Agribusiness Review - Vol. 9 - 2001

Paper 7
ISSN 1883-5675

Profitability of the Australian Beef Industry: A Break-even Analysis

Chinna A Kannapiran
Acting Director / Senior Economist, Economics Branch,
THS, NT Government / P.O.Box : 40160 Casuarina NT 0811 Darwin Australia
Ph: 61-08-89992540 (Work) / Fax: 61-08-89451863
Email: kannan.chinna@nt.gov.au

Abstract

Profitability of the specialist beef production in the Australian Beef Industry is undertaken using a break-even model. The results reveal that during the financial years 1991-1996, the specialist beef producers were operating above the break-even level in the states of South Australia and to some extent in Queensland. They were operating marginally below the profitable break-even level in the states of New South Wales and Tasmania. In all other states and Northern Territory, they were facing losses and financial crisis. However during the financial years 1993-1998, the beef producers in Queensland, South Australia, Northern Territory and Western Australia were able to cross the break-even level. Beef producers in all other states continue to face financial crisis. In all the states and Northern Territory beef producers were not able to fully recover the imputed value of their family labour. The producers were underpaid entrepreneurs and the industry is apparently surviving by trading on capital and or other off-farm income. Increase in production and cost control measures are possible options to improve the profitability. Although the findings provide a view of financial profitability of the specialist beef production in general, the situation may be different in specific cases. The study also reveals the usefulness of the break-even model in management decision support.

Keywords: Agribusiness, Australian, Beef, Industry, Profitability

Acknowledgement

This research was conducted when the author was a Research Economist with North Australia Research Unit, Research School of Pacific and Asian Studies, The Australian National University. The research was benefited by the comments and suggestions of Dr Ron May and Prof. Ronald Duncan of RSPAS-ANU and the participants of a seminar held at NARU-ANU. The comments by two anonymous referees are acknowledged. The usual disclaimers apply.

Introduction

Australia is the world's largest net exporter of beef. Annual beef export income is around $ 3.3 billion with 60 per cent being derived from northern Australia. The total value of Australia's annual beef production is approximately $ 4.4 billion. While the cattle numbers have remained relatively stable (25 million heads since 1980), the beef production over this period has expanded by 30% and exports by 50%, highlighting a significant productivity gain in the industry (Meat and Livestock Australia (MLA) 1999a; Cattle Council of Australia 1999). Over the years, the industry has substantially changed its focus of production and financial performance. The beef industry has to adjust to cope with the financial, economic and market pressures caused by drought, falling market prices, competition in export markets, economic downturn in Asia, food safety scares overseas and increased competition from alternative protein foods (Martin, Riley, Jennings, O'Rourke, and Toyne 1998).

Beef producers, according to the Meat and Livestock Australia, are looking for a profitable and sustainable beef industry. A draft *Beef Industry Strategic Plan 1999/2000 to 2001/02* presents the strategy to improve business management skills and capability to prosper in a competitive environment and to assist the industry in the development of key performance indicators for the individual businesses (MLA 1999b).

The present study was undertaken to evaluate the profitability of the beef industries in all states and Northern Territory during the periods 1991-92 to 1993-94 (Martin *et al*. 1998) and 1995-96 to 1997-98 (Riley, Martin, Lubulwa and Gleeson 2000). The purpose of the analysis is to support producers and planners by providing empirical evidences of profitability of beef industry and an appropriate management decision support model. A brief introduction of the Australian beef industry is available in section 2. Sections 3 and 4 present detailed discussion on the theoretical background for the break-even model analysis and its application as a management decision support tool in making decisions on production, pricing, risk management, turnover, profit planning and cost management. Sections 6 and 7 discuss the results of the analysis and illustrate the usefulness of the break-even analysis as an effective management decision support tool.

1. Australian Beef Industry

The Australian beef industry is comprised of approximately 60,000 producers of whom 20% account for 74% of production (CSIRO 1996). There are approximately 19,900 specialist beef properties[1] in Australia, carrying 60 per cent of the Australian cattle herd. These specialist beef enterprises range in size from an average of less than 250 ha in the State of Victoria to more than 350,000 ha in the Northern Territory (NT). There are a further 28,700 properties in Australia that carry a mixture of sheep, cattle and crops (ABARE 1998). The beef industry contributes between 11 and 19 per cent per annum of Australia's gross value of agricultural production. It also plays an important role in regional economic development. Australian beef cattle production can be classified into two categories. In North Australia which includes Northern Territory and the northern regions of Queensland (QLD) and Western Australia (WA), cattle production is extensively undertaken in large cattle stations, grazing on native pastures at very low stocking densities. Their products are mainly beef destined for the United States (US), lot-fed beef and live cattle exports.

In the south, cattle are grazed more intensively on smaller farm holdings sown with introduced pastures and fodder crops. The industry here supplies smaller, younger

animals chiefly for the Australian domestic market and higher quality stock for the Japanese market. While pasture-fed production dominates the Australian industry, the use of feedlots has developed dramatically since mid 1980s. Feedlot production involves feeding cattle high protein feed for periods ranging from 60 to 300 days to achieve specific market requirements. Feedlots exist in both the north and the south of the continent, close to grain-growing areas. This sector provides high-quality marbled beef aimed primarily at Japanese consumers. Australia now has a feedlot capacity of around 851,000 head with over half of that contained in Queensland and one third in New South Wales (NSW). According to Meat and Livestock Australia (MLA 1999c) 'Queensland is the major cattle-producing State with 38 per cent of the nation's cattle population followed by New South Wales (24.9 percent), Victoria (16.9 percent), Western Australia (7.5 per cent), the Northern Territory (5.6 per cent), South Australia (4.5 per cent) and Tasmania (2.6 per cent)'.

2. Theoretical Background

Financial analysis measures the profitability using the market (financial) price for inputs and outputs and facilitates investment decisions of private sector or commercial investment of public sector. In contrast, economic analysis[2] measures economic profitability using the shadow prices or the opportunity costs which may be different from their prices in the market and facilitates public sector investment decisions and public policy analysis (Gittinger 1982; Ward et al. 1991). Financial analysis is concerned with the return to the contributors of capital, and shows the profitability to the investors. Economic analysis reflects profitability from the viewpoint of the economy, and is concerned with the flow of real resources (hence, any transfer payments are excluded and time value of money accounted). Financial analysis is most appropriate to evaluate the private firms, public commercial investment and the industry as a whole and without financial profitability no industry can attract private investment. Similarly, the beef industry in Australia must be financially attractive to entrepreneurs and therefore the present study is undertaken to evaluate the financial viability of beef industry and is focussed on specialist beef producers in Australia.

Break-even analysis (BEA) is a financial analysis tool that provides one of the most useful decision models for financial management decisions (Ketz *et al.* 1991). It facilitates decision making in the short term, although long-term and strategic decisions can also be made based on BEA and it can assist in making investment decisions that are both technically and financially sound (Short and Lung 1996). Break-even point is simply the level of sales that a business must generate to achieve zero profit and or zero loss (cost recovery point); a business operating below that point for any length of time will fail.

Theory of firms provides the link between the economic theory and the break-even analysis. Classification of costs into fixed and variable component is necessary to understand the theoretical analysis. The total cost (TC) of a firm is classified as fixed costs (FC) and variable costs (VC). FC primarily consists of "overhead expenses" that firm incurs even if a product is not produced (Zero production) or no sales are made and therefore remain constant regardless of the level of production (e.g. salaries of management staff (not direct labour), rents, rates, taxes, leases, utilities, insurance, advertising). The total fixed cost curve is always horizontal because it does not change with output changes (Baumol et al 1988). VC changes in direct proportion to a change in the number of units sold or produced (include raw materials, direct labour, direct expenses (i.e. cost of goods sold). When the FC remains constant, the VC is the marginal cost per unit of production and the sale price (P) per unit minus VC remains as the contribution (C =P-VC) to recover the FC.

Rules that govern the decision by firms to continue or shut down the business are discussed below applying the Baumol's constrained sales maximisation model (see Baumol 1967; Baumol et al 1988):

1. If total revenue or income (TR) = Total cost (TC) or expenditure, the business continues to operate - **Breakeven or cost recovery point** (the TR_0 curve is at 500 units or the TR_2 curve is at 200 units in Figure 1).
2. If total revenue or income (TR) > Total cost (FC + VC) or expenditure, the business continues to operate – Income above the breakeven point and profitable (the TR_0 curve is above 500 units or the TR_2 curve is above 200 units in Figure 1).
3. In the short run, if the total revenue (TR) > total variable cost (VC), the business continues to operate - Income is below the breakeven point and the contribution towards FC is zero but sufficient to recover VC (the TR_0 curve is between 0 to 500 units or the TR_2 curve is between 0 to 200 units in figure 1).

4. In the short run, if the total revenue (TR) < total variable cost (VC) – the business below the shut down point - Income is below the breakeven point and not sufficient to recover VC (the entire TR_2 curve in figure 1).
5. In the long run, if the total revenue (TR) > total variable cost (VC) (but TR < TC) – Shut down the business - Income below the breakeven point and not sufficient to recover FC and TC (the TR_0 curve is between 0 to 500 units or the TR_2 curve is between 0 to 200 units and the entire TR_2 curve in figure 1).

Applying these theoretical rules, the BEA is used to evaluate the financial viability of the beef industry. BEA is a powerful decision-making tool in determining cost recovery price, level of production and profit and in the preparation of forecasts and budgets, and in budgetary control of expenses. It reveals how changes in sales and costs will affect profits and the financial risks associated with price and quantity variability. BEA can help management to simulate the effects of alternative management decisions on costs, profits and financial performance (Welsch, Hilton and Gordon 1988). By adding a planned profit to the fixed cost, BEA can determine the production or sales required (in dollars or units) to cover costs and achieve or maintain that desired level of profit. The resulting break-even volume becomes the target volume necessary to achieve the firm's profit objective (Kannapiran 1989; 1982).

Some of the basic assumptions of BEA are listed below (Ketz, Campbell and Baxendale 1991):

- Costs can be divided into fixed and variable components.
- The relationship of sales and costs is linear over the relevant range;
- Total fixed costs remain the same over the relevant range.
- Total variable costs are proportional to volume.
- The sale price does not change over the relevant range.
- No change in efficiency occurs.
- Either one product is analysed or a given sales mix of multiple products is analysed.
- Sales and production are equal.
- All relevant factors and data are known.

3. Methodology

At break-even point, the total income equals the total expenditure or the total revenue equals the total costs. A pure enterprise generates income from a single output or product and therefore, the costs and revenue can be easily identified and allocated to the product as in break-even equation 1:

Total revenue = Total cost or Income = Expenditure

$$Q \times P = FC + (VC \times Q) \quad (1)$$

Where Q is the quantity (units) produced or sold and P is the sale price per unit produced or sold, FC is fixed cost for the enterprise and VC is the variable cost per unit of production or sale (Van Horne 1983). In a mixed enterprise with multiple products and sources of income (beef, sheep, crop etc), the break-even equation must be modified to account for other income and expenditure on production of products other than the main product.

$$(Q \times P) + OI = FC + (VC \times Q) + OVC \quad (2)$$

Where OI is the sum of other income and OVC is the sum of other variable cost. FC is allocated for the whole enterprise. Equation 2 (Eq. 2) can be articulated in a variety of

ways to evaluate alternative choices for strategic and operational decision making in an enterprise (Ketz, Campbell and Baxendale 1991) as discussed below.

Production decision: To determine the production quantity in order to recover the given costs (fixed and variable) at the prevailing price of output, Eq.2 must be solved for Q. The estimated Q^e, which is also known as the break-even quantity (units of the major product), can be estimated for a given level of price and cost structure (Eq.3):

$$Q^e = (FC + OVC - OI) / (P - VC) \quad (3)$$

Where (P – VC) is contribution or profit margin per unit (Hilton 1994) and Q^e is the estimated or break-even quantity. The contribution per unit (sale price per unit minus variable expense per unit, i.e. P – VC) is the available income (or contribution) to recover fixed expenses. The fixed cost is then divided by the contribution per unit to determine how many units (break-even quantity) the firm must produce and sell to pay for fixed expenses. The break-even quantity indicates the number of units that must be produced and sold to cover all expenses.

Pricing decision[3]: The break-even price (P^e), below which the enterprise will not be able to recover the given costs, can be estimated by solving Eq.2 for P.

$$P^e = [(FC + OVC - OI) / Q] + VC \quad (4)$$

Where P^e is the break-even or estimated price. When the market price goes below this level, then there will be no full cost recovery and the enterprise incurs loss.

Risk Management Decision (Safety Margin Analysis): Safety margin or margin of safety analysis reveals the difference between the planned (budgeted or actual) sales and the break-even sales (Hilton 1994; Meredith 1994). It suggests to the management how close to the breakeven sales or production point the enterprise is operating (Welsch, Hilton and Gordon 1988). It essentially calculates the extent (or percentage) of decrease in sales quantity or price an enterprise could suffer before it began to operate unprofitably. Safety margin can be expressed in terms of quantity ($Q - Q^e$) and or price ($P - P^e$).

Safety margin (in terms of quantity) (SMQ) $= Q - Q^e$

Safety margin (in terms of price) (SMP) $= P - P^e$

Turnover decision: The total sales volume or income required to recover all the costs can be determined by multiplying the break-even price (P^e) and break-even quantity (Q^e).

Break-even sales volume or income $= P^e \times Q^e$

Profit Planning Decision: All business enterprises desire to make a profit and not just break even. A desired or planned profit[4] (payment to the entrepreneur) should be added to the fixed cost. This reduces the gross profit, which in turn raises the break-even volume. The resulting break-even volume thus becomes the target volume necessary to achieve the firm's profit plan (Meredith 1994). After adding a planned profit to the fixed cost amount, the BEA can be re-estimated to determine the break-even P, Q and SM for the revised FC (plus profit). The sales price per unit or the sales quantity required (units) to cover costs and achieve or maintain that desired level of profit can be determined (Kannapiran 1982, 1989).

Cost management decision: The tolerable level of fixed cost (or the maximum limit for the fixed cost), that can be recovered for the given level of production, variable costs and price, can be estimated by multiplying the contribution or profit margin (PM) per unit by the actual quantity produced (Q).

Tolerable fixed cost = PM x Q

While the break-even point indicates the level of profitability, other estimated parameters provide reasons for that level of profitability.

4. Data Collection and Processing

The main source of data for the present study came from Martin *et al*. (1998) and Reily *et al.* (2000). The survey contains data for monitoring the financial performance of beef producers in all the states and Northern Territory of Australia. The survey focussed on specialist beef producers. Five years average data for the financial year ending 1995-96 and 1997-98 were used to carry out the BEA of the specialist beef producers. The analysis based on five years average data for two periods is expected to provide the consistency of performance of the industry over the years. The data was classified into fixed costs (administrative cost, rents and taxes, repairs and maintenance, depreciation, debt servicing etc.), variable costs (cost of beef cattle purchased, freight, handling and marketing, feed and fodder costs etc.), other variable costs (cost of production for activities other than beef) and beef income and other incomes (income from sources other than beef).

A special mention must be made about the treatment of depreciation. Although depreciation is a non-cash expenditure in a particular year, it accounts for recovery of the capital invested already and or a deferred expenditure resulting from amortization of the capital expenditure already incurred. Failure to treat depreciation as cost leads to a situation of 'trading on capital'. All business enterprises aim at 'return of capital (recovery of capital invested)' and 'return on capital (income from the capital investment)' (Gittinger 1982). In marginal cost analysis, like BEA, depreciation is a deferred cost to recover the capital invested (return of capital). It must, therefore, be treated as a fixed cost. This convention has been adhered to in this study.

5. Results and Discussions:

A break-even model (Eq. 1 - 4) of the Australian Beef Industry was developed and used in the present study. The model was articulated and estimated to obtain various results to evaluate the financial viability and to assist beef producers in making decisions on production, pricing, risk management (safety margin), cost control and profit planning. The results of the study are presented for the five years period ending in financial years 1995-96 and 1997-98 (see Table 1 and 2 and in figures 2 to 10). The break-even charts for all the states and NT are available in figures 4-10. The effectiveness of the model as a management decision support tool has been illustrated in this paper. The main findings of the study are briefly discussed here.

1. Between 1991-92 to 1995-96, beef producers in South Australia (SA) were the most efficient in terms of production, costs and risk management and profitability, followed by QLD. Beef producers in Tasmania and NSW were operating on a narrow margin of financial viability and in all other states and in the NT, the beef industry was facing a serious financial crisis (see Table 1 and figures 2 to 10). During the period 1993-94 to 1997-98 the situation changed and beef producers in QLD were most efficient followed by SA, NT and WA. Beef producers in all other states continue with financial crisis. The recent increase in market prices might help the beef producers to break-even (see Riley *et al*. 2000)
2. One of the reasons for the continued financial success of the beef industry in SA is the location of almost 60 per cent of the beef properties in high rainfall districts that favours higher productivity and quality of beef. The industry also targets the potential markets for grass and grain finished animals. The South Australian beef industry is growing at a rate of about 5 per cent a year. Larger cattle enterprises with associated economies of scale[5] and extension of quality assurance (already occurring in many feedlots and processing facilities) contribute to improving efficiency of beef industry in SA (PIRSA 1997), QLD, NT and WA.
3. Apparently the scale economy affects the viability of beef industry in Victoria and Tasmania as the average size of the beef properties and herd strength (less than 200 cattle head) are comparatively lower in these states (see Table 1 and 2). According to the Tasmanian Department of Primary Industries (DPIWE 1999), lack of

profitability is one of the major problems facing the beef industry. Seasonality of production and the extra cost resulting from freighting meat across Bass Strait are some of the factors contributing to the problem of declining profitability. Increasing beef cattle population per property and greater efficiency in the production, processing and marketing sectors of the industry are some of the strategies proposed by the DPIWE.

4. NT has some of the largest beef properties with average herd strength of about 1500 beef cattle per property. According to Murti (1998) the NT beef industry is primarily based on extensively managed enterprises on land areas of low carrying capacity with low profits and higher debts situations. He also pointed out that a shift from extensive to intensive production had necessitated greater capital investment. Over capitalisation, however, increased the debt servicing cost and or alternatively reduced the return on capital. Better management, improving the productivity and product quality will possibly improve the profitability of the beef industry in NT (see Murti 1998).
5. The average producers' price per beef head (Table 1 and 2) was highest in Tasmania ($564 and $521) followed by Victoria ($510 and $457), QLD ($498 and $488) and SA ($492 and $490) and the NT producers were receiving the lowest price ($374 and $384). The fluctuation in the average producers' price was mainly due to the average body weight, quality of the beef cattle and the product exported or sold (meat, live cattle etc.). The Cattle Council of Australia (CCA 1999) indicated that the failure or inefficiency of the service sectors such as processing, transporting, handling and shipping, adversely reduced the producers' share of the consumers' price from 58 per cent in 1988 to 47 per cent in 1995 (see also PIRSA 1995). If the producers' share of consumers' price is maintained around 58 per cent the beef industry in all states and NT will be financially viable and break-even for the current level of production and cost-price combinations.
6. In order to reach the break-even level, beef production must increase from the level of 1991-96 by an average of about 20 per cent per beef property in Victoria, WA and NT. The productivity increase of 24 per cent achieved from 1980 to 1995 is not sufficient enough to make the industry viable. Increasing the number of cattle per property might lead to over grazing and therefore the other option is to increase feed conversion ratio. According to Lucey (1999) the bull with high net feed efficiency gained 80kg in live weights from an average feed intake of 492kg when compared with 73 kg gained by the bull with low net feed efficiency. Beef cattle that utilise feed more efficiently to produce beef will enable the industry to reduce production costs. During the five years ending 1997-98, the industry has improved its financial performance and the increasing trend in commodity prices also has been contributing to increased profitability (see also Riley *et al.* 2000).
7. During the five years ending 1995-96, the overhead or fixed cost was almost 10-15 per cent more than the tolerable costs per beef property in Victoria, WA and NT. The position slightly changed in the five years ending 1997-98 and the overhead or fixed cost was almost 10-15 per cent more than the tolerable costs per beef property in Tasmania, NSW and Victoria. Over capitalisation and higher debt-equity ratios contribute to increased fixed cost through increased depreciation and debt servicing costs. This is an important area for further research.
8. For the five years ending 1995-96, the variable cost per beef cattle was less than $190 in NT and SA, around $200 in NSW and QLD, more than $ 220 in WA and Victoria, and the highest being ($311) in Tasmania. There are some changes during the five years ending 1997-98 and the variable cost per beef cattle decreased substantially in QLD ($122), Tasmania ($281), WA ($204), Victoria ($201) and decreased slightly in NT (179), NSW ($193) and SA ($183) (see table 2). This disparity in variable cost has also substantially contributed to the financial crisis and this is also another area for further research.
9. Assuming the planned or expected profit equivalent to the imputed value of family labour used in the beef cattle farms (wages for family labour and no payments for entrepreneurs), in the five years ending 1995-96 SA is the only state where the beef properties were capable of generating that level of profits and Queensland must increase beef production by 25 per cent to reach that required level. Beef producers in all other states and NT must increase beef production by over 50 per cent from their current level of production to reach that level of profitability. The situation further deteriorated during the five years ending 1997-98 and all states (QLD is a marginal case) and NT could not reach that level of profitability. Ultimately the beef producers are not able to recover the imputed value of family labours used (i.e. wages lost). This finding indicates that currently, the industry must be surviving by trading on capital or other off-farm income. The trend might be changing because of the increasing trend in commodity prices.
10. In the five years ending 1995-96, beef producers in SA were operating with a price and quantity safety margin of about 25 per cent of the current quantity and prices. In Queensland, beef producers were operating with a safety margin of around 7 per cent whereas in Tasmania and NSW the beef industry was marginally below the safety margin level. In all other states and NT, producers were operating with a negative safety margin. However, during the five years ending 1997-98, there were some improvements and the beef producers in QLD, SA, NT and WA were operating with a reasonable price and quantity safety margin with QLD having the highest the safety margins. This analysis reveals the level of business and financial risk facing most producers in the country.
11. The estimated parameters of the break-even model of the beef industry provide a variety of quantitative indicators of financial performance. Based on these results,

informed and justifiable decisions can be made in the areas of production, pricing, capital investment, risk assessment, cost control and profitability. The break-even model is, therefore, an effective decision support tool for the beef industry.

6. Summary and Conclusions

The results of the financial analysis of the Australian beef industry (Specialist Beef producers) undertaken using the break-even model are presented and discussed in this paper. Several interesting conclusions can be drawn from the results:

- During the five years ending 1995-96, the specialist beef industry is financially sound in SA and QLD. The industry in NSW and Tasmania is operating marginally below the break-even level. In all other states and NT the industry is facing financial crisis.
- The profitability of specialist beef industry in QLD, SA, NT and WA improved during the five years ending 1997-98. In all other states the industry continues to operate below the break-even levels with continuing financial crisis. Increases in productivity by another 15% and cost reduction by 15% are possible options to improve the profitability of the industry.
- The overhead or fixed cost exceeded the tolerable fixed costs per beef property in all states and NT except SA and QLD during the five years ending 1995-96. The position slightly changed in the five years ending 1997-98 and the overhead or fixed cost was less than the tolerable fixed costs per beef property in QLD, SA, WA and NT but in other states it exceeded the tolerable limit. Over capitalisation and higher debt-equity ratios contribute to increased fixed cost through increased depreciation and debt servicing costs. This is an important area for further research.
- In the five years ending 1995-96, SA is the only state where the beer producers were able to recover the imputed value of family labour cost; but in the five years ending 1997-98 beef producers in all states and NT could not recover the it. This finding indicates that currently the producers are losing their wages used in the production activities and they are surviving by trading on capital or other off-farm income. The recent increases in commodity prices might have changed the trend.
- The results illustrate the usefulness of the model as an effective decision support tool for the beef industry in Australia. The break-even point indicates the level of profitability and all other estimated parameters reveal the reasons for that level of profitability.

According to CCA (1999), the obvious advantage of cheaper production costs of Australian beef is lost by the less cost competitive marketing chain. ‘Without benchmarking the whole production - transport - processing - marketing chain, it cannot be determined exactly where the greatest pay-offs from improving efficiency will come from' (PIRSA 1995). The present study does not evaluate the efficiency of the marketing chain. However, if it were proved that an inefficient marketing chain was one the major causes for the financial crisis in the beef industry, then the transport, processing and marketing sector reform must be a priority in public policy.

Although the findings provide a view of financial profitability of the beef industry in general, the situation may be different in specific cases. Moreover, an assessment of overhead costs and the level of capitalisation are necessary to justify the debt servicing and the current capital structure that might have adversely affected the break-even points. The limitation of the present break-even analysis is that it assumes that all output is sold at a given level of production. This problem could be avoided if the net sales are considered instead of the output. Another limitation is that the costs are assumed as linear but in reality some components of costs are non-linear. Although non-linearity is not seriously affecting the results, a combined regression-break-even model (Kannapiran 1982) will minimise the problem of non-linearity.

Reference

Baumol, W.J. 1967, Business Behaviour, Value and Growth, Rev. Edn., Harcourt Brace Jovanovich, New York.

Baumol, W.J., Blinder, A.S., Gunther, A.W. and Hicks, J.R.L. 1988, Economics – Principles and Policy, Aus. Edn., Harcourt Brace Jovanovich, Sydney.

Cattle Council of Australia, 1999, *History of Australia's Beef Industry*, http://www.farmwide.com.au/cca/Australian%20Beef%20Industry%20History.html 7-12-1999.

CSIRO 1996, *The Meat Dairy and Aquaculture Outlook* (Outlook on industry & research trends), prepared for CSIRO Outlook Forum, August 1996, CSIRO Canberra.

DPIWE (Department of Primary Industries, Water and Environment) 1999, *Red Meat* (beef and sheep meat), http://www.dpif.tas.gov.au, 1999.

Gittinger, J.P. 1982, *Economic Analysis of Agricultural Projects*, 2nd Edn., Johns Hopkins University Press, Baltimore.

Hilton, R.W. 1994, *Managerial Accounting*, Second Edn., McGraw-Hill, New York.

Kannapiran, C. 1982, *Profit Planning for Rural Banking*, M.B.A. Dissertation, University of Madras, India.

Kannapiran, C. 1989, *Project Appraisal by Break-even Analysis: Case Study of a Dairy Project*, Journal of Rural Development, Vol. 8 (5) p.537-44, NIRD, Hydrapad (India).

Ketz, J.E., Campbell, T.L. and Baxendale, S.J. 1991, *Management Accounting*, Harcourt Brace Jovanovich, Florida.

Lucey, J. 1999, *Savings for Beef Producers*, News Release, 4 February 1999, Agriculture Western Australia.

Martin, P., Riley, D., Jennings, J., O'Rourke, C., and Toyne, C. 1998, *The Australian Beef Industry 1998*, ABARE Research Report 98.7, Canberra.

MLA 1999a, *Red Meat Needs to Adopt*, Media Release dated 18-3-99, http://www.mla.com.au/media/current/180399.cfm, 1999.

MLA 1999b, *Draft - Beef Industry Strategic Plan 1999/2000 To 2001/02: A sustainable and profitable customer driven beef / live cattle industry*, http://www.mla.com.au/default.cfm 1999.

MLA 1999c, *Industry News: Industry Overview – Livestock Production*, http://www.mla.com.au/industry/overview/livestoc.cfm, 1999.

Murti, S. 1998, *Pastoral Industry Portrait*, NT Department of Primary Industry and Fisheries, http://www.nt.gov.au/dpif/pastpro/2pastpro.shtml#Economic, 1998.

PIRSA (Primary Industries & Resources South Australia) 1997, *Primary Industry - Beef*, http://www.pir.sa.gov.au/invest_opps/beefPS.shtml, 1999.

PIRSA 1995*, South Australian Beef Industry Development Plan - Executive Summary*, http://www.pir.sa.gov.au/invest_opps/xbeefPS.shtml, 1995.

Riley, D., Martin, P., Lubulwa, M., and Gleeson, T. 2000, *The Australian Beef Industry 2000*, ABARE Research Report 20.9, Canberra.

Short, J.A. and Lung, K.R. 1996, *A Break-Even Analysis Model for the Evaluation of Capital Spending in Laboratory Automation*, Pharmaceutical R&D; The DuPont Merck Pharm. Company; Wilmington, http://www.islar.com/abstract/lung.htm, 25-4-99.

Van Horne, J. 1983, *Fundamentals of Financial Management*, Fifth Edn., p.299, Prentice-Hall.

Ward, W.A., Deren, B.J. and D'Silva, E.H. 1991, *The Economics of Project Analysis¾A Practitioner's Guide*, Economic Development Institute of the World Bank, Washington, D.C.

Welsch, G.A., Hilton, R.W. and Gordon, P.N. 1988*, Budgeting: Profit Planning and Control*, Fifth Edn., Prentice-Hall, New Jersey.

Figure 1. Costs and Revenue Curves and Break-even Point

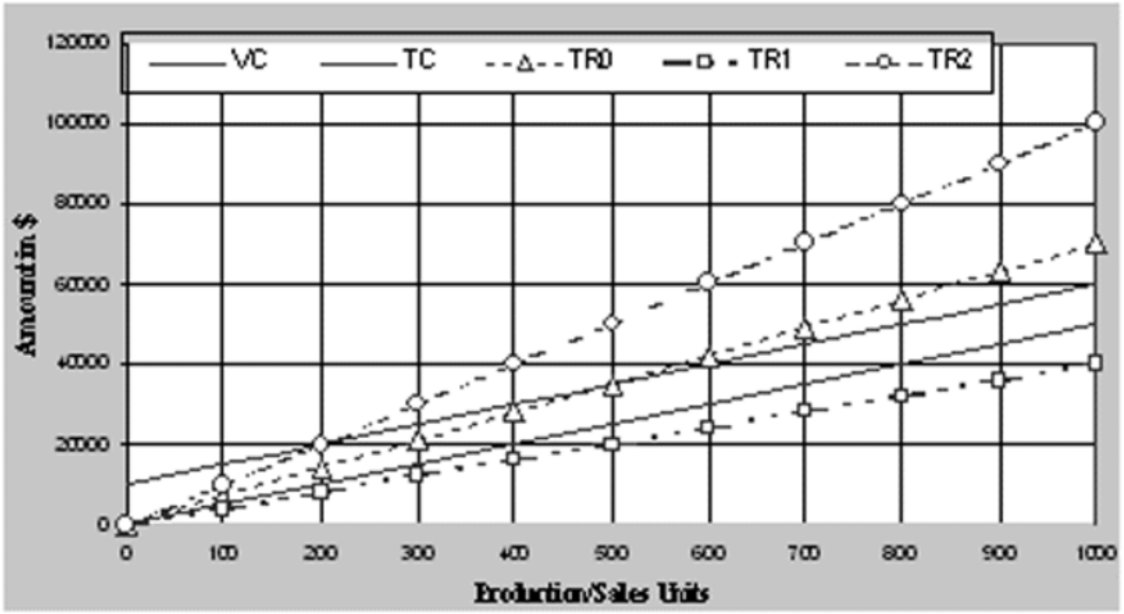

Figure 2. Break-even Sale Price and Quantity

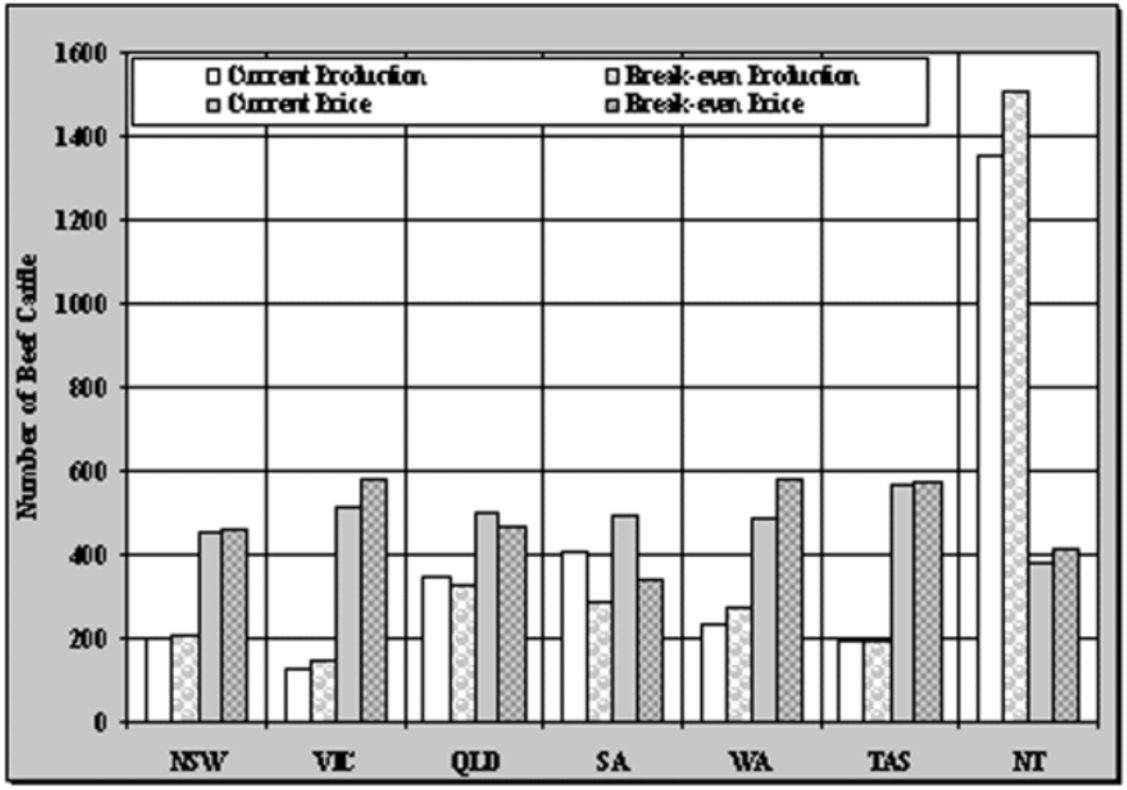

Figure 3. Safety Margin in Terms of Price and Quantity

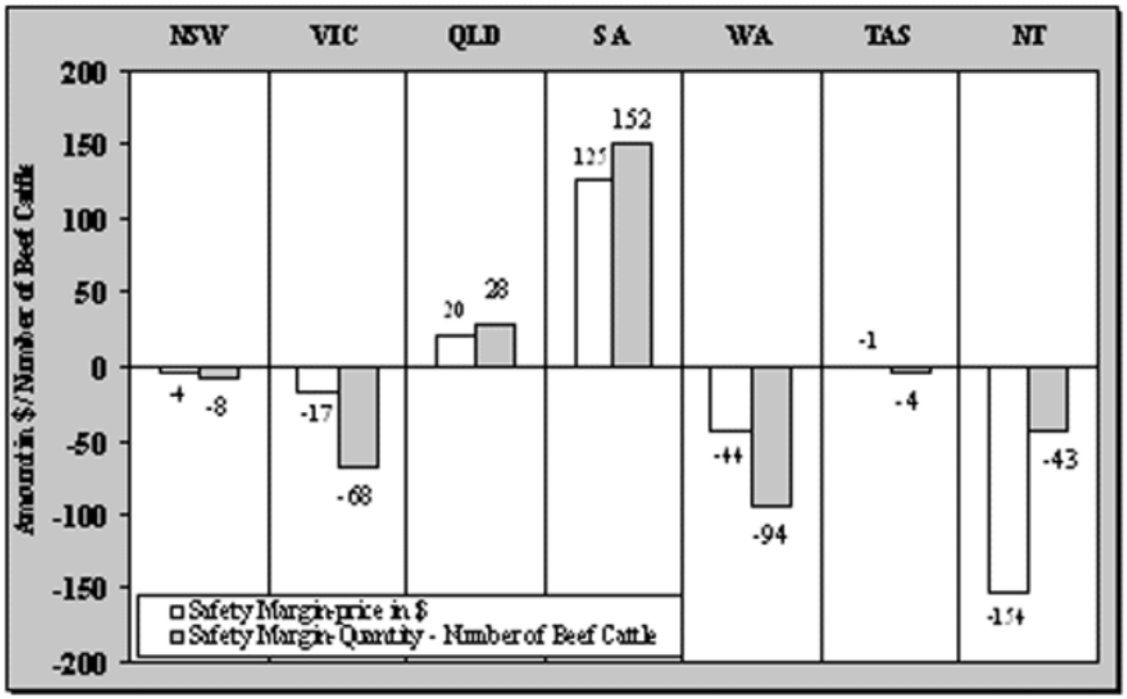

Figure 4. Break-even Chart - NSW

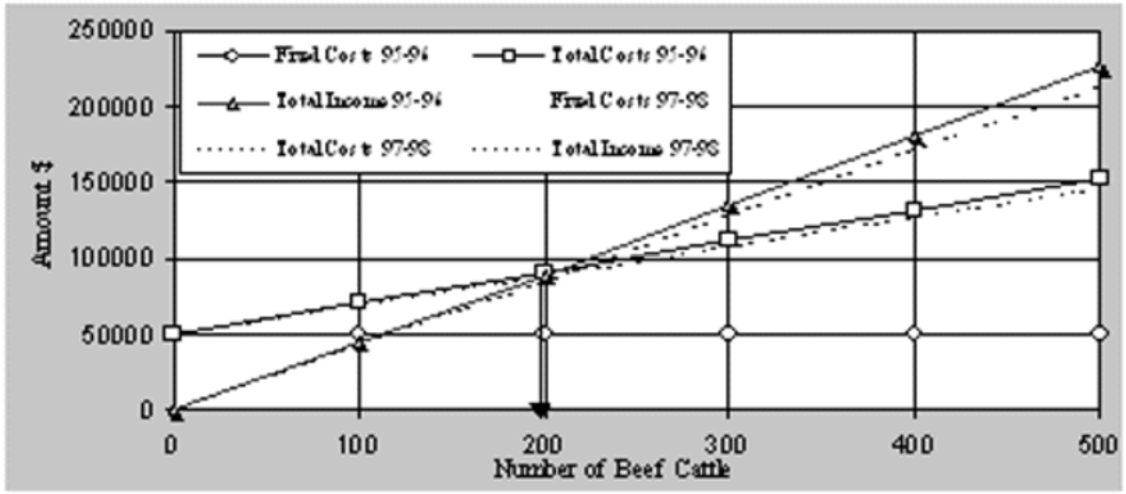

Figure 5. Break-even Chart - Victoria

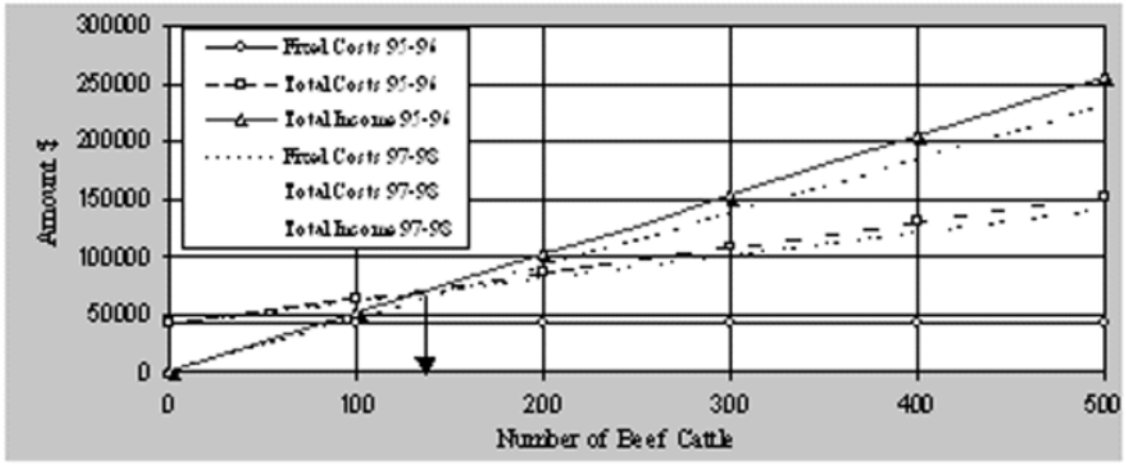

Figure 6. Break-even Chart – Queensland

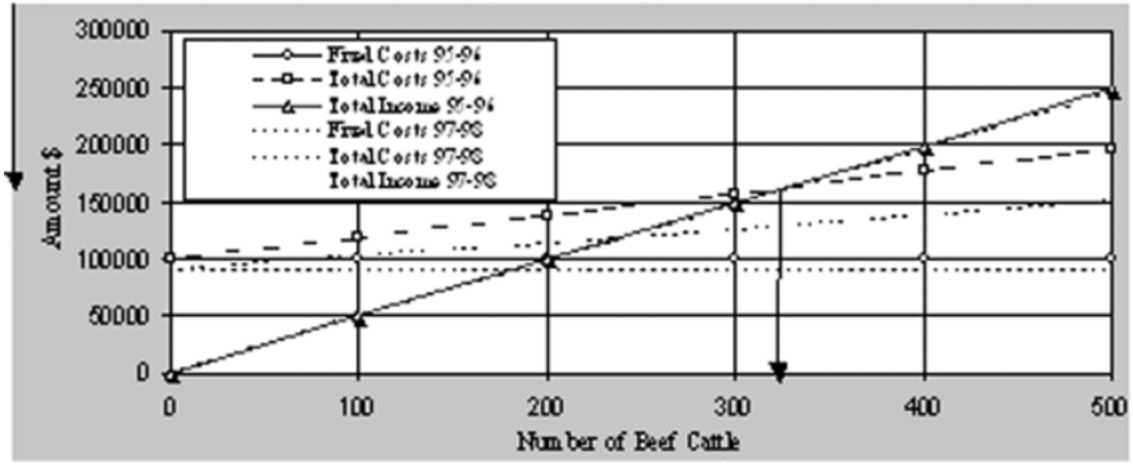

Figure 7. Break-even Chart – South Australia

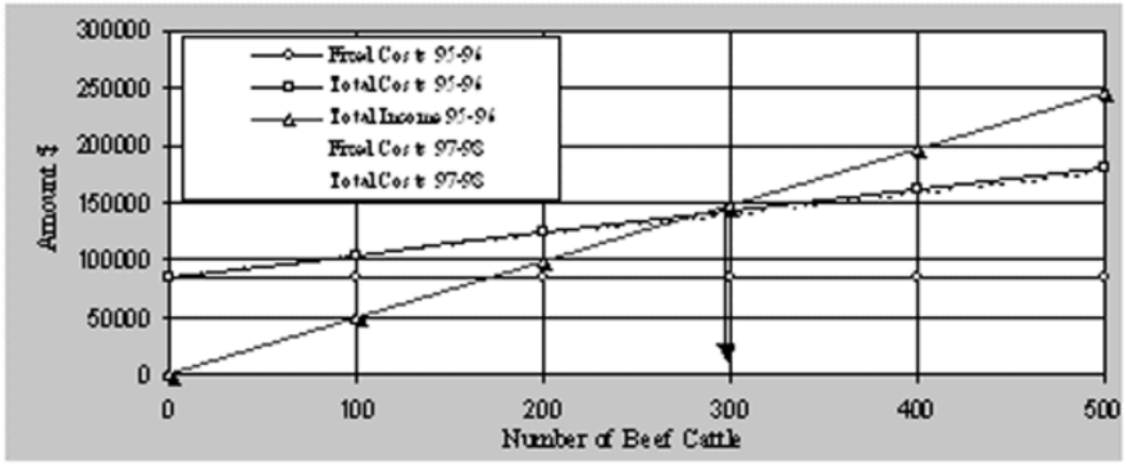

Figure 8. Break-even Chart – Western Australia

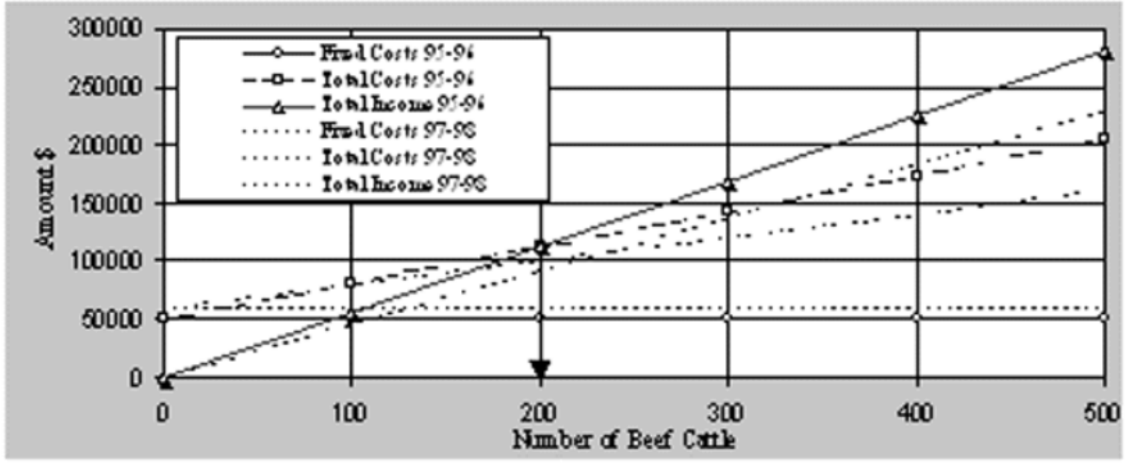

Figure 9. Break-even Chart - Tasmania

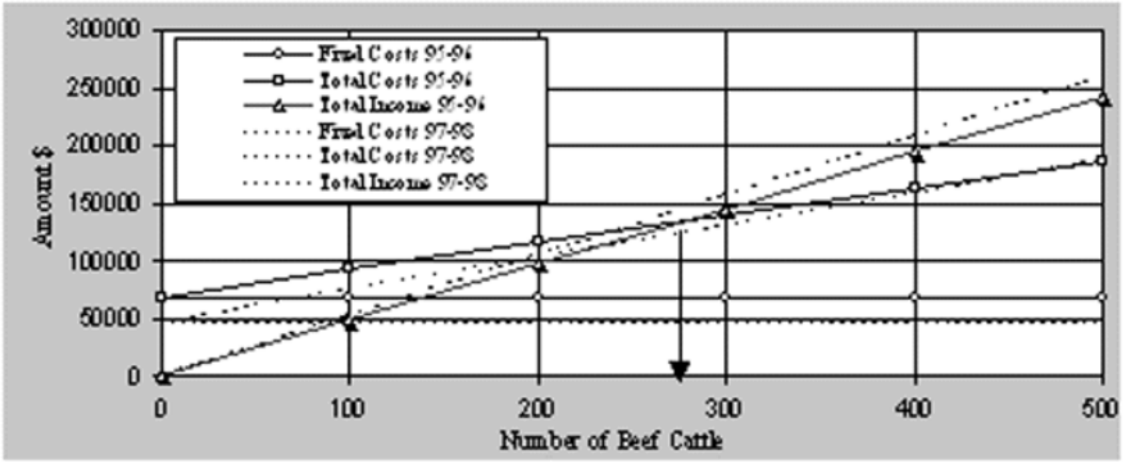

Figure 10. Break-even Chart – Northern Territory

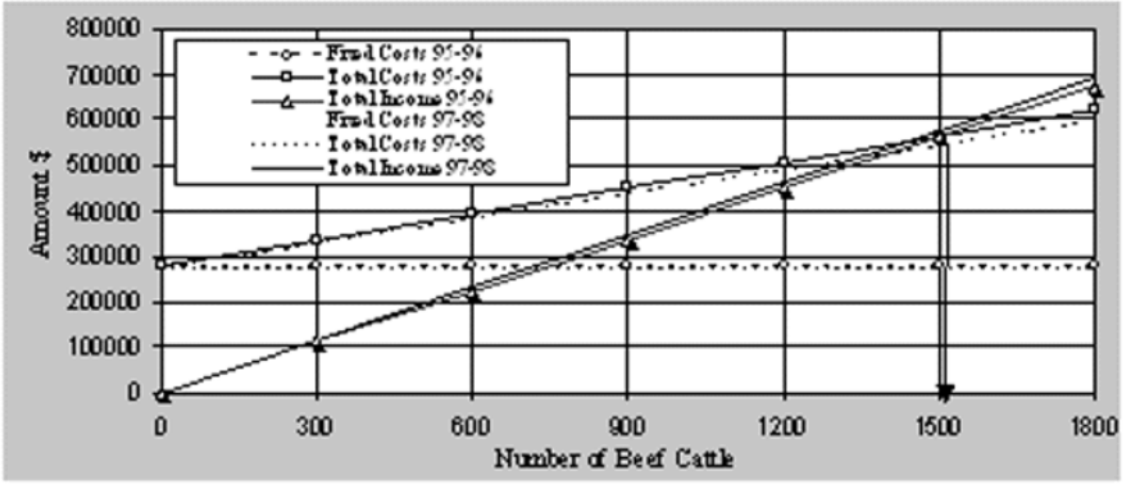

Table 1. Results of Break-even Analysis of Australian Beef Industry for the financial years: 1991-92 to 1995-96

Details	NSW	VIC	QLD	SA	WA	TAS	NT
1. Break-even production units	204	142	326	281	273	196	1504

Note: Figures in bold indicate viability or favourable position. style=" text-align:center;line-height:normal">**Table 2. Results of Break-even Analysis of Australian Beef Industry**
for the Financial Years: 1993-94 to 1997-98

Details	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**
Break-even production units	212	155	244	320	226	221	1228
Current production units	196	145	**340**	**361**	**235**	194	**1341**
Safety margin – quantity (2-1)	-16	-10	**96**	**42**	**10**	-27	**113**
Break-even price per unit	461	488	352	397	437	594	351
Current price per unit	426	457	**490**	**449**	**456**	521	**384**
style=" text-align:left;line-height:normal;">Safety margin – price (5-4)	-39	-31	**138**	**52**	**18**	-73	**32**
Break-even volume (income)	90352	70754	119637	143292	102731	115216	471286
Current volume (income)	83500	66273	**166495**	**161905**	**107057**	101088	**514476**
Variable cost per beef head	193	201	122	183	204	281	179
Tolerable fixed costs	45677	37135	124994	96014	59123	46537	274510
Current fixed costs	49425	39646	**89816**	**84976**	**56734**	53041	**251465**
Break-even for planned profit	346	258	343	430	343	349	1438

Note: Figures in bold indicate viability or favourable position.

[1] According to a definition by the Australian Bureau of Agricultural and Resource Economics - ABARE (Martin, P. et al. 1998), the specialist beef producers are those producers mainly involved in running beef cattle.

[2] Conventionally, the term ‘economic analysis' includes both financial and economic analysis.

[3] Australian beef producers are price takers in the market and, therefore, they do not make the pricing decision. However, the break-even price suggests to the producers the profitable price.

[4] In the present case the imputed value of family labour cost is used as the minimum desired profit for the enterprise.

[5] In terms of production quantity, NT ranks first followed by SA, QLD, WA, NSW, Tasmania and VIC.