THE CAPACITY OF THE N.S.W. PIG MARKET TO ABSORB POSSIBLE INCREASES IN NORTH COAST PIG PRODUCTION*

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Likely changes in gross income to farmers on the north coast of N.S.W. from an expansion of pig production are considered in the light of estimated demand conditions and the forecast future production of grain fed pigs in inland areas. Price elasticity of demand for pigmeat is estimated to be only slightly greater than unity; prospects for future expansion in inland areas are favourable given the strong direct relation found between pig production and wheat acreage and the low estimated elasticity of supply of 0·7; hence it is concluded expansion of milk-fed pig production would do little to solve the farm problem on the north coast. Pig numbers in coastal areas are found to be mainly determined by pig prices and coastal production of butter in previous periods; elasticity of supply is estimated to be 0·5. In the demand analysis the importance of the level of migration as a determinant of the demand for pork is highlighted.

This study was initiated as part of a much wider project concerned with possible methods for improving the lot of low income dairy farmers on the north coast of N.S.W. The expansion of pig production was being considered as one of the alternatives and to this end an experiment had been undertaken at Wollongbar Agricultural Research Station to determine optimal rations for pigs on north coast dairy farms. However, before any expansion of pig production could be recommended it was essential to try to determine the capacity of the N.S.W. pig industry to absorb such an increase, and this was the main aim of this project.

Most of the work was carried out over the period from 1964 to 1966. It involved primarily an examination of factors influencing the supply of pigs and the demand for pigmeat in N.S.W., and in the light of this information an evaluation of the prospects for the pig industry on the north coast was made. However, the results do have implications for the whole of the N.S.W. pig industry, particularly since it is a field which has been largely neglected by agricultural economists in the past.

The original intention had been to estimate a detailed economic model of the pig industry in N.S.W. However, data was far from adequate for estimating simultaneous relationships and eventually the supply and demand functions were obtained as single equations. The models estimated are largely the result of experimentation. *A priori* models were formulated but lack of data concerning many of the relevant variables made it impossible to estimate them. Before the actual models are presented it is pertinent to examine briefly that economic background of the industry which provided a basis for their formulation.

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The Pig Industry in New South Wales

There were 1·7 million pigs in Australia at 31st March, 1966, nearly 40 per cent of which were in N.S.W.[1] Figures available in 1960 indicate that nearly 20 per cent of N.S.W. rural holdings recorded pigs amongst their listed enterprises. Pig enterprises in the state have tended to be purely sideline so the average unit has been small, supporting only about 3 to 5 sows. The number of large specialized holdings, while showing a gradual increase in postwar years, appears to have fluctuated with the fortunes of the industry.

Dairy by-products and cereal grains provide the main sources of feed for pigs in N.S.W., and pig producers tend in the main to be associated with one or the other industry. Since it was anticipated that pig producers in dairying areas would exhibit different behavioural patterns from producers in grain areas, an attempt was made to classify the N.S.W. pig population broadly along these lines. All pigs in coastal statistical divisions of N.S.W. were deemed to be associated with the dairying industry, while the remainder were presumed to be grain fed. While this assumption simplified the picture somewhat, it did lead to a better understanding of supply responses. It is interesting to note that in 1964-65, 46 per cent of the total N.S.W. pig population was located in coastal areas compared with 56 per cent in 1955-56 and 66 per cent in 1947-48.

Pig raising in N.S.W. dairy areas is generally associated with butter production as pigs are kept to utilize skim-milk by-products. Hence a large proportion of N.S.W. coastal pigs are located on the north coast, where dairy farms are mainly butter producing. Grain is the main supplementary feed and some, particularly maize, is grown locally. However, much has to be imported from inland areas.

It is in areas outside the coastal divisions that the pig population has expanded rapidly in the postwar period, an expansion which appears to have paralleled the increase in wheat acreages, (much of the poorer quality wheat being used as pig feed). Pigs are fed all types of grain and are associated with all types of agricultural enterprises. The farms vary in size from small subsistence operations to large well-managed concerns which are highly capitalized. The major supplementary feed, apart from dairy by-products, is meat meal supplied by the local abattoirs. Some supplementary crops are grown, while in times of low pig prices relative to feed costs, pigs may be grazed.

N.S.W. is a net importer of pigmeats, and any study of prospects for expanded pig production in the state must take into account alternative sources of supply. Both N.S.W. and Victoria rely heavily on Queensland to boost their supplies, and this deficit has increased in recent years. The industry in Queensland, while formerly largely associated with dairying, is now expanding rapidly in conjunction with increases in grain production, particularly sorghum. Unfortunately it was not possible to take into account the position in other states when estimating demand and supply models as there are no statistics available concerning interstate trade in pigs and pigmeat. Overseas trade in pigmeat has been of little consequence in recent years. However, the trade agreement

[1] Statistical information presented in this section has been derived from various publications of the Commonwealth Bureau of Census and Statistics.

concluded with New Zealand in 1965 could lead to larger imports from that country when pigmeat is scarce in Australia.

Mention can also be made at this stage of the tendency towards regular fluctuations over time in most of the economic variables pertaining to the industry, e.g. the number of pigs on farms, quantities of pigmeat produced, and prices of pigs. While these fluctuations have not been regular during the postwar period, they have caused considerable concern to producers. Since prices and quantities have tended to fluctuate in an inverse fashion, aggregate income accruing to the industry as a whole has been relatively stable. However, fluctuations in prices have proved hazardous to the producer maintaining a fixed herd, particularly the small producer with low capital reserves.

Supply Response of Pig Producers in N.S.W.

In examining the prospects for the pig industry in N.S.W. and more specifically the consequences of an expansion in north coast areas, it was necessary to ascertain the factors likely to influence the supply of pigs in N.S.W. While much of this analysis was severely hampered by inadaquate data, an attempt was made to estimate supply functions for the industry looking at dairy and inland areas separately. The number of sows on farms was regarded as the crucial supply variable and was in fact the only one since no adequate data is available in Australia concerning farrowings. Regression equations with this as the dependent variable were estimated for the two regions for the period 1951 to 1964.[2]

The equation estimated for dairying areas was

$$Y_t = 8923{\cdot}0 + \underset{(12{\cdot}6)}{884{\cdot}6X_{1t}} + \underset{(0{\cdot}02)}{0{\cdot}04X_{2t}} \quad (R^2 = 0{\cdot}84)$$

where Y = number of sows in coastal districts at 31st March,

X_{1t} = deflated price of pigs for the twelve months to the previous August,[3]

X_{2t} = coastal production of butter for the previous financial year (tons).

The coefficients of both explanatory variables are significant, at the 1 per cent level for X_1 and the 5 per cent level for X_2. There is no significant autocorrelation at the 5 per cent level of significance using the Theil-Nagar test.

Thus the major determinant of sow numbers in coastal areas appeared to be the price of pigs, with an average lag lying between eight and twenty months. However, the lagged level of butter production also exerted a positive influence, reflecting both the trend to whole milk production, and also changing climatic conditions. The price elasticity of supply, 0·5, was somewhat low, implying that a comparatively large price change would be required to bring about a change in sow numbers.

The price of grain was found to exert no significant influence on sow

[2] Data used to estimate the regression equations were obtained from three sources: (1) Bureau of Census and Statistics publications, (2) The Australian Meat Board publication *The Meat Producer and Exporter*, (3) *The N.S.W. Statistical Register*.

[3] This was a simple average of baconer and porker prices in cents per pound. It was deflated by the 'prices paid by farmers' index, published by the Commonwealth Bureau of Agricultural Economics in the *Quarterly Review of Agricultural Economics*.

numbers in dairying areas. No satisfactory series for the price of skim milk could be obtained.

In inland areas the estimated equation was

$$Y_t = -7704{\cdot}0 + \underset{(49{\cdot}1)}{172{\cdot}3X_{1t}} + \underset{(303{\cdot}1)}{1036{\cdot}4X_{2t}} + \underset{(1{\cdot}1)}{2{\cdot}2X_{3t}} \quad (R^2 = 0{\cdot}90)$$

where Y_t = number of sows in inland areas at 31st March,
X_{1t} = index of the ratio of pig prices to coarse grain prices with 1965 as the base year,[4]
X_{2t} = linear trend,
X_{3t} = N.S.W. wheat acreage for the previous season.

The coefficients of all explanatory variables are significant at the 1 per cent level for X_1 and at the 5 per cent level for the other two. There is no serial correlation at the 5 per cent level.

In inland areas, three factors were found to influence sow numbers; an index of pig prices relative to grain prices in the previous year, the wheat acreage in the previous season, and a linear trend. The price elasticity of supply was found to be 0·7, slightly higher than in coastal areas but still rather low. There is no doubt as to the relevance of the wheat acreage variable. The expansion of the wheat industry in N.S.W. in postwar years has been largely responsible for the expanding pig industry. The linear trend was included to take account of technological improvements in the industry, mainly a trend to larger herds but also reflecting better management conditions.

Demand for Pigmeat in N.S.W.

Demand for pigmeat in N.S.W. at both the retail and wholesale level was the prime concern of the study. However, since no data was available concerning the consumption of pigmeat on a state basis it was necessary to examine the demand for pigmeat in Australia as a whole. Since, at the retail level, pork is consumed as two essentially different commodities, the demand for pork, and bacon and ham, was examined seperately again using regression techniques. Data covered the period from 1948-49 to 1961-62.

For bacon and ham the equation estimated was

$$Y_t = 177{\cdot}01 - \underset{(0.02)}{0{\cdot}18X_t} \quad (R^2 = 0{\cdot}85)$$

where Y_t = consumption of bacon and ham (pounds per capita)
and X_t = deflated retail price of bacon (cents per pound).

The regression coefficient is significant at the 1 per cent level and there is no apparent autocorrelation.

Hence it was found that per capita consumption was primarily determined by current price with a price elasticity of demand of $-1{\cdot}3$, implying that consumption was sensitive to changes in the price of bacon. The other variables considered likely to influence the demand for bacon in Australia were the price of other meats, and the level of income. The best measure of the price of other meats was felt to be a weighted

[4] The pig price variable is the same as that used in the coastal supply relationship, while the measure of grain price was a simple average of indices of the prices of oats, maize, feed barley, and sorghum prices as supplied by the N.S.W. Department of Agriculture for the Sydney market.

average of the deflated prices of beef, mutton, and lamb, with per capita consumption figures used as weights. Unfortunately the variable proved to be highly correlated with the price of bacon ($r = 0{\cdot}77$) so was omitted to avoid multicollinearity problems. In tune with traditional demand theory, real income was included as a variable in the original equation but its coefficient was not significant. In fact there was little change in real per capita income over the period considered. The price of eggs also appeared to exert no influence on bacon consumption.

The demand for pork proved more interesting. The regression equation was

$$Y_t = 14{\cdot}45 - \underset{(0{\cdot}07)}{0{\cdot}26X_{1t}} + \underset{(11{\cdot}33)}{68{\cdot}95X_{2t}} \quad (R^2 = 0{\cdot}87)$$

where Y_t = consumption of pork (pounds per capita)
X_{1t} = deflated retail price of pork (cents per pound)
X_{2t} = proportion of the population which has arrived in Australia since 1947.

This showed that while the demand for pork was sensitive to price changes (price elasticity is $-1{\cdot}2$), it has been considerably influenced by the tastes of an increasing proportion of migrants in the population. It was possible to disaggregate the demand function into two separate functions, one showing the demand by Australians and the other the demand by newcomers, if it was assumed that the two functions had the same slope.

These functions are,

(1) Demand for pork by Australians,
$$Y_{at} = 14{\cdot}45 - 0{\cdot}26X_{1t}, \text{ and}$$
(2) Demand for pork by newcomers,
$$Y_{nt} = 83{\cdot}40 - 0{\cdot}26X_{1t}$$
where X_{1t} is defined as in the aggregate equation.

In estimating the original equation, both the level of real income, and the price of other meats as defined in the bacon function, were included but both failed to show significant coeffiicients. Thus so long as an immigration programme is maintained in this country, the demand for pork can be expected to increase, almost regardless of price.

Prospects for Expansion on the North Coast

The ultimate aim of this study was to try to determine the capacity of the pig industry in N.S.W. to absorb increased production on the north coast. This was considered from two points of view. Firstly, at a theoretical level, the consequences of an expansion on the north coast were examined under the assumption that conditions prevailing throughout the rest of the industry, and hence production, remain static.

Given several simplifying assumptions, it was shown empirically that if research were to lead to technical innovations whose benefits accrued solely to north coast producers, the consequent expanded production would be expected to increase the income of producers in the area. The calculations were based on a technique used by Powell in a study of the possible effect on Australian wool receipts of an expansion in the wool industry peculiar to Australian producers.[5]

[5] A. Powell, 'Export Receipts and Expansion in the Wool Industry'. *The Australian Journal of Agricultural Economics*, 3 (December, 1959), pp. 67-74.

It was assumed
(1) N.S.W. constituted the whole market facing N.S.W. producers,
(2) 40% of N.S.W. pigs were in coastal areas,
(3) there was a cost neutral technical innovation benefiting coastal producers.

It has been estimated
(a) the elasticity of demand facing N.S.W. producers is $-1{\cdot}0$,
(b) the elasticity of supply of inland producers is $0{\cdot}7$,
(c) the elasticity of supply of coastal supplies is $0{\cdot}5$.

It can then be shown that a 10 per cent increase in output confined to coastal areas could be expected to lead to a 7 per cent increase in gross income of coastal producers. On the other hand a 10 per cent increase in total N.S.W. production would lead to only a 1 per cent increase for these producers.

Tentative results of experiments conducted at the Wollongbar Agricultural Research Station in N.S.W. have shown that by increasing the proportion of grain to milk in pig rations, the time taken to bring pigs to desired market weight can be significantly reduced. Moreover technical innovations in the dairy industry are likely to lead to increased milk production and a modification of the seasonal pattern.

Thus an expansion of production confined to dairying areas could be expected, and if conditions remained static in inland areas, coastal districts could expect to increase their gross incomes by boosting production. Under such circumstances increased production would surely be recommended.

Unfortunately the position is not in practice as clear cut as this. It was necessary to attempt to evaluate prospects for the state-wide industry in the light of possible trends of supply and demand. The supply position will be considered first.

In inland areas prospects for expansion are favourable. The major factors influencing supply in these areas were found to be the pig-grain price ratio, wheat acreage, and time. So long as the future of the wheat industry remains assured, technological improvements are expected to lead to further expansion in wheat acreage though possibly at a reduced rate. The time trend influence could also be expected to continue particularly as more and more large scale enterprises are established. Since the elasticity of supply is less than unity it would take a considerable drop in the price ratio to inhibit expansion in these areas.

On the demand side, the price elasticity of demand of slightly more than unity does indicate that a price fall would cause quantity demanded to rise slightly more than proportionally with a consequent slight benefit in income to the industry. This is assuming there is no change in the proportion of the population which has arrived in Australia since 1947. Since there seems little possibility of developing any significant export markets the possibility of absorbing extra production would thus appear to hinge on whether the level of migration can be maintained.

Conclusions

Given the apparently favourable results of research carried out at Wollongbar it is tempting to recommend an increase in pig production in the north coast of N.S.W. in the hope of increasing the incomes of

small farmers. However, so long as the wheat industry continues to expand, pig production in inland areas will follow suit. With the slackening off in the level of migration and limited export prospects, per capita demand cannot be expected to increase rapidly. Thus I feel that supply may tend to outstrip demand with a consequent reduction in price. With demand slightly elastic the market may just be able to absorb the increased production without a fall in total revenue. However, the results do not appear sufficiently optimistic to encourage the belief that large scale expansion of the pig industry would be even a partial solution to the low income problem.