Longitudinal analysis of dairy farm income and expenditure in New Zealand: A review of 25 years of adjustment.

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ABSTRACT

The cost-price squeeze in dairy farming has forced farmers to become more competitive in the market place. This has primarily occurred through increased herd size and productivity gains associated with labour-saving technology. The cost and revenue structures and changes in the contribution of key dairy production inputs to total cash expenditure and farm income over the 1972/73-1996/97 period were analysed. Data were taken from the annual publications of the Livestock Improvement Corporation and the New Zealand Dairy Board. Implications for the future growth of dairy farms and the industry are drawn from the analysis.

Keywords: farm costs, farm returns, dairy farms, and cost and revenue structure.

INTRODUCTION

Dairy farming in New Zealand has changed dramatically in the past five decades. The number of dairy farms has declined from 53,100 in 1951 to less than 15,000 in 1996/97, while average herd size increased from 53 cows to nearly 200 cows over the same period (LIC, 1997). In addition to decling real returns and new technology, the economic reforms during the mid-1980s including market deregulation, floating of the exchange rate and removal of direct and indirect subsidies to agriculture (Johnston & Frengley, 1994) accelerated the dairy industry's drive to become more efficient through economies of size and enhanced pasture and dairy cattle productivity. The latter is reflected by steady increases in both milksolids per cow and per hectare (Parker and Holmes, 1997).

The success of dairy farming in New Zealand has largely been due to the favourable physical environment which allows milk to be produced at a low cost through the year-round grazing of dairy cattle on pasture (Bryant, 1990). The adaptability and resilience of the New Zealand dairy farmer, and the vertically integrated farmer-owned New Zealand Board, are others factor that should not be underestimated in the industry's ability to respond to international competition.

The payout received by farmers from dairy companies for one kilogram of milksolids has halved *in real terms* since 1951. Nevertheless, dairy farming is still considered to be a financially rewarding enterprise by most farmers and this is reflected in the strong demand by sharemilkers for positions and their progression to farmer ownership (Rauniyar & Parker, 1996). The declining returns in the sheep and beef cattle sector encouraged farm conversions to dairying in the early 1990s, even in the presence of substantial development costs and, from 1994, the need to purchase shares

in the local dairy cooperative and the New Zealand Dairy Board (Rauniyar *et al*., 1998). Unlike other farming enterprises, seasonal dairying provides a steady cash flow throughout most of the year, and generally all extra milk production is rewarded at the season average, rather than the marginal, price. In this paper we examine trends in major dairy farming input costs in relation to total cash expenditure and farm income for the period 1972/73 to 1996/97.

DATA AND METHODOLOGY

Data for the analysis were sourced from the Livestock Improvement Corporation (LIC) and New Zealand Dairy Board (NZDB) publications for the period 1972/73 to 1996/97. These are based on an annual economic survey of factory supply dairy farms. The time period for the analysis covers the pre- and post-deregulation economic environment in New Zealand. Data for the year 1971/72 were not available and hence information from earlier years could not be used. The number of farms surveyed decreased from 1,314 farms in 1972/73 to 125 in 1986/87 and 1987/88, but increased to 222 farms in 1996/97. The survey sample, however, has always been drawn to represent average New Zealand farm conditions.

Trends in farm income and cash expenditure and the relative share of major cash expenses in relation to total cash expenditure and farm income were analysed. Total farm income was derived from sales of milk, bobby calves, cattle, other livestock raised on a dairy farm, and income from non-dairy sources. Total cash expenditure includes expenses associated with farm administration, animal health, breeding and herd testing, contractors, dairy shed operation, electricity, feed and grazing, fertiliser, seed, freight, weed and pest control, vehicles, repairs and maintenance, farm development, insurance and accident compensation, rates, rent and bailment fees, labour and rations, interest, wages, standing charges and non-dairy expenses. Ratios were computed for selected items as follows:

$$\text{Input-Cost Ratio (ICR)} = (C_{it}/TC_t) \times 100$$

$$\text{Input-Income Ratio (IIR)} = (C_{it}/TFI_t) \times 100,$$

where,

C_{it} = total farm cost of input I at time t,
TC_t = total cash expenditure at time t,
TFI_t = total farm income at time t and
$_i$ = 1 to N cash expense type.

In order to make data comparable over time, all milk production figures were converted to milksolids (milkfat x 1.74) and, where appropriate, total farm income and cash expenditures were converted to 1996 New Zealand dollars using the consumer price index (Lincoln University, 1998). Some of the inter-year variation in values may be associated with sampling rather than real effects on costs and income as different farmers participated in the survey each year.

The input-cost and input-income ratios (ICRs and IIRs) were computed for nine major farm expenditure items -- administration, animal health, breeding and herd testing, dairy shed, electricity, feed and grazing, fertiliser, repair and maintenance and interest

payments. Total cash costs include all relevant costs for which data were available for the entire period of analysis.

ECONOMIC ENVIRONMENT AND FARM PRODUCTIVITY

Interest rates and milksolids payout

New Zealand's economy was deregulated in 1984/85 at a time when interest rates were more than 17%. These further increased to a record 18.7% in 1986/87 (Figure 1). With market adjustments taking effect, interest rates steadily declined to about 7% in 1993/94, before rising slowly to 9.1% in 1996/97.

Farmers enjoyed high milksolids (MS) prices in real terms and some input subsidies (for example, fertiliser) along with concessionary interest rates for land and livestock purchases in the early 1970s. Milk returns peaked to NZ$5.53 (1996 prices real terms) per kg MS in 1973/74 (Figure 1). Dairy farmers received no direct subsidies on milk payments because their market prices were always above the trigger level. Milksolids returns have generally trended downward since 1978/79 due to variation in international prices for dairy products and exchange rate movements. The MS price sank to just NZ$2.76 in 1986/87, a year following the floating of the exchange rate. Deregulation fully exposed dairy farm returns to external shocks and the MS price has become volatile as a result. International demand for dairy products, exchange rate relativities and Dairy Board/Company investment policy (eg retaining earnings to build a new factory) exert a strong influence on the farm-gate MS price. Domestic factors, other than exchange rate via Reserve Bank have limited effect on the MS price – besides more than 90% of milk production is exported.

Farm size, herd size, stocking rate and productivity

The effective area (farm size) of sample survey farms underwent limited change (±13%) over the study period, but herd size increased by 66% and stocking rate (cows/ha) increased by 50% (1.63 in 1972/73 to 2.45 in 1996/97). Farm productivity increased by 42% and 114% in terms of MS/cow and MS/ha, respectively. Relationships between MS/cow and stocking rate and herd size are presented in Figures 2 and 3, and between MS/ha and farm size and stocking rate in Figures 4 and 5.

While herd size increased steadily, MS/cow has fluctuated somewhat due to the seasonal impact of weather (e.g. drought in 1988/89) and possibly due to lower farm inputs such as in 1986/87 when the MS price plummeted. Milksolids per ha, on the other hand, has been less volatile and continued to increase steadily in most years, particularly after deregulation as farmers concentrated their efforts in enhancing farm efficiency in order to reduce the impact of lower MS returns. The trends in MS/ha mostly followed those for stocking rate, indicating this variable rather than MS/cow drove increases in farm productivity. This is consistent with the heavy emphasis that the New Zealand Dairy Board Consulting Officers have placed on pasture utilisation and stocking rate (Stritchbury, 1994).

TERNDS IN FARM INCOME AND CAST COSTS

Farm income vs. farm cash expenditure

Total cash expenditure has corresponded closely to changes in total farm income since 1972/73 (Figure 6). In years with higher farm income (both on a total and a per cow basis) farm cash expenses tended to increase and vice versa (Figures 6 and 7) (r=0.99). However, adjustments in cash costs were relatively more erratic than changes in farm income, meaning farmers spent a smaller proportion of extra income on farm inputs. The correlation between total farm income and cash expenditure with MS/kg payout was negative but modest (r=-0.5) indicating, as expected, reduced expenditure in years with lower payouts. However, a higher per kg MS payout did not necessarily mean higher farm income/expenditure (Figure 8).

Input-cost ratio vs. input-income ratio

Between 1972/72 and 1997/97 administration costs remained within a narrow band of 2-3% of total farm income but fluctuated between 3.5-5.6% of cash expenses (Figure 9). Administration costs were relatively high during the first three years of deregulation as the Goods and Services Tax (GST) were introduced in October 1996 and increased levels of "user pays" began to apply. In recent years, farmers have "tightened their belts" and gradually reduced costs to the level achieved in the early 1970s.

Animal health costs have steadily increased over time both in proportion to farm income and total cash expenses (Figure 10). They accounted for more than 6% of cash expenditure and around 4% of farm income in the 1990s. This may be associated with the greater animal stresses associated with higher stocking rates and per cow productivity. Likewise, breeding and herd testing costs also increased over time (Figure 11). This was associated with proportionately more cows being subjected to tests as well as increased use of reproductive interventions such as Controlled Internal Drug Release (CIDRs) devices (e.g. MacMillan *et al.*, 1993; MacMillan 1995). Gains in dairy cow productivity over time reflect genetic improvement as well as improved feed management (Parker & Holmes, 1997). In proportionate terms, breeding and herd testing costs doubled over the study period, as a share of both total cash costs and farm income.

Dairy shed costs have stabilised to around 1.5% of farm income and less than 3% of cash costs (Figure 12). Although milk parlour size has increased in terms of sets of milking cups, farmers have benefited from cost reductions in cleaning agents, possibly due to economies of scale through bulk purchases as well as new technology. Similarly, electricity costs have also been contained within a narrow band, with the exception of the initial years of deregulation (Figure 13). This has been achieved despite increased use of electrical equipment such as fences, milk refrigeration units and irrigation pumps.

Feed and grazing costs took an upward turn after 1987/88 and had doubled as a proportion of total cash expenses and of farm income by 1996/97 (Figure 14). Farmers have increased the use of supplementary feed, opted for more off-farm grazing and used more nitrogen fertiliser to increase the feed supply to their milking

cows and replacements (Penno, 1998). Per cow and farm productivity increases have been modest over this period, raising concerns amongst some industry commentators that the efficiency of feed utilisation, particularly pasture, declined over the decade. On the other hand, some farmers have reached a pasture supply "feed barrier" (Bryant, 1990) and, other than through buying more land, are unable to increase farm productivity except by using non-pasture feeds and using more off-farm grazing (Edwards & Parker, 1994).

Fertiliser accounts for about 18% of total cash expenditure and 10% of farm income (Figure 15). Like those for feed and grazing, fertiliser costs have contributed to higher farm productivity but there may be some instances where farmers are using more fertiliser than can be economically justified. For example, benefits from further increasing Olsen phosphorus test levels above 30 are small when MS prices are less than $3.80/kg (Thomson *et al.*, 1993).

The share of repairs and maintenance (R&M) costs in total cash costs declined during the 1990s (Figure 16). This may be due to the "mining" of earlier investment in soil fertility and land improvements made when MS prices were higher as well as greater use of contractors instead of owning and maintaining farm machinery. In addition, improvements in race construction, fencing and water supply technology, along with increased farm scale, are all likely to have contributed to savings in R&M expenditure.

Finally, the variation in interest costs has been marked over the past 25 years (Figure 17). The removal of concessionary interest rates and the market reform measures in during the 1980s (Figure 1) meant interest charges accounted for an all time high 35% of total cash costs and 19% of farm income in 1985/86. Despite the increased financial pressures relatively few dairy farmers were forced to sell by rural lenders.

DISCUSSION

The previous 25 years confirm that New Zealand dairy farmers face little choice but to (a) further increase farm and herd size, (b) improve cost efficiency through new technology, economies of scale and better management practice and (c) demand the New Zealand Dairy Board and its associates increase the farm-gate MS price through product differentiation and process efficiency. Increasing feed and fertiliser costs are a concern but the trend data suggests farmers have resorted to these because they had exploited the productive potential of existing pastures. Increased stocking rate, larger cows (because of increased Friesian-Holstein genetics) and higher per cow production have all increased feed demand. A commensurate increase in feed supply, from improved pastures, better pasture utilisation, more fertiliser and pasture substitutes (including off-farm grazing) has therefore been required to increase total farm MS output. While some of these actions increased input costs, farmers made savings in other areas in order to keep cash costs in the range of 50-60% of total income.

Dairy research needs to find ways to improve the effectiveness of additional inputs, and in reducing their unit cost, as these are vital to sustaining farm productivity. For example, Stantiall's (1999) survey of a sample of dairy farmers revealed that farmer' knowledge of using feeds was very poor. Improving farmers' knowledge and skills in dairy cow nutrition and in business management (particularly marginal analysis) of

benefits from extra inputs (see Ferris and Malcolm, 1999) will be a critical factor in ensuring farm viability into the new Millenuum.

The effects of changes in land price have been excluded from this study but they have an important influence on dairy farm profitability. Rauniyar *et al.* (1998) reviewed changes in dairy land prices over the period 1990-1997 and showed the sharp increases in land values between 1992/93 and 1994/95 were not associated with improved MS prices. Rather, they were based on a combination of factors including expected high future MS prices, lower interest rates, the low cost of entry to new suppliers, and continuation of capital gains in land values. These dynamics have now changed and dairy land prices are realigning to economic worth of milk production. As a consequence some farmers are under considerable financial pressure because their capital structure imposes high fixed costs on their business.

The analysis presented in this paper reflects industry averages and trends - these should be interpreted with caution. The survey sample farmers include both outstanding and poor farmers, and it is notable that some farmers have very successfully increased inputs, productivity and profit over the 1990s despite fluctuations in MS prices. These farmers provide benchmark examples for others to aspire to in terms of dairy farm business management.

CONCLUSIONS

Dairy farmers in New Zealand have retained competitiveness in milk production by expanding herd size, containing and reallocating farm expenditure, and using new technology. They have been able to achieve higher productivity by containing administrative, repairs and maintenance, electricity and dairy shed costs over time. However, gains in productivity could not have been achieved without incremental increase in fertiliser, feed and grazing and finance costs. Capitalisation of land values in the late 1980s and the first half of the 1990s along with the larger capital outlay required for a dairy farm contributed to a steady reduction in the number of dairy farm through to the early 1990s. A small increase in farm numbers between 1992 and 1996 reflected new entrants to the industry through conversions from less profitable, sheep and beef cattle farms and some cropping enterprises. Dairy farmers face an on-going challenge in containing overhead costs in the future and need to continue to adopt productivity enhancing farm inputs (including improved management practices) in order to keep pace with a highly competitive and externally exposed market environment. Overall this also means that most farmers have to progressively move toward a more intensive production system, although some may be able to lower inputs and increase profit through a high cow number-low output per cow strategy.

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Figure 1. Trends in interest rates and milksolids prices (1996 NZ$)
1972/73 - 1996/97

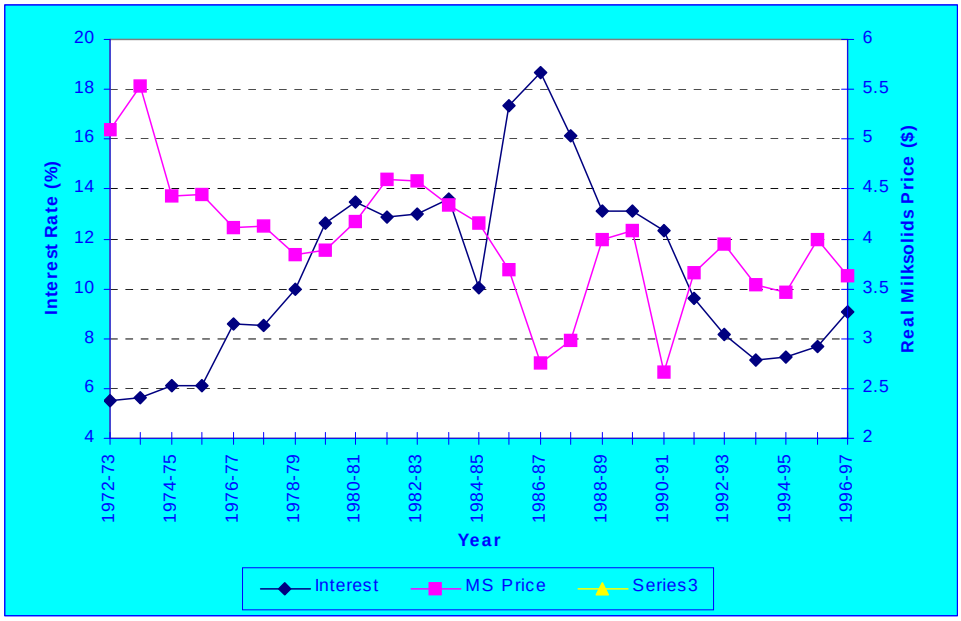

Figure 2. Relationship between herd size and milksolids per cow (1972/73-1996/97)

Figure 3. Trends in milksolids per cow and stocking rate (1972/73-1996/97)

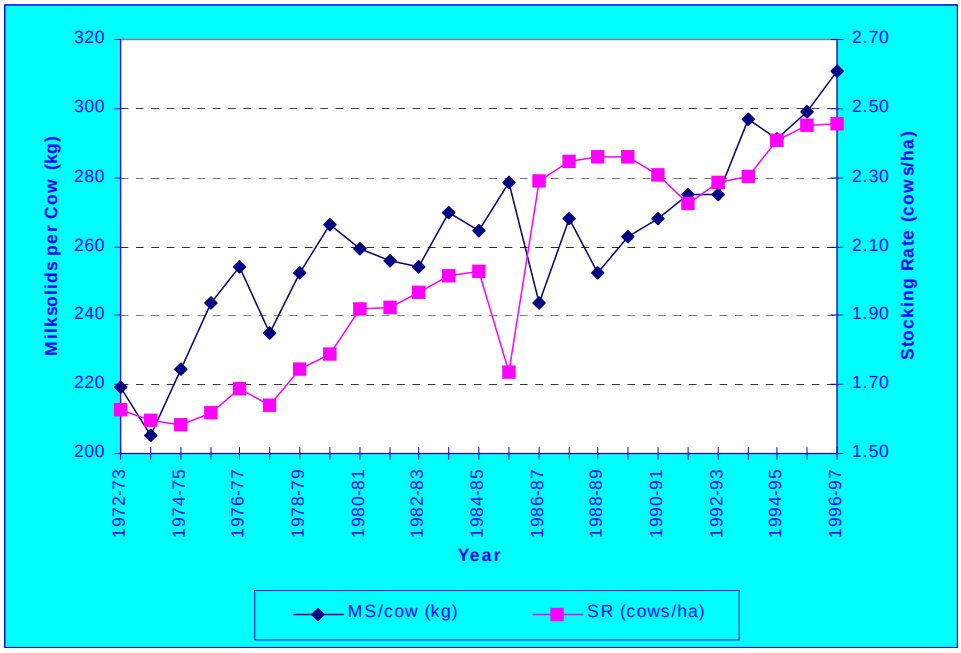

Figure 4. Trends in farm sizse and farm productivity (MS/cow), 1972/73 - 1996/97

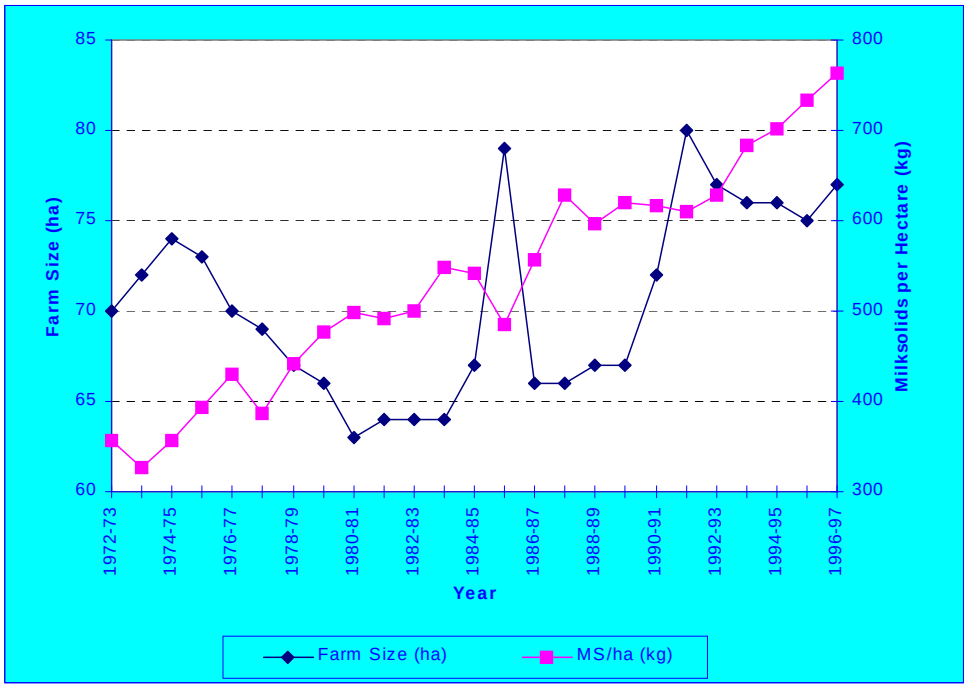

Figure 5. Relationship between farm productivity and stocking rate (1972/73 - 1996/97)

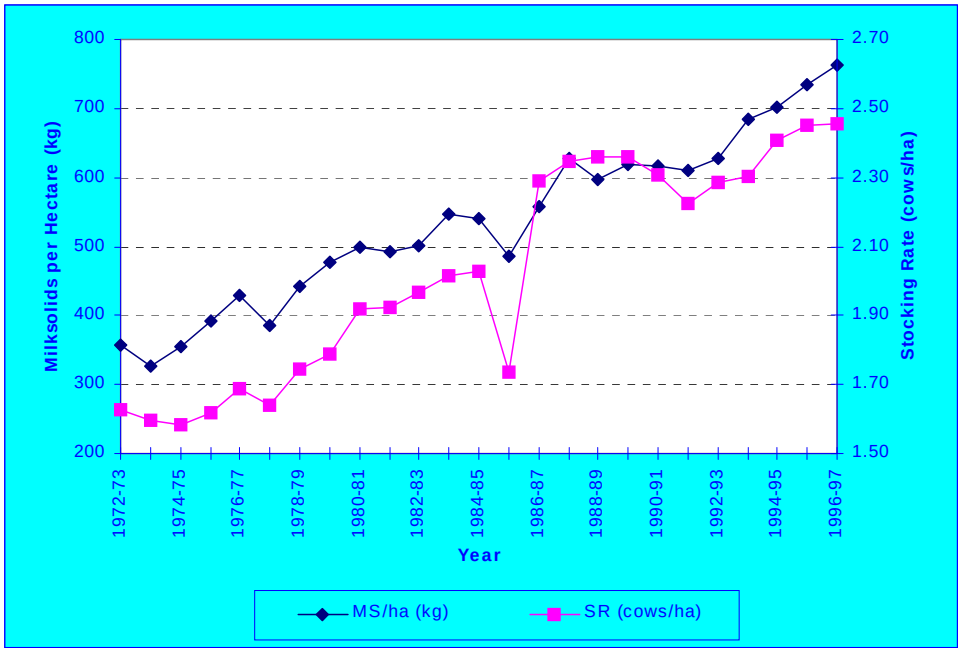

Figure 6. Trends in total farm income and cash expenditure (1972/73 - 1996/97)

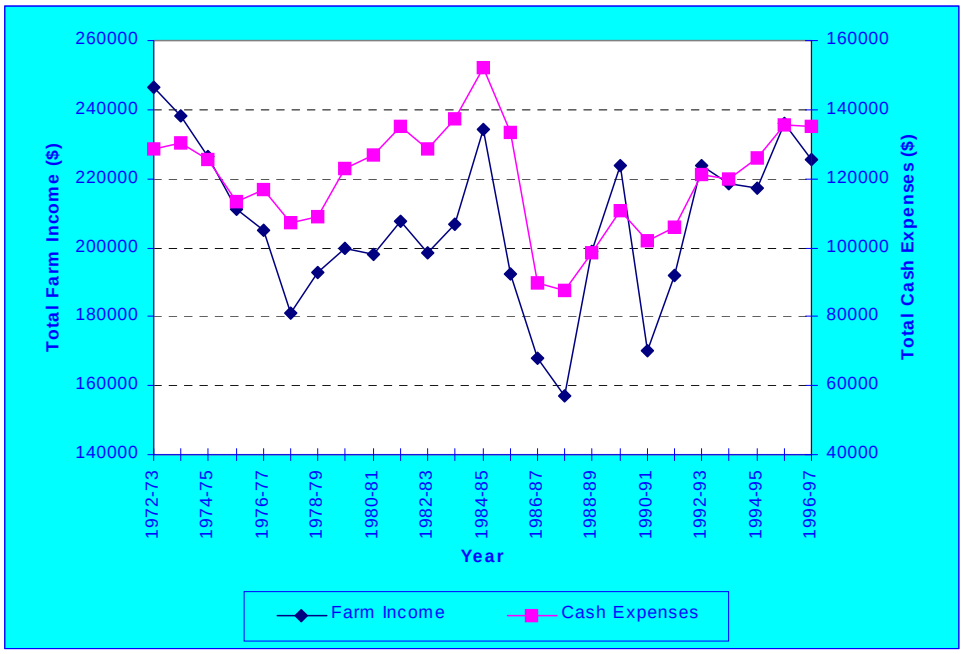

Figure 7. Farm income vs. cash expenses per cow for an average dairy farm (1972/73 - 1996/97)

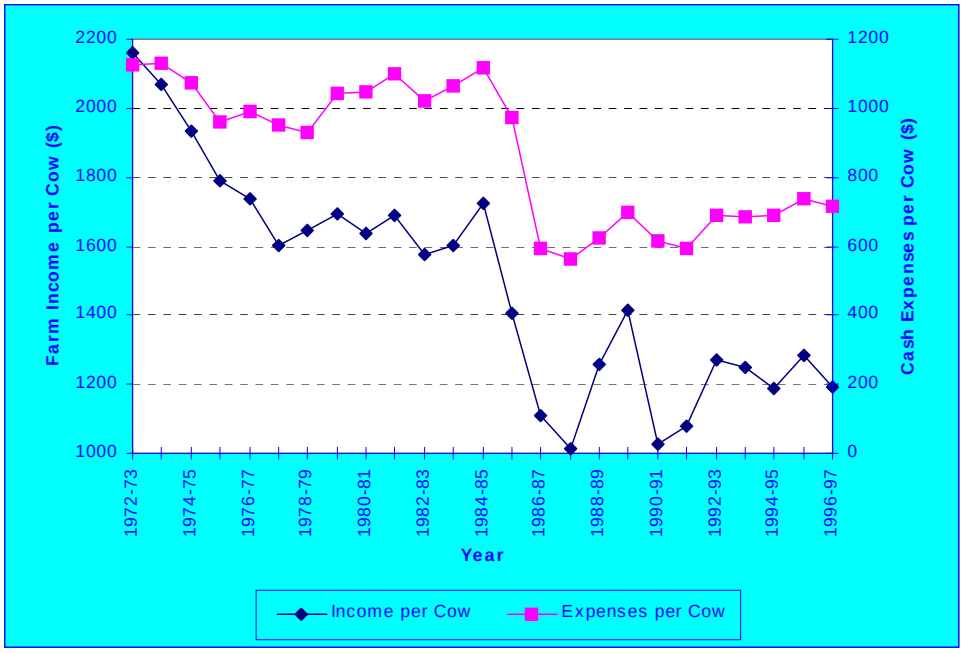

Figure 8. Trends in real milksolids prices and ratio of toal cash expenses to farm income

Figure 9. Share of administration cost in total farm income and cash exepnditure

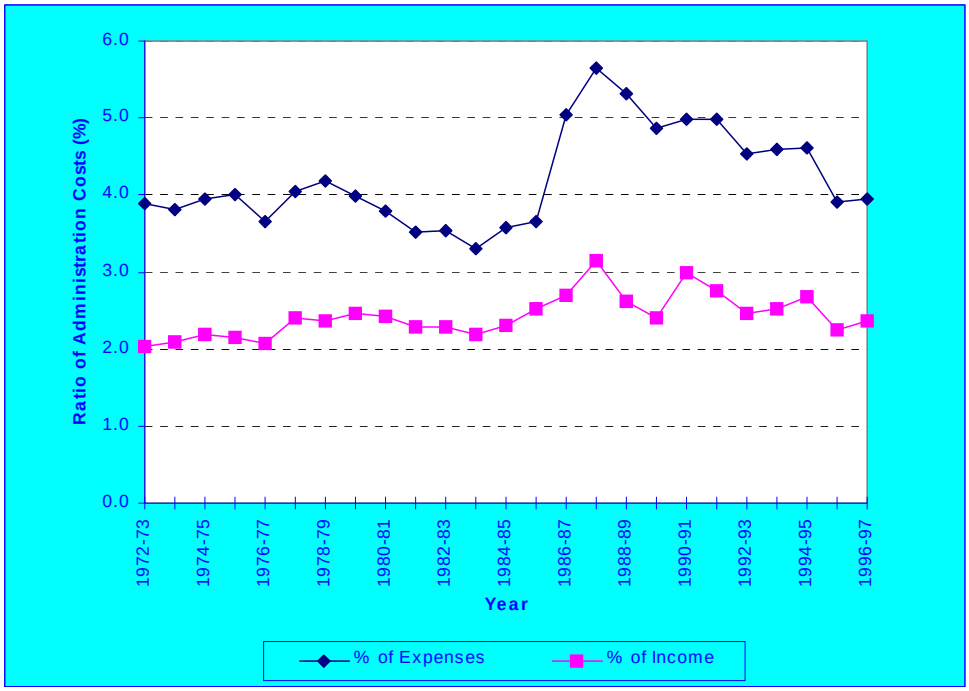

Figure 10. Share of animal health costs in total farm income and cash expenditure

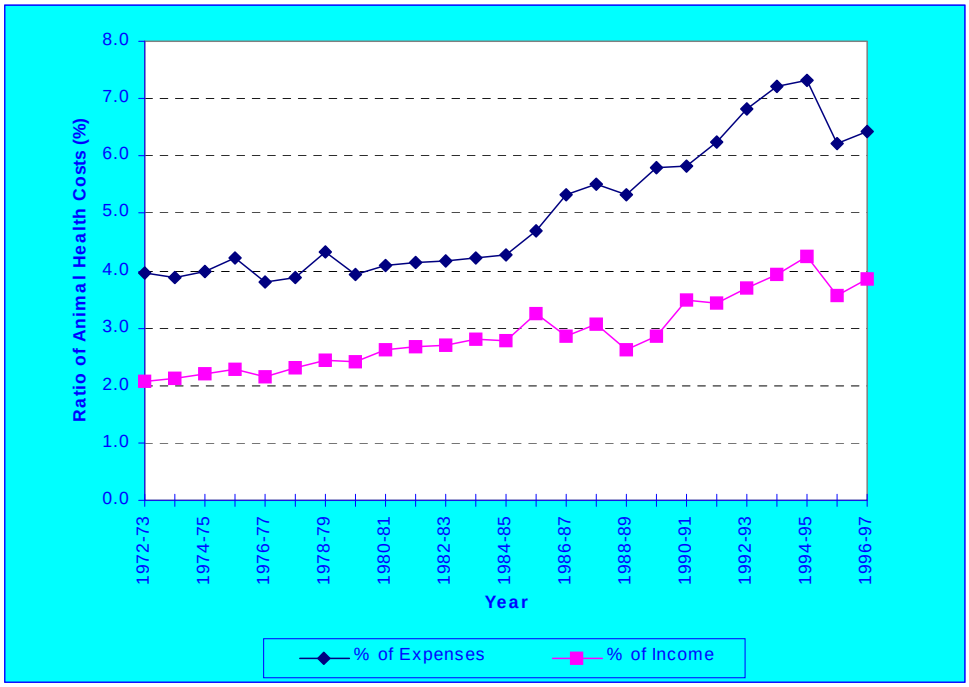

Figure 11. Share of breeding and herd testing costs in total farm income and cash expenditure

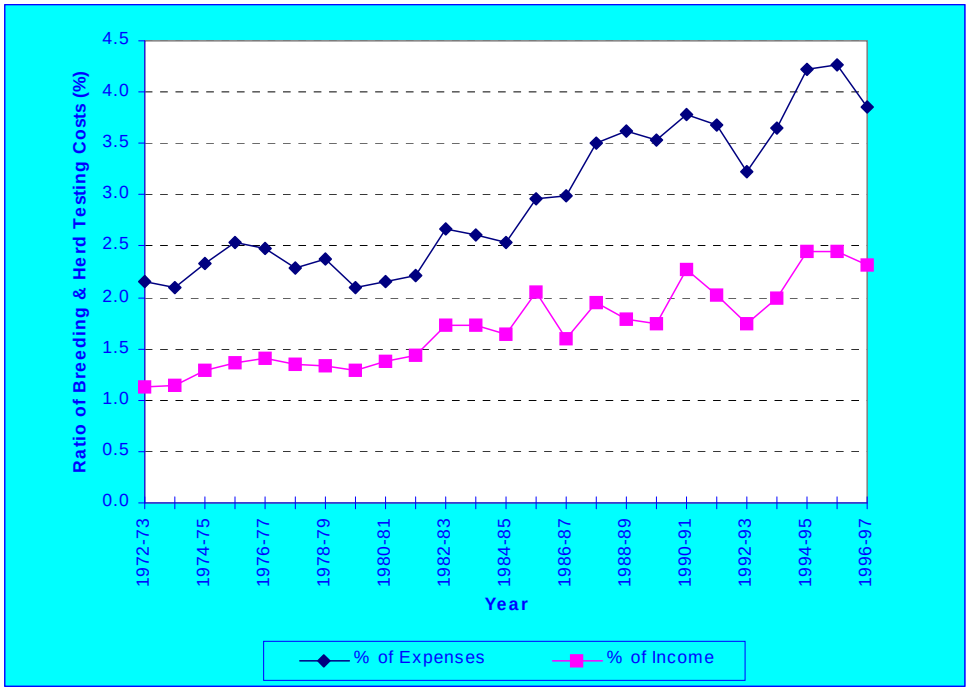

Figure 12. Share of dairy shed costs in total farm income and cash expenditure

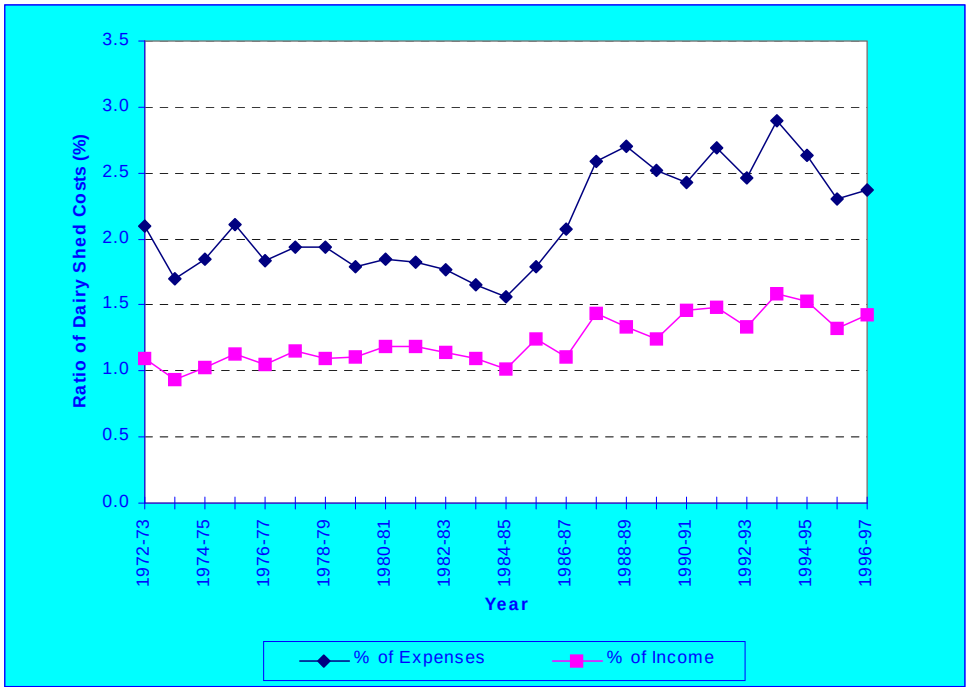

Figure 13. Share of electricity costs in total farm income and cash expenditure

Figure 14. Share of feed and gazing costs in total farm income and cash expenditure

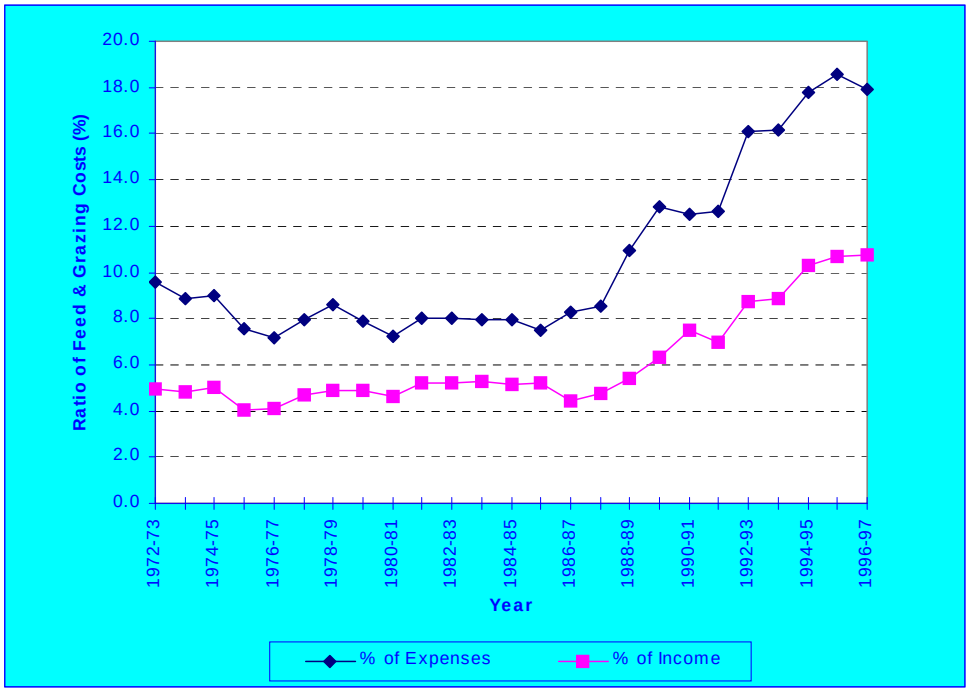

Figure 15. Share o fertiliser costs in total farm income and cash expenditure

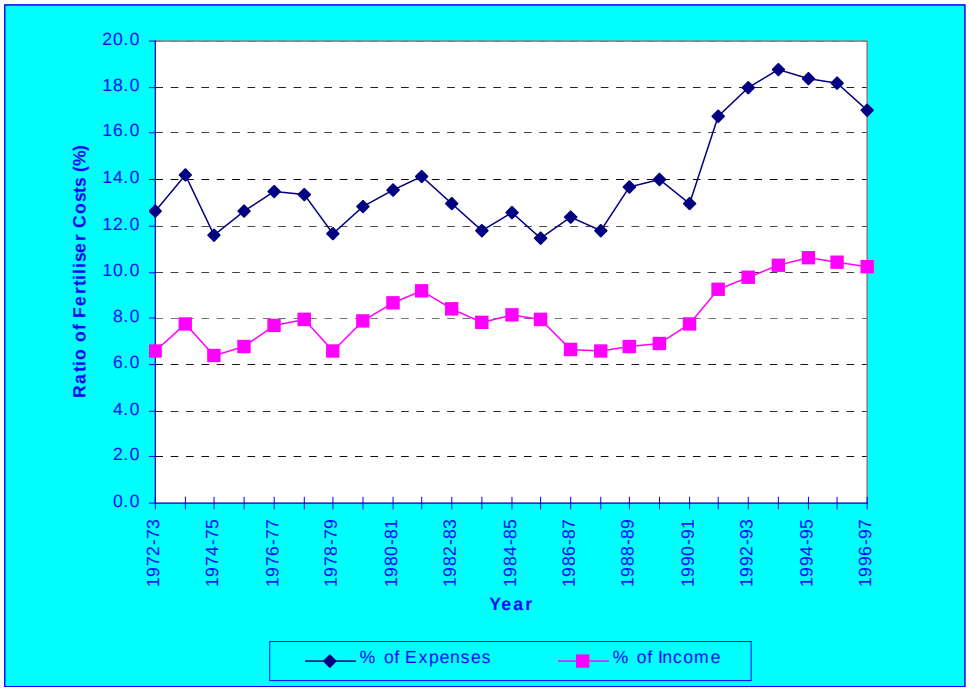

Figure 16. Share of repair and maintenance costs in total farm income and cash expenditure

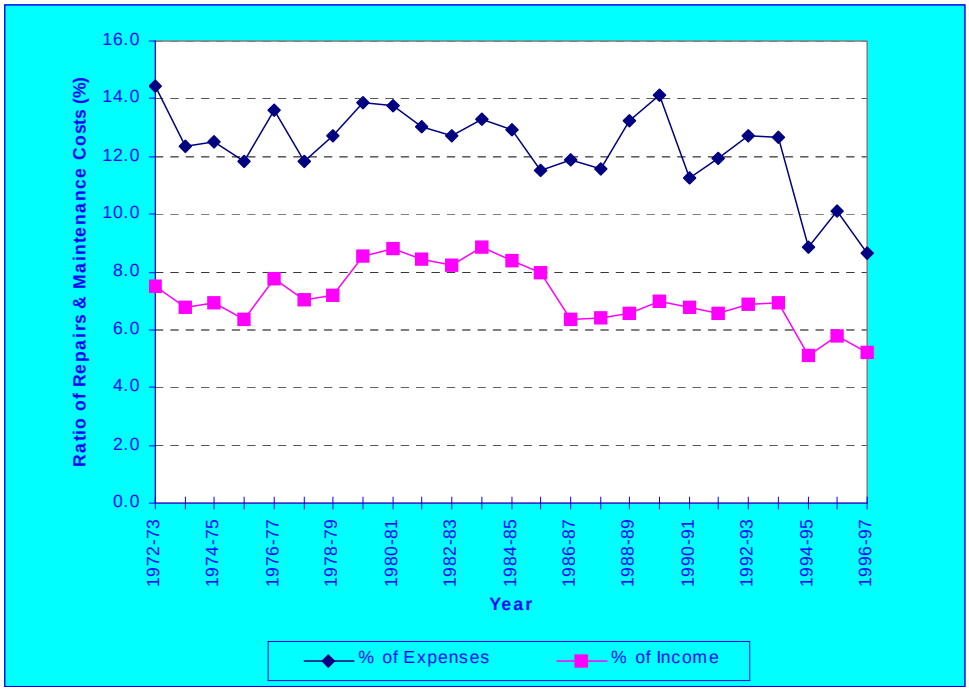

Figure 17. Share of interest costs in total farm income and cash expenditure (1972/73 -1996/97)