SUPPLY RESPONSES FOR POTATOES IN FIVE NEW SOUTH WALES SHIRES

John W. Longworth and Edmond J. O'Loughlin*

Potatoes are grown in a number of different regions of New South Wales. This study examines the supply responses of producers in five major potato growing shires. Three models of price response are examined. The most successful of these, the general Nerlove adaptive expectations model, is extended to test, first, how important the number of growers is in determining the acreage planted in each of the shires and, second, whether growers tend to expand or contract acreage in response to good yields in the immediate past.

This study has a twofold purpose. First, to present an exposition of the methodology of supply response which both integrates the usual approaches into an overall system, and extends the Nerlove model of adaptive expectations to test two other hypotheses. Secondly, to discuss the problems encountered and the results obtained, when these models are applied to the supply responses of potato growers in five New South Wales shires. A brief comment on the potato industry and the instability of prices provides a backdrop. The paper is aimed primarily at people who may not be well acquainted with supply response research and its pitfalls.

1 BACKGROUND

New South Wales is a key state in the Australian potato industry. Total annual production in this state represents less than half its total requirements and there is a large interstate trade in potatoes to fill this gap. The importance of the Sydney market has been stressed in other studies[1].

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* University of Sydney.
Mr O'Loughlin is now with the Western Australian Department of Agriculture.

[1] Bureau of Agricultural Economics, *The Australian Potato Industry: An Economic Survey*, 1961–62 *to* 1963–64. (Canberra: B.A.E., 1967), p. 101; The National Materials Handling Bureau, *Potato Handling*. (North Ryde: October, 1967), pp. 2-4; and J. van der Meulen, "The Organisation of the Sydney Potato Trade", *Review of Marketing and Agricultural Economics*, vol. 28, no. 4 (December, 1960), pp. 207-23.

TABLE 1

Variability in Production, Acreage, Yield and Wholesale Prices of Potatoes, New South Wales, 1951–52 *to* 1964–65

	Mean	Coefficient of Variation
		%
Production*	72,570 tons	33.5
Area planted	18,617 acres	20.5
Yield	3.84 tons per acre	17.4
Price†	$77.58 per ton	47.8

* Includes potatoes sold or retained for seed.

† Average wholesale prices, Sydney.

Source: Commonwealth Bureau of Census and Statistics, *New South Wales Statistical Register, Rural Industries and Settlement and Meteorology.*

The potato-growing industry in this state has been traditionally unstable. The variation in four of the key variables during the period covered by this analysis (1951–52 to 1964–65) is summarized in table 1. The variation in the area planted each year may be understandable since the cost of entry and exit from the business of growing potatoes is not high[2]. The industry is characterized by a core of regular growers and a group of intermittent producers who may be owner-operators, share farmers or part-time farmers. These intermittent growers regard potato production as a speculative sideline-enterprise from which large cash returns can be achieved in good years.

The average yield of potatoes in New South Wales is not only unstable but low when compared with other states[3]. There are two major features of the industry which help explain this. First, potatoes are grown over a wide area of New South Wales frequently in areas or upon soils not well suited to this crop; and second, the irrigation of potatoes is not practised as commonly as in the southern states[4].

Over the period covered by this study the annual wholesale price of potatoes in Sydney had a coefficient of variation of 47.8 per cent. In addition to the inter-year variation in price, intra-year variation is also important. To assess the extent of the intra-year fluctuation an index of seasonal variation was computed for the period 1952 to 1965 using moving averages. For comparison the seasonal index for the pre-war

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[2] For details see Bureau of Agricultural Economics, *op. cit.*, pp. 64-90.

[3] For example, over the 14 years covered by this analysis the average yield for New South Wales was 3.84 tons per acre compared with 4.19, 4.85, 4.93, 7.35 and 7.67 tons per acre respectively for Queensland, Victoria, Tasmania, Western Australia and South Australia.

[4] Bureau of Agricultural Economics, *op. cit.*, pp. 38-9.

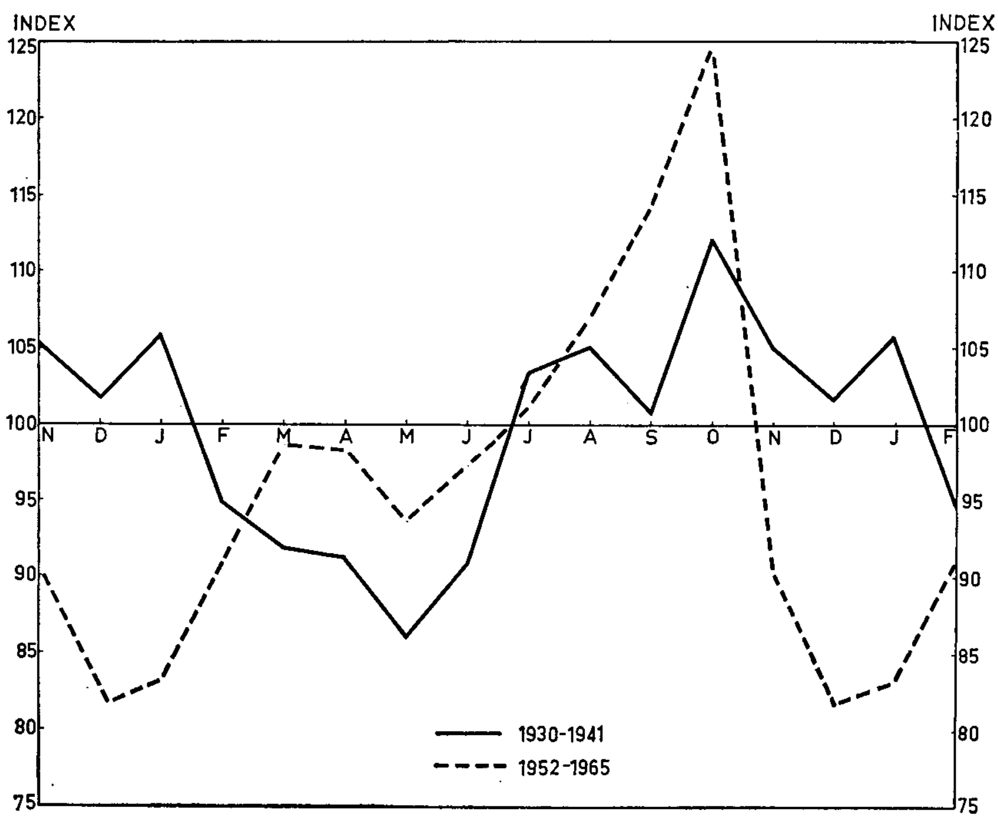
TABLE 2

Index of Seasonal Variation Average Monthly Wholesale Prices of Potatoes, 1930–1941 *and* 1952–65

Month	1930–1941	1952–1965
January	105.8	83.1
February	94.9	90.9
March	91.9	98.6
April	91.1	98.4
May	86.0	93.7
June	90.8	97.3
July	103.4	101.2
August	105.0	107.0
September	100.9	114.1
October	112.1	124.8
November	105.0	90.5
December	101.7	81.7

FIGURE 1

Seasonal Variation in Average Monthly Wholesale Prices of Potatoes, 1930–1941 *and* 1952–1965



period 1930 to 1941 was also computed. The indices for the two periods are given in table 2 and plotted in figure 1. Intra-year variation has become more pronounced in the post-war period. During the last 13 years the period from September to December has on average been characterized by a sharp rise in prices followed by an even more rapid fall in prices. This same tendency was also evident in the period 1930 to 1941 but it was much less marked. The price patterns between February and October reflect the influence of the tableland crops. The crop from the Northern Tablelands is normally marketed from February to July, and the crop from the Central and Southern Tablelands from approximately April to August or September. Price tends to reach its lowest point for these crops in May, just after digging commences in the Central and Southern Tablelands. By October digging is virtually completed in the tablelands, and the sudden decline from the high prices usually achieved in October (especially evident for the 1952 to 1965 period) results from the advent of the early season crop which is mainly from the North Coast and Queensland[5].

As a result of the seasonal movement in prices growers on the tablelands receive higher prices for their main crop than the South Coast growers who market their main crop in January to May. The time of marketing seems to be especially important for North Coast growers who sell most of their crop over the October to December period. The earlier individual growers can sell their crop the more likely they are to avoid the slump in prices which occurs at this time of the year.

To analyse the supply response of potato growers in New South Wales at the state level would be inappropriate as each producing area aims at a different marketing period and can expect quite different prices. In addition, growers in different parts of the state have different alternative production possibilities. In the statistical divisions in which potato-growing is an important enterprise, certain shires account for a large part of total production. For this reason and because suitable data are not available for areas smaller than shires, the shire was chosen as the unit of analysis. Five shires were selected for study; Crookwell, Canobolas, Lyndhurst, Guyra and Wingecarribee. The first three shires are representative of the Central and Southern Tablelands, while Guyra is the main potato producing shire on the Northern Tablelands, and Wingecarribee can be regarded as part of the South Coast growing area.

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[5] The chief producing areas and the time of sale of their major crops are as follows:

North Coast	October to December;
Hunter Metropolitan	January to March, June to August and November to December;
South Coast	January to May;
Northern Tablelands	February to July;
Central and Southern Tablelands	April to August.

For further details see van der Meulen, *op. cit.*, p. 211.

Over the period 1951–52 to 1964–65 these shires on average produced 41.6 per cent of the New South Wales crop from 42.0 per cent of the state's potato acreage. However, in these shires were found only approximately 26 per cent of the total number of growers in the state. This indicates that there is a large number of small growers in the shires not selected. Growers on small holdings surrounding urban centres are likely to grow two or more crops of potatoes in the same year. In such cases it is not possible, with the data available, to determine the area sown to each of the crops, and as a result the response of such producers to particular prices cannot be isolated. This difficulty is also present with the five shires that have been selected, but only to a slight extent in the shires of the Central Tablelands (Crookwell, Canobolas and Lyndhurst), where crops other than the main crop are very small. However, this problem may be more important in the Guyra and Wingecarribee shires.

2 METHODOLOGICAL CONSIDERATIONS

Nerlove has extended the Hicksian notion that the expected "normal" price in the current period is the expected "normal" price in the immediate past period plus some factor depending upon the elasticity of expectations and the price ruling in the immediate past period. Nerlove has suggested that the adjustment factor, "the coefficient of expectation", "is proportional to the difference between actual and expected 'normal' price"[6]. For a supply response model this implies that producers re-adjust their view of expected price in proportion to the difference between the current price and their previous notion of "normal" price.

In symbols this hypothesis can be written,

(1) $P^*_t = P^*_{t-1} + \beta\,[P_{t-1} - P^*_{t-1}],\ 0 \leqslant \beta \leqslant 1,$

where P^*_t is the expected "normal" price in period t;

P^*_{t-1} is the expected "normal" price in period $t-1$;

P_{t-1} is the actual price received in period $t-1$;

and β is the coefficient of expectations.

A general supply response function in terms of expected "normal" price is

(2) $x_t = a_o + a_1 P^*_t + u_t,$

where x_t is the planned output in the current period called forth by the expected "normal" price. From equations (1) and (2) it can be seen that if $\beta = 1$ the response function becomes

(3) $x_t = a_o + a_1 P_{t-1} + u_t$ . . . . (MODEL I).

[6] M. Nerlove, *The Dynamics of Supply* (Baltimore: Johns Hopkins Press, 1958), pp. 52-3.

This function is the first model examined in this study and is equivalent to testing the hypothesis that farmers plan production upon the basis that this year's price will be the same as the price realised last year. This specification of the response function has been referred to as a "simple cobweb model" and as "the model of extrapolative expectations"[7]. It is regarded here as a limiting case of the more general Nerlove model of price expectation formation or "adaptive expectations"[8].

When more than one past price is to be considered there arises the basic problem of how to discover the "best" distribution of the lagged response to price[9]. The simplest approach is to make no assumptions about the form of the lag, and to fit a function of the form

$$(4)\ x_t = a_o + a_1 P_{t-1} + a_2 P_{t-2} + \ldots + u_t \ldots \text{(MODEL II)}.$$

The decision as to how many past prices should be included can, in principle, be answered by using step-wize regression, continuing to add more remote prices until there is no significant increase in the regression sum of squares. In practice, however, either the signs of the coefficients become erratic or the standard errors of the coefficients begin to increase after more than two or three lagged prices are included. This effect is due to the intercorrelation between the lagged explanatory variables and to serial correlation in the residuals. It was found in this study that in all cases the standard error of a_1, already large, increased further with the addition of only one more lagged price.

When only two lagged prices are included model II may also be interpreted as a special case of the Nerlove adaptive expectations model intermediate between model I above and the general model presented below as model III. In this case the expected "normal" price is regarded as a weighted average of two lagged prices. If α is the weight given to price lagged one year, then

$$(5)\ P_t^* = \alpha\, P_{t-1} + (1 - \alpha)\, P_{t-2}.$$

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[7] For example, see T. J. Mules and F. G. Jarrett, "Supply Responses in the South Australian Potato Industry", *Australian Journal of Agricultural Economics*, vol. 10, no. 1 (June, 1966), p. 54, and J. H. Duloy and A. S. Watson, "Supply Relationships in the Australian Wheat Industry: New South Wales", *ibid*, vol. 8, no. 1 (June, 1964), pp. 36-7.

[8] In the original specification of the model, Nerlove did not use the phrase "adaptive expectations" but rather referred to his "model of price expectation formation" (see Nerlove, *op. cit.*, p. 199). The term "adaptive expectations" had its origin in K. J. Arrow and M. Nerlove, "A Note on Expectations and Stability", *Econometrica*, vol. 26, no. 2 (April, 1958), pp. 297-305. In this paper the authors also drew distinctions between models of "static expectations", "extrapolative expectations" and "adaptive expectations" which are at variance with the later use of these terms by Duloy and Watson in the article referred to in footnote 7.

[9] F. L. Alt, "Distributed Lags", *Econometrica*, vol. 10, no. 2 (April, 1942), p. 113.

For $\alpha = 0.5$, P_t^* is the simple average of the prices in the last two years. Again, for $\alpha = 1.5$, P_t^* is last year's price plus half the change in price which occurred between the year before last and last year.

The general price expectation model expressed as equation (1) implies that the expected "normal" price to which producers respond is a weighted average of past prices, with the weights declining as the price becomes more remote[10]. The rate of decline in the weights depends upon the value of β, the coefficient of expectation. If β is close to one then the weights decline sharply and only a very few past prices are important. If β is close to zero a great many past prices are given consideration. Clearly an estimate of β would shed a great deal of light on the price response pattern. To obtain an estimate of β it is first necessary to assume that there is no lag in the adjustment of farmers of current output to "desired" output. This is a reasonable assumption in the case of potatoes. For this crop agronomic limitations such as rotation requirements, and technological rigidities such as limiting machinery capacity, are not likely seriously to restrict the producer making a complete and "instantaneous" adjustment to changes in expected "normal" price[11].

With this assumption equation (2) can be solved for P_t^*. This new expression, lagged one period to obtain an expression for P_{t-1}^*, is then substituted into equation (1). Upon re-arranging terms the following equation is obtained:

$$(6)\ P_t^* = \beta P_{t-1} + \frac{(1-\beta)\, x_{t-1}}{a_1} - \frac{a_o(1-\beta)}{a_1^2} - \frac{(1-\beta)\, u_{t-1}}{a_1}.$$

When this expression for P_t^* is substituted into equation (2) the result is

$$(7)\ x_t = a_o\beta + a_1\beta P_{t-1} + (1-\beta)\, x_{t-1} + u_t - (1-\beta)\, u_{t-1}.$$

This supply response function suggests a regression model of the form

$$(8)\ x_t = b_o + b_1 P_{t-1} + b_2 x_{t-1} + v_t \ . \ . \ . \ \text{(MODEL III)}.$$

In estimating the coefficients of equation (8) by ordinary least-squares it is assumed that the v_t residuals are normally and independently distributed. For this to be true it can be shown that the residuals of equation (2) must be serially correlated[12].

To obtain empirical estimates for the three price response models an appropriate response variable and a relevant price series had to be chosen. As the output planned in response to a set of conditions in any year is

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[10] For the proof of this proposition under fairly general assumptions see Nerlove, *op. cit.*, pp. 54-5.

[11] This assumption is necessary to enable β to be unambiguously interpreted as the coefficient of expectation. Such an assumption may not be realistic if the crop in question is new to the area being studied. Perhaps this explains the "new areas" results of Duloy and Watson, *op. cit.*, p. 39.

[2] See Nerlove, *op. cit.*, p. 193.

an unobserved variable, some measurable (and measured) indicator of planned output was needed. Actual output was obviously not appropriate due to the effects of weather, disease and other extraneous factors upon yield. If planned acreage had been recorded this may have been a good indicator of planned output, although not ideal because it is possible for a grower to change his cultural techniques and hence his planned output from a given acreage in two different years. The only solution was to use the actual acreage planted as the response variable. This has been a common approach in supply response studies, and in the present context any difference between the planned acreage and actual acreage should be slight. A discrepancy could occur in a year in which widespread unfavourable seasonal conditions at the time of planting prevented a significant number of growers from planting as large an acreage as they had intended. However, in the five shires considered potatoes are grown mainly on mixed farms where they comprise a minor part of the whole farm operation. Hence it is usually possible to plant the planned acreage of potatoes within a comparatively short period. In addition there is some flexibility in the time of planting. Under these conditions it is reasonable to assume a close correspondence between the actual and planned acreage.

The choice of a relevant price variable was not clear cut. Even at the shire level of disaggregation it was not possible to specify a particular historical price series as that received by the growers. Potatoes grown in any one shire are marketed over several months. Hence it was decided to use a simple average of the Sydney wholesale prices quoted for the main months in which potatoes from each shire were marketed, as an indication of prices received by the growers in that shire. In the case of Crookwell, Canobolas and Lyndhurst Shires the months averaged were April to August; for Guyra Shire the months were February to July; and for Wingecarribee Shire the wholesale prices received in December to March were averaged.

On theoretical grounds the prices of alternative products ought to be taken into account. If, as was the case in this analysis, the data are relatively short time series, it is important to limit the number of explanatory variables[13]. In the case where there are only two major alternatives, with certain assumptions it is reasonable to use the ratio of the prices[14]. Unfortunately in all five shires there are more than two competing products. The way out has been to assume that producers compare potato prices with the general level of alternative product prices—a not unrealistic assumption. The potato price series for each shire was deflated by an index of prices received for alternative products. The "indicator price" series mentioned above were deflated by components

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[13] If growers are assumed to respond to expected "normal" prices for alternative products, the situation in this regard becomes hopeless as the introduction of one alternative product involves adding four additional variables to the equation. See *ibid.*, p. 194.

[14] For example, see Duloy d Watson, *op. cit.*, p. 36

of the Bureau of Agricultural Economics Index of Prices Received by Farmers in New South Wales. In the shires where the alternative products were chiefly livestock products, that is the shires of Crookwell, Lyndhurst, and Guyra, the indicator prices were deflated by the index component "Total All Livestock Products". In the Canobolas Shire other crops as well as livestock are important, and hence the "Total All Products" component of the index was used[15]. For the Wingecarribee Shire where dairying is a major enterprise the "All Dairy Products" component was more appropriate. These deflated price series are presented in the Appendix.

It was suggested earlier that one of the contributing factors to the instability in the New South Wales potato growing industry is the ease of entry and exit. To test just how important the number of growers is in determining the acreage sown it was decided to extend model III as follows:

(9) $x_t = b_o + b_1P_{t-1} + b_2x_{t-1} + b_3G_t + w_t$ . . . (MODEL IV),
where G_t is the number of growers in year t. The inclusion of this variable is subject to the criticism that G_t may also be some lagged function of past prices[16].

During an informal survey of growers in the selected shires it was frequently suggested that the yield in the previous season influenced the decision of how many acres of potatoes to grow in the current year. A good yield engendered confidence in the crop and hence the area sown the following year was increased and vice versa. This is in direct contrast with the concept of "normal" yield discussed by Nerlove[17]. If producers plan output by taking into account an expected "normal" yield then a high yield in the immediate past ought to result in some revision of their expected "normal" yield upwards and hence, *ceteris paribus*, lead to a contraction in the acreage they plant in the current year. If the average yield for each shire is assumed to indicate a good or a bad season for that shire then it may be possible to shed some light on this aspect of grower response by adding average yield lagged one year. This variable y_{t-1} was added to obtain model V which can be written

(10) $x_t = b_o + b_1P_{t-1} + b_2x_{t-1} + b_3G_t + b_4y_{t-1} + z_t$ . . . (MODEL V).

3 RESULTS AND CONCLUSIONS

Both model I and model II yielded poor results for all five shires. In no case did the regression explain more than 20 per cent of the variation in the acreage planted nor were any of the price coefficients significant

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[15] Strictly speaking since this index includes potato prices, the variance of the deflated prices will be biased downwards.

[16] However, a simple regression of the form

$$G_t = a + bP_{t-1}$$

did not explain more th 11 per cent of the variation in G_t in any of the five shires.

[17] Nerlove, *op. cit.*, p

TABLE 3

Least Squares Estimates for Model III

Estimates	Shire				
	Crookwell	Canobolas	Lyndhurst	Guyra	Winge-carribee
Constant	887.0	249.5	325.7	2401.0	—141.1
Coefficient of price lagged 1 year†	—7.99 (5.73)	—1.01 (3.51)	—0.21 (5.60)	—5.17 (7.57)	5.65 (4.67)
Coefficient of acreage lagged 1 year†	0.75* (0.21)	0.85* (0.19)	0.83* (0.19)	0.14 (0.37)	1.03* (0.19)
$\bar{R}^2$‡	0.48	0.57	0.53	0.05	0.69
β§	0.25	0.15	0.17	.. ¶	.. ‖

* Significant at the 1 per cent level.

† The standard errors of these coefficients are given in brackets.

‡ Adjusted R^2.

§ $\beta = 1\text{-}b_2$.

‖ Since $\beta \geqslant 0$ and the coefficient of acreage lagged 1 year was not significantly greater than one β is assumed to be close to zero in this case.

¶ The poor results for this shire do not allow any meaningful estimate of β to be derived.

at the 5 per cent level and it was not possible to derive any meaningful estimates of α. The results for model III, however, were more encouraging and are presented as table 3. As the regressions are based upon only 14 observations, $\bar{R}^2$ was calculated to take account of the upward bias in R^2.[18]. The coefficient of expectation, β, has also been derived. As none of the price coefficients was significant it was not possible to calculate meaningful long-run elasticities of acreage with respect to price lagged one year[19]. However, the results seem to suggest that all of these would be extremely low. The Theil and Nagar tables were used to test for autocorrelation in the v_t residuals[20]. At the 5 per cent level this test supported the null hypothesis that there was no autocorrelation.

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[18] See J. Thomas, *Notes on the Theory of Multiple Regression Analysis*, (Athens: Centre of Economic Research, 1964), pp. 77-83.

[19] See M. Nerlove, "Distributed Lags and Estimation of Long-run Supply and Demand Elasticities: Theoretical Considerations", *Journal of Farm Economics*, vol. 40, no. 2 (May, 1958), p. 310.

[20] The more usual Durbin-Watson test gave inconclusive results. The Theil and Nagar test was used in this case with reservations as it is strictly only applicable when the first and second differences of the explanatory variables are small in absolute value relative to the range of the corresponding variable. See Theil, H., and Nagar, A. L., "Testing the Independence of Regression Disturbances", *Journal of the American Statistical Association*, vol. 56, no. 296 (December, 1961), pp. 793-806. Since this work was completed a test for autocorrelation which does not require the rigid assumption of the Theil and Nagar test, and which is more powerful than the Durbin-Watson procedure, has been developed. See H. Theil, "The Analysis of Disturbances in Regression Analysis", *Journal of the American Statistical Association*, vol. 60, no. 312 (December, 1965), pp. 1067-79; J. Koerts, "Some Further Notes on Disturbance Estimates in Regression Analysis", *ibid.*, vol. 62, no. 317 (March, 1967), pp. 169-83; and J. Koerts and A. P. Abrahamse, *On the Power of The Blus Procedure* (*Blus versus Durbin-Watson*), (Netherlands School of Economics, Econometric Institute, Report 6801, January, 1968) *mimeo.*

Both the large constant term and the low $\bar{R}^2$ for Guyra are anomalous. A partial explanation may be that between 1951–52 and 1953–54 the area planted to potatoes in this shire, unlike the other shires, showed a marked increase. Again, in the later years covered, from 1962–63 to 1964–65, the acreage of potatoes in the Guyra Shire declined more sharply than in the other shires.

Intuitively if the prices received for a commodity have a wide variance, and this is certainly the case for potatoes, then the coefficient of expectation may be expected to be low. In the shires of Crookwell, Canobolas and Lyndhurst where model III explained about half the variation in acreage, the coefficient of expectation ranged from 0.25 to 0.15. In the shire of Wingecarribee where over two-thirds of the variation was explained, the coefficient of acreage lagged one year is significantly different from zero at the 1 per cent level but it is not significantly greater than one at the 5 per cent level using a one tail t-test. Therefore, β can be regarded as being close to zero for this shire. These results support the poor results obtained for models I and II because if β is small a large number of past prices would be considered in the formulation of the expected "normal" price[21].

Economic theory stresses the role of price in determining supply response. The results from the first three models in this study suggest that prices, as specified for this analysis, are almost irrelevant in the explanation of the supply responses of potato growers. This highlights a major problem area in supply analysis, the identification of the relevant prices. This study has focused upon relatively small geographical areas for which it is possible to select, not only specific marketing periods, but also a price series which represents the average level of prices received during these marketing periods. Despite these special features the undeflated price series gave such poor results that it was decided to use the deflated series, not because deflation had any great effect upon the explanatory power of the models, but chiefly on theoretical grounds as already discussed. While the appropriateness of the price variable in this analysis is open to question, the results do point to growers being unresponsive to price. This, after all, given the notorious instability in potato prices is not altogether unbelievable.

The addition of the number of growers and yield lagged one year both had interesting effects and the results are presented in tables 4 and 5. Model V explained 92 per cent of the variation which occurred in the acreage planted in Lyndhurst shire over the period studied. In the other shires the percentage was lower, being about 70 per cent in all four. The results for Guyra showed a marked improvement over those obtained for model III, first when the number of growers alone was added and then again when both this variable and lagged yield were included.

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[21] The sum of the weights over the first N past prices is equal to $1 - (1 - \beta)^N$, see Nerlove, *The Dynamics of Supply*, *op. cit.*, p. 187. This implies that if $\beta = 0.45$ about 95 per cent of the weight is given to the last 5 years' prices; but when $\beta = 0.26$ ten years are necessary before 95 per cent of the weight has been assigned.

TABLE 4

Least Squares Estimates for Model IV

Estimates	Shire				
	Crookwell	Canobolas	Lyndhurst	Guyra	Wingecarribee
Constant	—2475.0	—437.3	—2473.0	—362.4	—887.8
Coefficient of price lagged 1 year	—4.04	—0.27	—0.60	—4.18	5.85
	(4.92)	(3.29)	(2.91)	(5.46)	(4.53)
Coefficient of acreage lagged 1 year	0.48*	0.72†	0.52†	0.36	1.19†
	(0.21)	(0.19)	(0.12)	(0.28)	(0.22)
Coefficient of number of growers	25.12*	7.91	27.09†	13.98*	8.18
	(10.12)	(4.93)	(5.11)	(4.36)	(6.39)
$\bar{R}^2$	0.66	0.62	0.88	0.36	0.72

* Significant at the 5 per cent level.

† Significant at the 1 per cent level.

TABLE 5

Least Squares Estimates for Model V

Estimates	Shire				
	Crookwell	Canobolas	Lyndhurst	Guyra	Wingecarribee
Constant	—2361.0	—904.8	—2838.0	—2227.0	—804.8
Coefficient of price lagged 1 year	—4.29	0.85	—0.50	0.89	5.73
	(4.60)	(2.86)	(2.37)	(3.82)	(4.63)
Coefficient of acreage lagged 1 year	0.39	0.55*	0.38*	0.33	1.31*
	(0.20)	(0.19)	(0.11)	(0.18)	(0.27)
Coefficient of number of growers	21.25	8.78	26.66*	17.38*	8.91
	(9.79)	(4.13)	(4.17)	(2.99)	(6.58)
Coefficient of yield lagged 1 year	160.00	126.10	142.40*	354.00*	—51.21
	(105.20)	(67.45)	(60.44)	(97.42)	(64.13)
$\bar{R}^2$	0.69	0.73	0.92	0.73	0.69

* Significant at the 1 per cent level.

Models IV and V must be interpreted with care. For example, one could expect G_t to be a catch-all variable which picks up the effects not only of changes in the number of growers, but also of expansion or contraction in potato acreage on the regular potato-growing holdings. The variable G_t is most important in Lyndhurst and Guyra shires. In these shires the coefficient of G_t remains significant and stable at a reasonable magnitude for both models IV and V. The simple correlation coefficient between the number of growers and acreage planted for Guyra shire was 0.65 which, along with the regression results, tends to confirm the earlier suggestion that in this shire there are many small part-time growers who move into and out of the industry and who tend to grow more than one crop in any one year. Under these circumstances the poor fit obtained for Guyra by model III is understandable.

In model V, conventional supply and demand analysis indicates that lagged yield and lagged price may show a strong negative correlation, thus creating multicollinearity and meaningless coefficients. This problem did not arise in this study as the simple correlation coefficients for y_{t-1} and P_{t-1} ranged from $r = —0.10$ for Crookwell to $r = —0.37$ for Guyra shire. Therefore, the large, positive and significant coefficients for lagged yield in both Lyndhurst and Guyra lend support to the hypothesis that a high yield in one year encourages producers to sow a larger area the following year. On the other hand, perhaps the regular producers do tend to behave according to the increased expected "normal" yield idea, but this effect is swamped in the aggregate by the increase in the number of growers encouraged to enter the industry by the good yields obtained in the district the previous year.

This argument may be checked because, for it to be valid, the correlation between the number of growers and yield lagged one year should be both positive and fairly high. For Lyndhurst shire the relevant correlation coefficient, though positive, is rather low ($r = 0.34$); for Guyra shire the correlation coefficient is negative ($r = —0.34$). The results for these two shires, therefore, may be taken as strongly supporting the popular belief that good yields lead to larger crops the next season.

APPENDIX

Area Sown, Deflated Prices Received, Number of Growers and Average Yield of Potatoes in the Five Selected Shires* 1951–52 *to* 1964–65

Year	Crookwell				Canobolas				Lyndhurst				Guyra				Wingecarribee			
	Area Sown	Deflated Price Recd.	No. of Growers	Average Yield	Area Sown	Deflated Price Recd.	No. of Growers	Average Yield	Area Sown	Deflated Price Recd.	No. of Growers	Average Yield	Area sown	Deflated Price Recd.	No. of Growers	Average Yield	Area Sown	Deflated price recd.	No. of growers	Average Yield
	acres	$/ton		tons/acre	acres	$/ton		tons/acre	acres	$/ton		tons/acre	acres	$/ton		tons/acre	acres	$/ton		tons/acre
1951–52	1973	18.56	167	2.84	1038	22.18	123	2.94	1022	18.56	126	2.78	1985	18.56	177	3.22	506	41.22	76	2.62
1952–53	1809	36.86	158	2.43	944	37.24	121	2.78	1038	36.86	115	2.33	2565	39.49	184	2.66	479	42.16	85	4.85
1953–54	1574	40.92	149	2.72	901	42.58	118	4.70	1026	40.92	117	3.96	2715	35.32	179	2.71	588	31.16	93	4.27
1954–55	1409	19.88	122	3.70	754	21.04	87	4.14	845	19.88	96	4.01	2423	23.25	156	2.88	492	26.14	72	3.75
1955–56	1396	40.00	133	3.40	591	42.48	85	3.41	821	40.00	99	4.04	2564	36.72	169	2.48	442	25.20	73	4.63
1956–57	1236	105.76	135	2.96	590	109.82	81	2.75	787	105.76	109	3.12	2157	83.53	160	3.62	512	54.54	84	3.79
1957–58	1464	33.06	141	3.94	1674	34.26	75	3.49	888	33.06	118	3.65	2641	36.84	163	4.10	803	32.84	84	4.36
1958–59	1811	23.22	158	5.79	1026	23.36	97	5.40	1323	23.22	133	5.69	2862	21.96	160	4.23	873	17.06	74	5.13
1959–60	2540	25.48	153	4.78	1226	27.02	93	5.32	1463	25.48	115	5.64	3141	31.29	162	2.68	1009	30.46	79	4.92
1960–61	2195	30.44	157	5.27	1216	32.52	88	4.45	1379	30.44	113	4.41	2719	25.29	159	3.21	827	18.00	65	5.20
1961–62	1769	68.28	140	3.93	1319	67.50	100	5.94	1738	68.28	128	5.51	2569	70.10	144	4.57	1234	45.24	61	3.31
1962–63	2855	39.74	160	5.55	2043	40.50	133	5.88	2938	39.74	152	5.72	3285	38.96	117	4.50	1298	42.26	73	6.30
1963–64	3340	21.54	170	3.85	1796	22.28	116	3.53	2529	21.54	135	4.56	2160	21.96	117	3.36	1298	19.84	74	5.51
1964–65	2815	47.30	154	2.01	1559	50.96	91	2.48	2052	47.30	123	2.64	1566	41.75	101	2.85	1263	25.44	67	4.46
Average	2013	39.36	150	3.80	1120	40.98	101	4.09	1418	39.36	120	4.15	2525	37.50	156	3.36	795	32.25	76	4.51

* Producing one acre or more.

Source: Commonwealth Bureau of Census and Statistics, *New South Wales Statistical Register.*