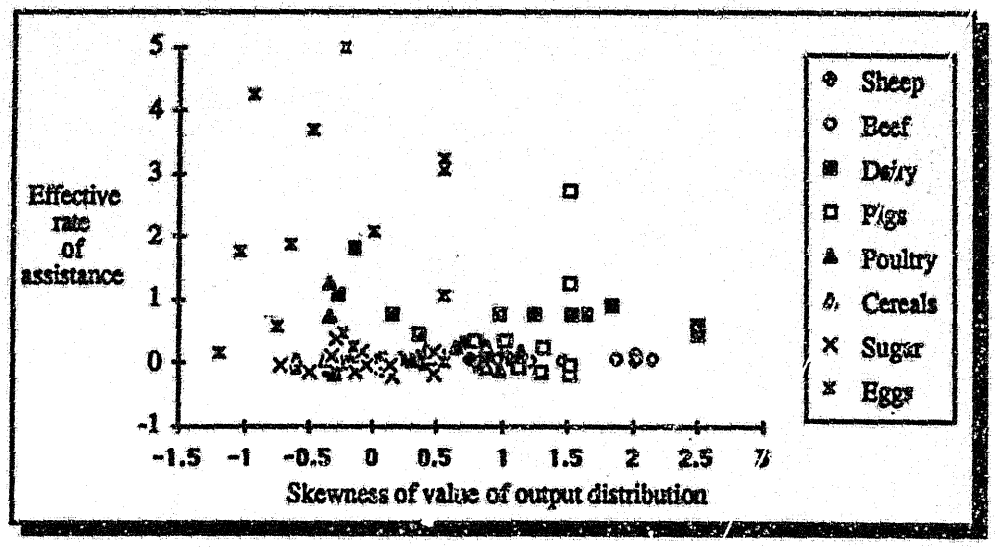

Figure 3 Effective rate of assistance versus the skewness of the value of output distribution for agricultural enterprises in eight industries over the period 1970/71 to 1984/85.

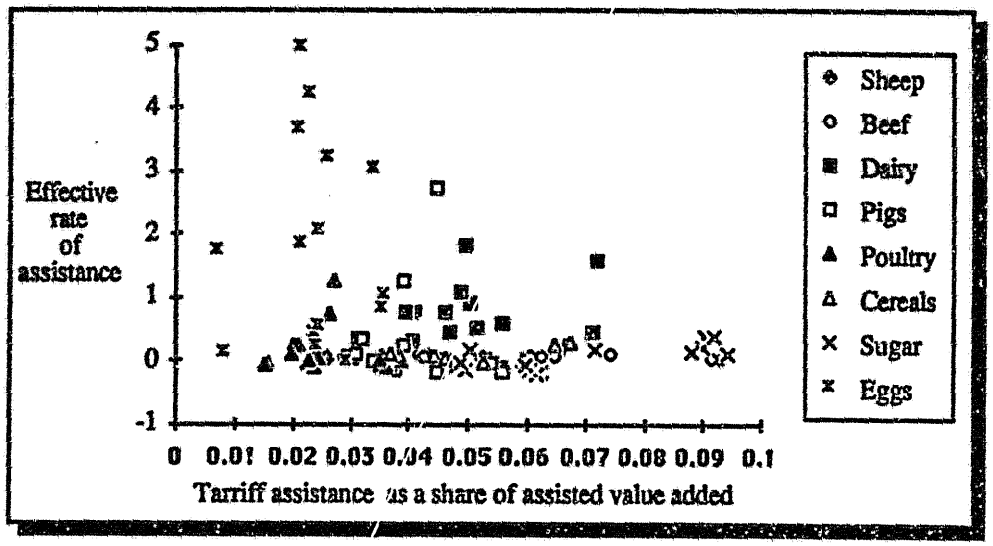

Figure 4 Effective rate of assistance versus tariff assistance on inputs as a share of the assisted value added for eight industries over the period 1970/71 to 1984/85.

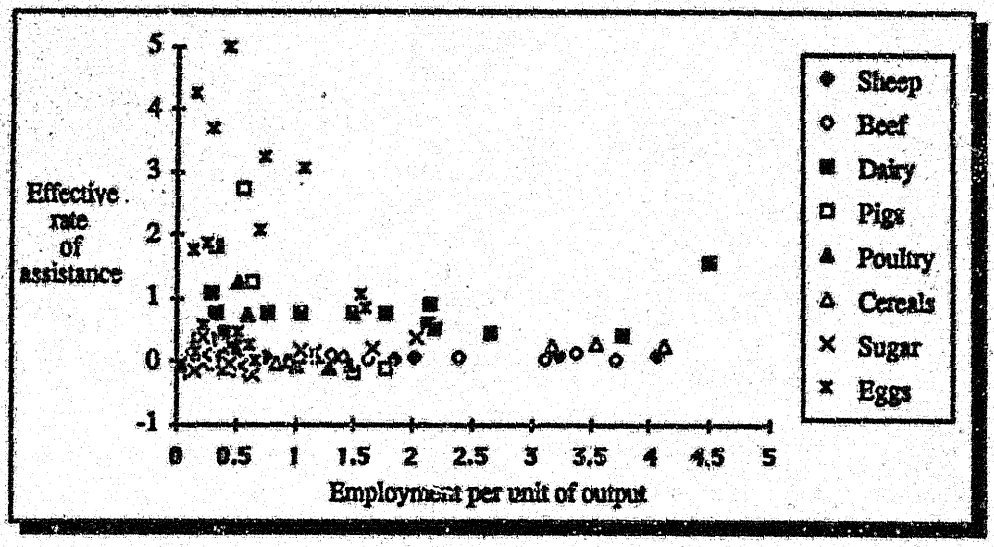

Figure 5 Effective rate of assistance versus employment per unit of physical output (as an index) for eight industries over the period 1970/71 to 1984/85.

A Simultaneous Equation Model

Based on the graphical analysis and the hypotheses of Anderson the basic model proposed is one 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. Simultaneous (within the context of an annual model) with a change in the level of assistance to an industry, production decisions will be made to adjust to changes in the level of assistance. Various substitution possibilities will be available for a given industry both in terms of outputs and the use of inputs. Since, for many agricultural commodities farmers have greater control over input decisions than output decisions it is likely that much of the change will impact on input decisions. If assistance is raised, then it is likely that value added will fall for a given level of output as newer and improved inputs are purchased and the profitability of an enterprise can be less to sustain the same income. Thus, it is also proposed that the level of the unassisted value added will be influenced negatively by a change in the rate of assistance. It will also be affected by the input and output prices. In a simplified form the model is as follows:

(1) $EFFAST_i = f(OUTPUT_i / UNSVAD_i, Z_{ik}) + e_{ij}$

(2) $UNSVAD_i = f(EFFAST_i, PI_i, PO_i, Y_{ik}) + v_{ij}$

where

$EFFAST_i$ is the effective rate of assistance for industry i;

$OUTPUT_i$ is the value of output for industry i;

$UNSVAD_i$ is the unassisted value added for industry i;

Z_{ik} and Y_{ik} are the k-th other exogenous variables for industry i;

PI_i is the input price 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 may be written as:

$$EFFAST_i = (ASSVAD_i - UNSVAD_i)/UNSVAD_i$$

where:

$ASSAVAD_i$ is the assisted value added for industry i.

Given that the available data were a series of eight industry cross-sections over 14 years and that the graphic observations suggested common slopes for each of the industries on the value-added share of output variable it appeared worthwhile to pool the data and apply standard time-series, cross-sectional techniques (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 shifter variables chosen were: the number of agricultural establishments in each of the industries used to provide a measure of the size of the industry; the skewness measure discussed above; and the approximate measure of labour intensity (employment in the industry divided by output).

In the case of equation (2) the price variables used were common to each industry thus slope dummy variables were needed. Testing of intercept variables indicated that there was no difference between the intercept variables so they were discarded.

The form of the model given above is simultaneous and non-linear. Since computer software was not readily available to estimate a non-linear, simultaneous, time-series, cross-sectional model the approach adopted was to present the pooled regressions without consideration of the simultaneity at this stage. The equations were estimated using SHAZAM (White and Horsman 1986) with allowance for cross-sectional heteroskedasticity and time-wise autoregression. Although a number of attempts were made at simultaneous estimation of the two equations satisfactory procedures could not be readily developed within the SHAZAM system. To estimate equation (1) some form of linearisation might be suitable or the appropriate matrix manipulations developed to handle the heteroskedastic and non-linear character of the equation.

Results

The estimated results are presented in Table 1 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.

Table 1

Estimated Regression Results

Variable[a]	Coefficient	Standard error
Effective rate of assistance--EFFAST		
CONSTANT (sheep)	-0.62	0.09*
OUTPUT/UNSVAD	0.41	0.005*
SKEW	-0.04	0.01*
LABINT	0.00002	0.000003*
DUM2 (beef)	-0.07	0.09
DUM3 (dairy)	0.16	0.09
DUM4 (pigs)	-0.68	0.10*
DUM5 (eggs)	-0.36	0.18*
DUM6 (poultry)	-0.35	0.10*
DUM7 (cereals)	-0.06	0.05
DUM8 (sugar)	-0.10	0.04*
R^2 (Buse) & SEE[b]	0.99	0.46
Unassisted value of output--UNSVAD		
CONSTANT	-56.39	16.75*
INDEXPO (sheep)	23.89	2.22*
INDEXPI (sheep)	-7.76	2.01*
EFFAST	-8.06	2.19*
DPO2 (beef)	-7.36	4.03
DPO3 (dairy)	-19.66	2.41*
DPO4 (pigs)	-22.61	2.08*
DPO5 (eggs)	-23.10	2.16*
DPO6 (poultry)	-23.88	2.31*
DPO7 (cereals)	-10.22	6.73
DPO8 (sugar)	-18.15	4.04*
DPI2 (beef)	2.57	3.65
DPI3 (dairy)	7.33	2.21*
DPI4 (pigs)	8.09	1.92
DPI5 (eggs)	8.22	1.98
DPI6 (poultry)	9.76	2.12*
DPI7 (cereals)	10.29	6.21
DPI8 (sugar)	6.03	3.69
R^2 (Buse) & SEE[b]	0.99	1.05

[a]Variables are defined as follows: OUTPUT is value of output, UNSVAD is unassisted value added, SKEW is skewness of the distribution of enterprise output, LABINT is employment per unit of output, DUM_i is an intercept dummy variable, INDEXPO is the index of agricultural product prices, INDEXPI is the index of prices paid by farmers, EFFAST is the effective rate of assistance, DPO_i are slope dummy variables for output prices, and DPI_i are slope dummy variables for input prices.

[b]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.

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. Consideration of Figure 1 provides some additional evidence in the case of the egg industry which in the 1970s had a value-added share of output of around 0.3, whereas in the mid 1980s it was about 0.1 and with very high rates of assistance by Australian standards.

Concluding Comment

It has been clearly established that differences in value-added share of output between industries provides a major explanation as to why different rates of assistance are provided to the different agricultural industries. The nature of the other factors proposed by Anderson (1978) as being involved is not so clear and will require continued research effort. In addition, it has been proposed that there is a simultaneous relationship between the assistance provided and the unassisted value added generated by an industry. 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 will be particularly so for output-based types of assistance and in instances where the industries tend to have industry specific capital and more mobile labour.

More work is required on the model to disaggregate the various components of assistance and examine their behaviour in relation to the value-added share of output. With greater disaggregation it may be possible to properly specify the simultaneity in terms of the production system and the decisions made in relation to inputs and outputs. It may also prove possible to find a more appropriate approach to the estimation of a non-linear, simultaneous time-series, cross-sectional model.

The implication of the work is that for industries with low value-added shares of output there is likely to be an assistance spiral or assistance trap. This implies that for the protected intensive agricultural industries that one way of achieving a greater value added is to avoid the protection spiral by a conscious policy of allowing the real value of protection to diminish with inflation.

The surprising closeness of the relationship between the rate of assistance and the

value-added share of output to the exclusion of other variables (at least the few tested) would seem to imply that techniques and technology designed to maintain the value-added in a sector may mean, in the longer term, a lower level of assistance to an industry.

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