AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

REVIEW OF MARKETING AND AGRICULTURAL ECONOMICS
Vol. 43, No. 1, (*March*, 1975)

RESPONSE FUNCTION ESTIMATES FOR LOT FED BEEF*

B. D. Buffier‡ and J. W. Freebairn†

The paper reports estimates of the short term response in the number of cattle placed on feed lots to changes in the prices of fat cattle, store cattle and grain. Data used in the analysis comes from interviews of a panel of feed lot operators regarding their intended 1974 throughput of cattle at different price combinations. Price combinations are identified at which no cattle would be placed in feed lots, at which feed lots would be used at maximum capacity, and at which price changes would induce changes in the number of cattle on feed. For the price responsive zone regression procedures are employed to estimate response price elasticities.

1 INTRODUCTION

Future trends in the Australian lot feeding industry have important implications for the supply of lot fed beef and for the demand for cattle and for grain to be used by the industry. A survey conducted by the A.N.Z. Banking Group [2] estimated that 7 per cent of Australian beef and veal production in 1971–2 came from lot fed beef. In terms of input demand the lot feed industry in 1971–2 required just over 350 000 cattle and a little under half a million tonnes of grain. Subsequent estimates by Beeby [5] and others suggested that lot feeding of cattle became relatively more important in 1972–3 but there has been a marked decline since then. Future growth of the feed lot industry will alter the existing seasonal patterns of beef production and beef prices since lot feeding of beef is less subject to the effects of seasonal conditions.[1] The feed lot industry has implications for the market for grass fed animals in terms of demand for slaughter cattle versus store cattle for intensive feeding and it has an important bearing on the domestic market demand for feed grains.

Profitability of lot feeding is largely a function of prices received for fat cattle, the output price, and of prices paid for store cattle and for grain, the most important input prices. The growth of the industry will be influenced by future levels of these prices and by the response of feed lot operators to different price combinations. This study aims to quantify the nature of the response in the number of cattle placed on feed lots to different market prices.

---

* Manuscript received October, 1974.

‡ Economist, N.S.W. Department of Agriculture, Tamworth.

† Australian National University.

[1] For an analysis of seasonality in beef production and prices see Bureau of Agricultural Economics [7].

The study employs producer panel data to estimate the number of cattle likely to be placed in Australian feed lots at different combinations of prices for fat cattle, store cattle and grain. The producer panel offers a useful methodology for analysing supply response of a relatively new industry and one for which there is an absence of suitable time series data. The estimated response function together with forecasts of market prices may be used to project the number of cattle to be placed in feed lots. In turn, the projections provide a basis for assessing the supply of fed beef and the demand for store cattle and for grain to be used in feed lots.

2 BACKGROUND

Lot feeding of cattle embraces activities in which cattle are intensively fed high quality rations in yards to achieve high rates of body weight gain, to produce heavier, well-fattened carcases of tender beef and to achieve a high degree of uniformity among carcases. Within this general definition a variety of feed lot activities are found in Australia.[2]

For the purposes of the response analysis it is useful to distinguish between full time and opportunity feed lot operations and between operations feeding cattle primarily for the export or for the domestic market. Full time or permanent feed lots normally aim for maximum utilization of feed lot capacity at all times of the year. They are relatively large scale operations (annual throughput in excess of 1 000 head per year), and are often integrated with other sectors of the cattle industry. Opportunity feed lots generally utilize regular seasonal variations in cattle prices and consequently feed a variable number of cattle at different times of the year. Most opportunity feed lots are relatively small scale operations and many use some home-grown store cattle and grain. Typically, cattle for the export market are placed on feed at an older age and heavier weight, fed for a longer period, and marketed at a heavier weight than are cattle for the domestic market. The different feed lot systems and the intended market outlet may be expected to influence the profitability of lot feeding cattle.

The number of cattle placed on feed lots would be determined to a large extent by the profitability of cattle feeding. Budgets of feed lot activities and interviews of feed lot operators indicate that profitability is determined by managerial skills and by market prices.[3] Managerial skills encompass the finishing and marketing of animals as well as the efficient operation of feed lots in terms of feed conversion, weight gain and mortality rates. Critical market prices are the prices received for the finished animal, denoted as the fat cattle price, the price paid for the input animal, denoted as the store cattle price, and the price paid for the grain to feed the animals. The fat cattle—store cattle price margin is important since it determines the gross gain (or loss) from maintaining the animal at its purchased weight, and the fat cattle price affects the gross value of the

[2] For a description of the Australian feed lot industry, see A.N.Z. [2].

[3] Some example budgets are reported in [2, 3, 4, 6, 8, 10], and the next section describes the feed lots interviewed by the authors.

additional weight gained by the animal while on feed. About 70–80 per cent of the costs of running and maintaining cattle on a feed lot (including feed, veterinary, depreciation, and repairs and maintenance costs) are grain costs.

Summarizing, fat cattle prices, store cattle prices and grain prices are important variables influencing the number of cattle placed on feed lots, particularly in the short run in which managerial skills may be assumed approximately constant. Since the level of profitability of cattle feeding may vary with the type of feed lot and with the intended market outlet for the fed cattle, the study will investigate differences, if any, between the price response behaviour of the different activities. While secondary data is available for the prices of fat cattle and of grain, it is necessary to obtain primary data for the prices of store cattle and for the number of cattle placed on feed lots.

3 METHODOLOGY

Graphic and regression procedures are used to analyse data collected from interviews of feed lot operators regarding their intended production levels at different price combinations. The methodology outlined below is essentially that of a producer panel.

4 DATA SOURCE

Primary data for the response analysis was obtained from personal interviews of feed lot operators who were asked to indicate their intended 1974 throughput of fed cattle at different price combinations.

During May-August 1973 the operators of all known operating feed lots in northwestern New South Wales were interviewed.[4] Answers to questions regarding operator's intended throughput of cattle at different price combinations were satisfactory for only half of the twenty-one operators interviewed. Those excluded from the producer panel included two operators who said they required detailed budgetary assistance before answering the questions, two used "rule of thumb" criteria, and the others had difficulties in conceiving their response at some or all the price combinations considered (either because the prices were beyond the range of their experience or because they were using home grown grain or stock and had no feel for the opportunity cost of these inputs). Only data from operators who expressed confidence that their intended response to hypothetical questions would be realized in a comparable real world situation were used in the response analysis.

Table 1 compares some characteristics of feed lots surveyed by the A.N.Z. Banking Group [2] in 1971–2, of all feed lots in northwestern New South Wales contacted by us in 1973, and of the feed lots used in the price response study. Our census describes an industry placing relatively more importance on larger scale feed lots and on full time feed lots rather

[4] Several operators were missed because mutually convenient times could not be arranged. Some of the interviews were carried out in conjunction with, or by, R. L. Ada. Ada's thesis [1] provides additional details of characteristics of feed lots in northwestern New South Wales.

than opportunity feed lots. The differences could be due to geographical reasons, to sampling errors associated with the A.N.Z. survey, or to a systematic change in the structure of the industry over time. Beeby [5] and others contend that such structural changes have been occurring and are likely to continue into the future.[5] In terms of numbers of cattle on feed, the industry is dominated by full time and relatively large scale feed lots. Feed lots included in the response analysis are similar to those contacted in the census with respect to relative importance of full time feed lot operations and average throughput capacity.

TABLE 1

Some Structural Characteristics of Feed Lots in the A.N.Z. Survey, in the Census of Northwestern New South Wales, and those Involved in the Response Study

Feed Lot Characteristic	A.N.Z. Survey of Australian Feed Lots, 1971–2*	Feed Lots in North Western N.S.W., 1973†	Feed Lots in Response Study‡
1. Full Time Feed lots:			
No. of operators	20	11	5
Per cent of operators	34	52	50
No. of cattle	n.r.	37 100	19 300
Per cent of cattle	90	94	93
Average capacity	1 200	2 070	2 160
2. Opportunity Feed lots:			
No. of operators	39	10	5
Per cent of operators	66	48	50
No. of cattle	n.r.	2 200	1 470
Per cent of cattle	10	6	7
Average capacity	270	270	350

* Source: A.N.Z. [2].

† Census conducted by authors.

‡ A subset of the 1973 census of northwestern New South Wales feed lots.

n.r. Not reported.

Without any information about the population of feed lots in Australia in 1973 it is not feasible to rigorously assess whether or not the ten feed lot operators of the producer panel provide a representative sample, nor is it feasible to specify the order of magnitude of the sampling errors. Certainly the operators are not representative in a geographical sense, but this is considered to be unimportant as long as they are representative in terms of structure of the industry and in terms of response to changing market conditions. Table 1 suggests that they are representative in terms of some structural characteristics and we have no *a priori* or other information to believe that they are representative or unrepresentative in terms of objectives and managerial skills. Given the foregoing reservations we assume that the producer panel members form a representative sample of current Australian feed lot operators.

[5] It is interesting to note that Australian feed lots are small relative to their United States counterparts.

Panel members were asked their intended 1974 throughput of fed cattle at different fat cattle, store cattle and grain price combinations given their existing and planned investment in feed lot facilities. In practice the operators' answers reflected a decision to operate at full capacity or not at all; this type of behaviour is suggested by economic theory since fixed costs are bygones and variable costs are constant and independent of scale except for a few discontinuities associated with lumpy labour inputs. Since feed lot facilities are treated as given, and no allowance is made for new entrants to the industry, the responses should be interpreted as depicting short run behaviour.

Choice of the price combinations over which operators intended response was sought involved consideration of likely future prices and the ability of operators to conceive their behaviour at these price combinations. While the prices at which operators purchase store cattle and sell fat cattle are not known (or are confidential), some data of an indirect and approximate nature regarding the relationship of fat cattle and store cattle prices are available. The Bureau of Agricultural Economics examined Queensland Department of Primary Industry data for fat cattle and store cattle prices on a monthly basis. They found no sustained differences for the period 1960–3, a positive margin of 2–5 cents/kg liveweight for the 1964–5 drought period, and a negative margin of as much as 5 cents/kg liveweight in the post drought period 1966–7[6]. Another Bureau of Agricultural Economics study [7] found evidence of seasonal fluctuations in cattle prices. Information provided by operators in our interviews of feed lot operators indicated that in 1973 fat cattle prices exceeded store cattle prices by 5–10 cents/kg liveweight. To some extent the premium for fed beef depended on contracts with export outlets, particularly in Japan, and speciality domestic markets. These "special contracts" resulted in margins of 10 cents/kg as indicated above. On the basis of the limited historical evidence we have assumed that future movements in fat cattle and store cattle prices will be highly correlated and conservatively that the fat cattle-store cattle price margin will fall within the range of -5 to 10 cents/kg liveweight.

The number of cattle placed on feed lots was assessed by producers for a set of price combinations. Five levels of the fat cattle price were considered—37·5, 42·5, 47·5, 52·5 and 57·5 cents/kg liveweight. For each fat cattle price, nine variations of the store cattle price ranging from fat cattle price less 10 cents to fat cattle price plus 6 cents were considered. For each fat cattle and store cattle price combination six levels of the grain price were considered—36, 40, 44, 48, 52 and 56 dollars/tonne of sorghum. Sorghum is the most commonly used grain in northwestern New South Wales feed lots, and other grain prices are readily converted into sorghum equivalents and *vice versa*. Operators use the grain providing the lowest cost digestible nutrients and protein. A total of 270 price combinations were covered. At the time of the interviews cattle prices were at the upper end of the range covered, but by late 1974 they were below the lower end. Grain prices moved in the opposite direction. Prices were near the middle of the range used in mid 1973, but by late 1974 had moved well above the upper end of the range.

[6] This data is reproduced in Bureau of Agricultural Economics [6].

5 RESULTS

Combinations of fat cattle price (cents/kg liveweight), store cattle price (cents/kg liveweight) and grain price (dollars/tonne sorghum) were classified into three zones in figure 1 according to price responsive characteristics. Prices of fat cattle and of store cattle southeast of points marked by an asterisk (*) and grain prices higher than the superscripted number isolate those price combinations at which the panel members would place no cattle on feed lots. At the higher fat cattle prices operators would place some cattle on feed lots at a negative fat cattle-store cattle price margin, but at the lower fat cattle price levels a positive price margin would be required. Also, the higher the grain price the higher would be the required margin and/or the higher the fat cattle price before operators would place cattle in feed lots. For example, with a fat cattle price of 57·5 cents/kg and a store cattle price of 63·5 cents/kg some cattle would be placed on feed at a grain price less than $44/tonne. With a fat cattle price of 37·5 cents/kg and a store cattle price of 36·5 cents/kg no cattle would be placed on feed when the grain price was greater than $52/ton. Prices of fat cattle and of store cattle north-west of points marked by a cross (X) and grain prices lower than the superscripted number isolate those price combinations at which the existing and planned feed lot facilities of the panel members would be used to maximum capacity. This zone of very favourable price combinations is associated with a fat cattle-store cattle price margin of at least 5 cents/kg liveweight and relatively low grain prices. At a fat cattle price of 57·5 cents/kg and a store cattle price of 48·5 cents/kg, feed lot facilities would be in maximum use when grain prices were less than $48/tonne. Similarly, with a fat cattle price of 37·5 cents/kg, a store cattle price of 27·5 cents/kg and grain prices less than $44/tonne, feed lot facilities would be in maximum use. Between the two extreme zones there is a range of price combinations within which the number of cattle placed on feed lots is responsive to changes in the prices of fat cattle, store cattle and grain.

Disaggregating the panel members into operators of full time and large scale feed lots versus opportunity and small scale feed lots or into export market oriented feed lots versus domestic market oriented feed lots had little effect on the zonal pattern of price responsiveness depicted in figure 1. That is, the price combinations at which no cattle would be placed in feed lots or at which feed lot capacity would be put to maximum use are not greatly different according to the type and scale of operation of feed lots or according to the intended market outlet for the fed cattle.

Our limited knowledge about the prices of fat cattle, store cattle and grain discussed in the previous section suggested that prices in recent years have been in the price responsive zone.

Using observations in the price responsive zone, regression equations describing the number of cattle placed in feed lots as a function of the prices of fat cattle, store cattle and grain were estimated. The preferred function is reported in table 2.[7] The number of cattle placed in feed lots

[7] Other algebraic forms of the function were estimated—a linear function in the price variables and a quadratic function in the price variables. The preferred function had the greatest explanatory power as measured by R^2 and gave at least as satisfactory properties in terms of signs of parameter estimates and of precision of the parameter estimates. Clearly, the algebraic form influences the elasticity estimates reported below, however the response price elasticity estimates for cattle price and for grain were largely invariant to the algebraic form.

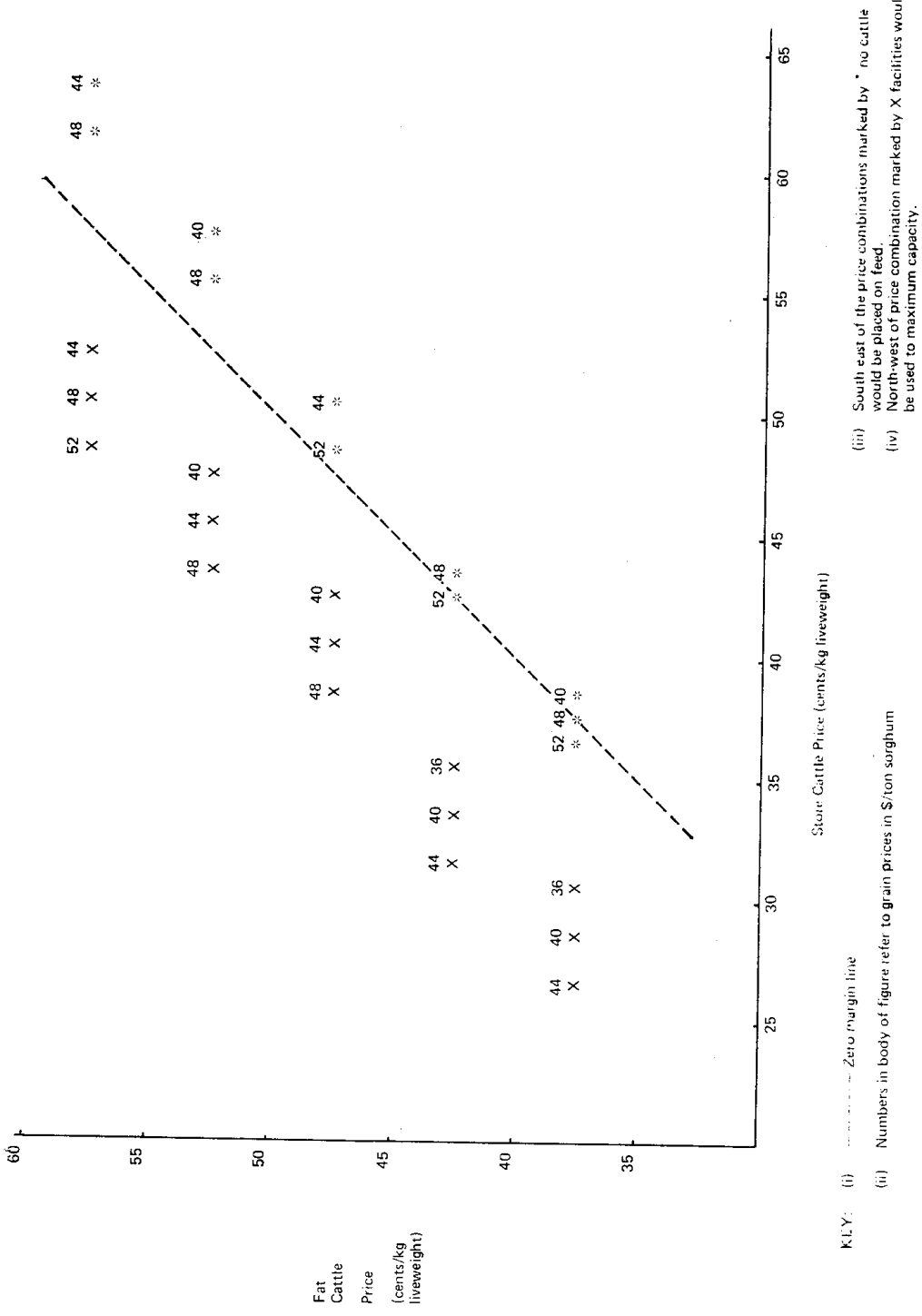

FIGURE 1—Feedlot Utilization at varying Input and Output Prices

is positively related to the fat cattle price and to the fat cattle-store cattle price margin, with the price margin having a relatively greater influence when the margin is closer to zero, and is negatively related to the grain price.

TABLE 2

Estimated Regression Equations for the Number of Cattle Placed in Feed Lots

	Dependent Variable		
	Number of Cattle Placed on All Feed lots	Number of Cattle Placed on Full Time Feed lots	Number of Cattle Placed on Opportunity Feed lots
Explanatory Variables*			
Constant	33 895	29 142	904
P_f	659	537	45
	(139)†	(113)	(3)
$P_f - P_s$	6 877	6 386	173
	(416)	(380)	(9)
$(P_f - P_s)^2$	−534	−462	−4
	(63)	(41)	(1)
P_g	−543	−313	−50
	(131)	(120)	(3)
R^2	·65	·63	·83
Number of observations	197	194	191

* P_f—fat cattle price (cents/kg liveweight); P_s—store cattle price (cents/kg liveweight); P_g—grain price (dollars/tonne sorghum). Estimates are for prices in the price responsive zone only.

† Estimated standard error terms in parenthesis.

Estimates of the price elasticity of response of the number of cattle placed in feed lots at an arbitrarily chosen set of prices in the price responsive zone are reported in table 3; recall that the price elasticity estimates will be zero in other price-zones (zone with no cattle on feed and zone with feed lots in maximum use). The price elasticities which we denote as E_i, where i refers to fat cattle price, store cattle price, cattle price (for perfectly correlated movements in fat cattle and store cattle prices) and grain price, are calculated as

$$E_i = (dQ/dP_i) / (\hat{Q}/P_i)$$

where P_i is price of i, Q is the number of cattle placed in feed lots, dQ/dP_i is a partial derivative computed from the estimated regression equation in table 2, and $\hat{Q}$ is the estimate of Q using the estimated regression equation in table 2. Since dQ/dP_i and $\hat{Q}$ are functions of the prices, the elasticity estimates also are functions of these prices.

TABLE 3

Mean Elasticity Estimates for Cattle Placed on Feed with Respect to Fat Cattle Prices, Store Cattle Price and Grain Price at Different Price Levels

Point of Elasticity Evaluation			Elasticity of Cattle Placed on Feed with Respect to*			
Fat Cattle Price (cents/kg)	StoreCattle Price (cents/kg)	Grain Price ($/tonne)	Price of Fat Cattle	Price of Store Cattle	Price of Cattle†	Price of Grain
55	55	50	9.64	−8.80	.84	−.63
55	55	40	8.56	−7.81	.75	−.45
55	50	50	1.89	−1.20	.69	−.42
55	50	40	1.74	−1.11	.63	−.31
45	45	50	9.32	−8.50	.82	−.75
45	45	40	8.11	−7.40	.71	−.52
45	40	50	1.72	−1.07	.65	−.47
45	40	40	1.57	− .98	.59	−.35
35	35	50	8.85	−8.08	.77	−.71
35	35	40	7.51	−6.85	.66	−.62
35	30	50	1.51	− .91	.60	−.53
35	30	40	1.37	− .82	.55	−.39

* Evaluated according to text.

† For perfectly correlated movements in fat cattle and store cattle prices.

The elasticity estimates in table 3 reveal several interesting characteristics of the response of the number of cattle placed on feed lots in the price responsive zone. For independent movements in the prices of fat cattle and store cattle the response price elasticities are large when the price margin is close to zero (elasticity estimates exceed seven in absolute value) and become smaller the greater the margin deviates from zero (elasticity estimates of less than two in absolute value for a 5 cent/kg margin). In recent years, movements in fat cattle and store cattle prices have been highly correlated[8] and in this context the cattle price response elasticity derived under the assumption of perfectly correlated price movements is relevant. The cattle price elasticity estimates range from 0·55 to 0·85, with the higher levels being associated with higher fat cattle prices and a zero price margin. The grain price elasticity estimates are of the opposite sign and smaller (in absolute value) than the comparable cattle price elasticity estimates. Thus, for similar percentage movements in cattle and grain prices the former have a more important effect on the number of cattle placed on feed lots.

[8] See the previous section for evidence.

Important differences are found in the estimated response price elasticities when the replies of panel members are segregated on the basis of full time and opportunity feed lots. As expected for this method of disaggregation, the response price elasticities for the opportunity operators are much larger than for the full time operators (see table 4 which is based on the estimated relations shown in table 2).

TABLE 4

Comparison of Mean Elasticity Estimates for Cattle Placed on Feed for Full Time Operators (FT) and Opportunity Operators (O) with Respect to Fat Cattle Price, Store Cattle Price and Grain Price

Point of Elasticity Evaluation			Type of Operator	Elasticity of Cattle Placed on Feed with Respect to			
Fat Cattle Price (cents/kg)	Store Cattle Price (cents/kg)	Grain Price ($/tonne)		Price of Fat Cattle	Price of Store Cattle	Price of Cattle*	Price of Grain
45	45	50	FT	6.02	—5.55	.47	— .30
45	45	50	O	23.92	—18.15	5.77	—5.82
45	45	40	FT	5.98	—5.52	.46	— .24
45	45	40	O	11.04	—8.38	2.66	—2.15
45	40	50	FT	1.44	— .98	.46	— .22
45	40	50	O	5.58	—3.12	2.46	—2.09
45	40	40	FT	1.43	— .98	.45	— .17
45	40	40	O	3.93	—2.20	1.73	—1.81

* For perfectly correlated movements in fat cattle and store cattle prices.

The estimates reported in this section of the response in the number of cattle placed on feed lots to market prices is subject to a number of limitations. The basic data comes from a small sample of current feed lot operators and is based on answers to hypothetical questions. Unfortunately it is not possible to comment on the order of magnitude of the errors associated with the methodology.[9] The estimates refer to the response of operators given their existing or planned investment in feed lot facilities and management skills are assumed to be constant. Given these reservations the estimated response function should be considered to provide only an approximate description of the short term response in the number of cattle placed in feed lots to the prices of fat cattle, store cattle and grain.

[9] The difficulty in estimating the errors arises because (i) the sample is from an unknown population, and (ii) it is not possible to assess to what extent the operators intended response to the hypothetical questions will be realised in a comparable real world situation. Regarding the latter point, the wide use and apparent success of surveys of anticipated investment expenditure in macroeconomic forecasting are encouraging [9].

6 CONCLUSIONS

This study used producer panel data to estimate the short run response in the number of cattle placed on feed lots as functions of the prices of fat cattle, the output price, and the prices of store cattle and of grain. Interviews of feed lot operators in northwestern New South Wales were conducted in 1973 to assess the numbers of cattle intended to be placed in feed lots in 1974 over a space of price combinations ranging from 37·5 to 57·5 cents/kg liveweight for fat cattle, 27·5 to 63·5 cents/kg liveweight for store cattle and 36 to 56 dollars/tonne of sorghum for grain. While operators would feed some cattle at a negative fat cattle-store cattle price margin when fat cattle prices were relatively high, they required a positive margin when fat cattle prices were below 40 cents/kg, particularly in the situation of high grain prices. A positive fat cattle-store cattle price margin in excess of 5 cents/kg liveweight, the precise level depending on the grain price, would be required before all available feed lot facilities would be used at maximum capacity. For price combinations between these extremes, response price elasticities were estimated.[10] The estimates suggested highly elastic responses in the number of cattle placed on feed lots to independent movements of the fat cattle or store cattle prices, particularly when the price margin was small. For correlated movements in fat cattle and store cattle prices and for changes in grain prices the response elasticities were estimated to be less than one (in absolute values).

Further research will be required to assess long term fed cattle response functions which allow for investment (and disinvestment) in feed lot facilities. Even though the overhead costs associated with investment in feed lot facilities comprise a small portion of total costs of feeding cattle, it seems reasonable to suggest that the long run response price elasticities will be greater (in absolute value) than the short run estimates reported in this paper.

[10] For price combinations in the non-responsive price zones the elasticities are zero by definition.

REFERENCES

[1] ADA, R. L., *Beef Cattle Lot Feeding in North-Western N.S.W.*, (Sydney University unpublished B.S. (Agric.) thesis, 1973).

[2] A.N.Z. Banking Group Ltd, *Beef Feedlotting in Australia*, (Melbourne, 1973).

[3] BEEBY, L. D., "Lot Feeding of Beef Cattle, Its Prospects in Australia", *Agric. Gazette of N.S.W.*, vol. 79 (1968), pp. 137–142.

[4] ——, "Management and Feeding in the Beef Cattle Feedlot", *Agric. Gazette of N.S.W.*, vol. 79 (1968), pp. 390–391.

[5] ——, "Lot Feeding of Cattle—Why Bother", *Proc. Aust. Soc. Anim. Prod.*, vol. 10 (1974), pp. 65–73.

[6] BUREAU OF AGRICULTURAL ECONOMICS, "The Economics of Fattening Store Cattle by Dry Lot Feeding", (Beef Research Report No. 5, Canberra, 1969).

[7] ——, "Seasonality in the Australian Beef Industry", (Beef Research Report No. 7, Canberra, 1970).

[8] CORAH, L., "The Cost of Lot Feeding", *Journal of Agriculture*—Victoria, vol. 67 (1969), pp. 108–109.

[9] EVANS, M. K., *Macroeconomic Activity* (New York: Harper and Row, 1969).

[10] RABBITTE, J. G., "The Economics of Grain Fattening of Steers", *Journal of Agriculture*—Victoria, vol. 68 (1970), pp. 129–130.