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# **An analysis of the growth of the Australian dairy and meat processing industries**

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*The dairy and meat processing industries are significant contributors to the Australian economy. Both industries underpin a large primary producer base and generate substantial domestic and export earnings. The growth of the processing industries and ongoing improvements to their productivity are important issues for the economy. The sources of growth of the dairy and meat processing industries over the period 1980–98 and some factors influencing future growth are examined in this paper.*

## **Introduction**

The growth of the food processing sector is important to the Australian economy in a variety of ways. In addition to its impact on those who have a direct stake in food processing operations, the sector influences the welfare of producers of the raw inputs, retailers and consumers of the final products.

The growth in food processing also influences the wider economy. The industry is an important part of Australia's manufacturing base, contributing significantly to the domestic economy, to employment and to trade. Consequently, the growth of the sector is of major interest to policymakers, most recently demonstrated in the development of the National Food Industry Strategy late in 2001 aimed at facilitating the further development of food industries.

This paper presents the results of an exploratory research into the factors influencing growth of the processed dairy and meat industries. Issues examined in the paper include key features of the dairy and meat industries within the overall food processing sector and recent economic performance. Estimates of the contributions of major factors, such as the contributions of labor, capital and technological progress, to the growth of the processed dairy and meat industries are presented. Some key findings and issues are then discussed.

## **Meat and dairy processing in the food industry**

The processed food and beverage sector is a major part of Australian manufacturing. In 1999-2000 the food processing sector had around 3400 business establishments and a total of 164 000 employees, representing 18 per cent of total employment in manufacturing industries, and accounting for 22 per cent of total manufacturing turnover.

The meat and dairy processing industries are the leading components of the food processing sector. The meat processing industry (comprising abattoirs, poultry processing and bacon, ham and smallgoods companies) had total estimated sales of A\$10 billion in 1999-2000, 20.4 per cent of total food manufacturing turnover. While smaller, the dairy processing industry had total sales of A\$8.2 billion (16.7 per cent of total food manufacturing turnover).

Both the meat and dairy processing industries have a strong export focus, contributing nearly 14 per cent by value to total Australian merchandise exports in 1999-2000. Over 36 per cent of meat processing sales revenue in 1999-2000 was derived from export sales — mainly meat to Japan and the United States. Exports (mainly milk powders and cheese products) accounted for around 19.5 per cent of dairy processing sales with ASEAN countries, with Japan being the main markets. However, both industries are relatively small participants in world trade. In 1998, the Australian share of world trade in processed meat was 4.1 per cent and 2.6 per cent, respectively.

In 1999-2000 employment in meat processing was nearly 48 000, while the dairy processing industry employed 17 300 people, 29 per cent and 10 per cent, respectively, of total food manufacturing employment. A significant part of both industries is based in nonmetropolitan regions and is an important contributor to rural employment. In the 1996 census, it was found that around 54 per cent of direct employment in the meat and dairy industries was in nonmetropolitan regions.

### Meat processing industries

While the abattoir sector is the largest constituent industry of the meat processing industry (comprising meat abattoirs, poultry processing and bacon, ham and smallgoods manufacture) in terms of sales and employment, over recent years its net value added has been low in relation to sales turnover. For example, in 1999-2000 the net value added by abattoirs was around 5.7 per cent of sales turnover. By comparison, the net value added of the poultry processing sector has been much higher in relation to sales, achieving a net value added of around 25 per cent of sales. While there are differences in the nature and organisation of the two industries, recent trends in industry net value added for the meat and poultry industries (figure A) form a stark contrast.

Between 1994-95 and 1999-2000 the net value added of abattoirs declined by 36 per cent in constant dollar terms. Over that period total sales revenue fell by 2.1 per cent in constant dollar terms despite stronger export sales. Increased total labor costs — up 26 per cent in constant dollar terms — were a major factor behind the fall in net value added. Employment increased by 16 per cent while the number of establishments fell by 18 per cent (from 354 to 292). The relationship between the value of purchases and sales declined slightly from 75 per cent in 1994-95 to 73 per cent in 1999-2000, suggesting a slight increase in processing margins over the period.

#By contrast to abattoir industries, the net value added by poultry processing firms increased over the same period. Much of this boost occurred between 1998-99 and 1999-2000. A reduction in costs was the main reason for this increase. While total sales declined by 2.3 per cent in between 1994-95 and 1999-2000 (to \$2.34 billion in 1999-2000), total costs declined by nearly 15 per cent. This fall was in the value of purchased inputs — presumably mainly in the cost of chicken purchases. Farm gate prices of chicken fell by 21 per cent over the period (ABARE 2001).

### Australian dairy processing industry

The dairy industry has been undergoing major changes over a long period, including the full deregulation of the industry on 1 July 2000, ending a long period of government involvement in regulating farm gate milk prices and production. Support for producers supplying the fresh milk market, the high value part of the dairy market, was removed. The milk manufacturing and processing sector has also undergone significant rationalisation, with acquisitions, mergers and strategic alliances of dairy processing enterprises to improve the efficiency of their operations. Around 120 dairy processing companies were operating about 206 establishments in 1999-2000 (table 1).

The three main sectors of the dairy processing industry are establishments specialising in the processing of milk and cream, ice cream and manufacture of other milk products, including butter, cheese and dried milk products. Over half of total industry sales revenue is generated by the manufactured products sector, with export sales accounting for around 40 per cent of their total sales. Milk and cream processing was the second largest sector with around 36 per cent of total industry revenue. The relationship between net value added by processing and total sales revenue varied on average from 36 per cent on ice cream manufacture, 25 per cent on milk processing and to around 18 per cent for manufacture of other products. In terms of their overall contribution to the value added by the dairy processing industry, manufacturing and milk processing have been converging because of strong growth in the latter between 1998-99 and 1999-2000 (figure B).

#Trends in the value added by dairy processing also provide some interesting contrasts. While total sales revenue from milk and cream processing increased by less than 4 per cent in constant dollar terms between 1994-95 and 1999-2000, the net value added by processing increased nearly 20 per cent. Part of this improvement was due to lower input costs, which fell in constant dollar terms from 68 per cent of sales revenue in 1994-95 to 63 per cent in 1999-2000. Conversely, while sales turnover in the processing of other products increased by 33 per cent over the period the growth in net value added was a more modest 4 per cent. In constant dollar terms both the sales turnover and the net value of ice cream manufacture were relatively unchanged over the period.

## Growth patterns and sources of growth

Many factors influence the development of food processing activities in Australia. Changes in the availability of raw inputs for processing and of other inputs, technology used and industry structure all have impacts on the industries involved. To examine some of these factors, a growth accounting model was applied to the meat and dairy industries over the period from 1980–98 to identify longer term trends in the productivity of labor, capital and the role of technological change. In undertaking this task, in the absence of detailed data, it was necessary to aggregate the components within each of the industries.

The Australian New Zealand Standard Industrial Classification (ANZSIC) system was used in aggregating the basic data used in the growth analysis. The basic data on outputs and inputs were assembled and collected from various sources such as ABARE (1987, 1994, 1999), ABS (various issues from 1977 to 2000), AFFA (2001) and BTE (2000).

In the growth accounting approach, the rate of growth in the output ( $G_O$ ) of the dairy or meat processing industry can be expressed as the cost-share ( $S_i$ , where  $i = L$  (labor),  $K$  (capital) and  $OI$  (other inputs)) weighted sum of the rate of growth ( $G_i$ ) in inputs plus a residual term measuring growth in total factor productivity ( $G_{TFP}$ ):

$$G_O = S_L G_L + S_K G_K + S_{OI} G_{OI} + G_{TFP}$$

Because output is usually measured in value terms, an additional term reflecting price changes could be added to the growth components.

In this analysis, GTFP was estimated through the framework developed by Diewart and Morrison (1986) and applied by Gopinath et al (1997) in their study of the US food processing industry. Diewart and Morrison (1986, p. 662) showed that given profit maximising behavior in each period among firms in a competitive environment, total factor productivity was equal to the translog implicit output index divided by the translog input index. The Diewart and Morrison approach has two advantages over other methods. First, it measures the total factor productivity index as a geometric mean, thereby resolving the issue of whether to use the past or the more recent base outputs and prices in estimating it. Second, the most current input prices are used in estimating its weights. Hence, the index approximates quality improvements to the extent that these are reflected by higher input prices.

There are two main limitations of the total factor productivity approach. First, since it is estimated as a residual, it is susceptible to measurement errors. Second, it might not be able to measure the nonmarket costs of growth accurately.

### Growth trends and decomposition results

Analysis of growth was undertaken over the period 1980–98 and in three subperiods (1980–86, 1987–92 and 1993–98) to better reflect the impact of changes in trading conditions and policies that might have affected the dairy and meat industries. One such policy was dairy equalisation whereby dairy farmers paid a levy of \$0.02 per litre produced for domestic consumption between 1986 and 1995. Dairy processing firms also paid a levy of \$0.04 per litre on all milk used in the production of cheese, powdered milk, butter and other manufactured dairy products for domestic sale

### Growth in the dairy processing industry

Over the period 1980–98, the output of the dairy processing industry grew by 1.47 per cent a year (table 2). Two-thirds of the aggregate growth was due to higher input use and one-third to improved productivity. However, lower prices associated with the growth in output efficiency reduced the growth in value by around 0.6 per cent a year. When disaggregated into subperiods, industry growth and the sources of this growth varied widely, with the period 1980–86 exhibiting strong growth in output and in prices, while technology growth was lower. From 1987 to 1992 there was little growth in the value of processing with increases in input use and in productivity largely offset by lower price levels.

Improved factor productivity has made a significant contribution to the growth of dairy processing over the period and could potentially reduce total cost cumulatively by \$4 million (see Harberger 1998 for estimation details) over the full period. While growth in GDP has been falling over the last two periods examined, this has been due to strong price effects (with declining real prices of outputs). With the exception of the last period examined (1993–98, when there was some loss in productivity), productivity gains have been an important source of industry growth.

Increased use of inputs was the main factor behind the growth in dairy processing GDP. Over the full period, about half of this growth was due to increased purchases of manufacturing materials (the largest item being raw milk) with increased capital and labor inputs contributing 20 per cent and 14 per cent respectively of the growth (of the 1.4 per cent a year) due to increased input use (table 3).

### Growth in the meat processing industry

Between 1980 and 1998, the value of meat processing output increased by 0.37 per cent a year (table 4), a quarter of that achieved by the dairy processing industry over the same period. Declining prices contributed to the low growth overall but, unlike the dairy industry, this was exacerbated by negative productivity growth. All the growth in meat processing GDP was associated with increased input use, mainly material inputs, such as stock for processing.

Examination of meat processing industry growth over the subperiods reveals substantial variations in performance with strong growth in the value of output between 1980 and 1986, with very strong contributions from growth in input use and improved productivity. However, the value of meat processing declined from 1987 to 1992, with negative contributions from purchased inputs, negative relative price movements and also a strong decline in overall productivity. Falling real prices, and lower labor output were the major factors behind this fall (table 5).

### Partial productivity growth

Partial productivity indexes are ratios of outputs to individual inputs or aggregates of inputs, normally estimated for the major inputs used by a firm or industry. For example, the output per hour of labor is a partial labor productivity index. To a certain extent, changes in partial labor productivity reflect factor substitutions (for example as indicated by the technical elasticity of substitution parameter) and changes in production efficiencies.

Partial labor productivity is measured as:

$$O/L = (O/K)*(K/L)$$

$O$  is output while  $L$  and  $K$  refer to labor and capital inputs. Hence, partial labor productivity can be decomposed into the partial capital productivity and the capital–labor ratio.

The growth in partial labor productivity is:

$$G_{O/L} = G_{O/K} + G_{K/L}$$

Hence, changes in the partial labor productivity reflect changes in partial capital productivity and changes in the capital–labor ratio. For example, a rising labor productivity could either be due to a rise in capital productivity or a rise in the capital–labor ratio or both. Higher returns to capital relative to labor cost could likely spur the higher use of capital relative to labor employment.

Estimates of the partial productivity for the period 1980–98 and the subperiods are given in tables 6 and 7. For the dairy industry, the growth in labor productivity over the entire period was 3.1 per cent a year but when examined in terms of the subperiods, was characterised by strong growth of nearly 6 per cent a year for the period 1987–92 with growth of around 2.2 per cent a year in the other two subperiods. This was largely achieved through the growth in capital productivity. Except for the period, 1993–98, growth in the capital intensity had been declining.

In the meat processing industry, labor productivity was much lower, averaging 0.9 per cent a year over the full period and ranging from 0.8 per cent to 2 per cent a year in the subperiods. Although capital productivity grew from 0.7 to 6.6 per cent a year, over the first two subperiods, the capital–labor ratio was declining during the second period, consistent with low rates of capital inflow to the industry (Zsirossy 1996, p. 2).

### Other factors affecting productivity growth

Investment in research and development infrastructure, training programs and other economic factors can affect the productivity in the dairy and meat processing industries. Since the growth in total factor productivity (TFP) sustains the overall growth of these industries, an analysis of the factors affecting it could provide policy insights. Hence, in this section, the estimated impact of changes in research expenditure on TFP in both industries is reported with the estimates having been obtained through a regression model.

For the period, 1980–98, the regression results for the TFPs are:

#### Dairy processing

$$\text{Log}(TFP) = 1.17 + 0.069 t + 0.35 D_1 + 0.15 D_2 + 0.15 D_3 - 0.017 pdar + 0.006 res$$

(1.91)    (1.91)    (1.85)    (1.87)    (1.35)    (-1.27)    (1.89)

Adjusted R square = 0.68; DW = 2.23

#### Meat processing

$$\text{log}(TFP) = -1.15 - 0.09 t + 0.103 D_1 + .062 D_2 + 0.26 D_3 + 0.29 pm + 0.008 res$$

(-1.86)    (-1.95)    (0.96)    (1.79)    (1.79)    (2.08)    (1.87)

Adjusted R square = 0.72 ; DW = 2.15

$D_1$ ,  $D_2$  and  $D_3$  are dummy variables that equal 1 when the observation belongs respectively to the periods, 1980–86, 1987–92 or 1993–98, otherwise 0. The variables  $pdar$  and  $pm$  are the aggregate real price of processed dairy and meat products. The variable  $res$  is the real annual research expenditure in million dollars, obtained from the ABS, while  $t$  is time.

The research variable has a statistically significant and positive impact on the total factor productivity of both the dairy and meat processing industries. It supports the important role that research investments can play in achieving a sustainable productivity growth in both industries.

Overall, on the basis of the coefficient for the time variable, the results indicate that TFP is increasing in the dairy processing industry and decreasing in the meat processing industry. The declining trend in relation to productivity in the meat processing industry over time, is a finding supported by other research, particularly Booz and Hamilton (1993). Zsirossy (1996, p. 3) noted that this technology pattern in the meat processing industry could likely be attributed to a slower rate of adoption of better work practices and introduction of technologically advanced equipment. However, workplace reforms implemented under the agrifood strategy in 1992 appeared to have boosted total factor productivity, as indicated by the positive sign of the  $D_3$  and its statistical significance at the 5 per cent level.

Changes in commodity prices appear to have affected productivity growth in the meat processing industry through its impact on the returns to the adoption of improved technologies. The coefficient of the price variable in the meat processing equation is positive and is statistically significant at the 2.5 per cent level. The meat industry works on relatively thin margins, such that small changes in the relativity between prices paid for slaughter animals and meat prices have a major impact on profitability of processing. In turn, this is likely to influence the level of investment in research and technological development.

## Implications of the future growth of the dairy and meat processing industries

Given the importance of the dairy and meat processing industries to the food sector and the economy, the maintenance of growth through productivity gains is an important issue. The results reported suggest that the productivity of dairy processing is improving.

Industry competitiveness depends on the efficiency of all aspects of production between producers and final consumers. Comparing productivity changes in the producer sector with those in the processing sector gives a more complete picture of industry productivity. In a study of farm sector productivity between 1977-78 and 1998-99 (Knopke, O'Donnell and Shepherd 2000), the dairy sector was found to have one of the strongest growths in output. However, this output growth was mainly associated with increased use of inputs, resulting in average annual total factor productivity of just 1.6 per cent. Livestock industries have achieved lower annual growth in output than dairy farms and their productivity gains have also been relatively low, ranging from 0.6 per cent per year for sheep to 2.1 per cent for beef (table 8).

The improvements in farm level productivity and the growing total factor productivity found in the Australian dairy processing industry supports a positive view of dairy industry prospects in both global and local markets, with lower processing costs.

Industry rationalisation has been a key feature of the dairy processing industry, with company mergers providing opportunities for economies of scale. The dairy manufacturing sector has become increasingly concentrated since the mid-1990s with the top 10 per cent of firms accounting for 61 per cent of sales in 1998-99 compared with 45 per cent in 1995-96 (figure C). Over the same period, sales concentration in the milk and cream sector actually fell, with the top 10 per cent of firms accounting for 37 per cent of sales in 1998-99 compared with 51 per cent in 1995-96. The increased merger activity since 1998-99 is likely to have increased the industry concentration levels.

It has appeared to be more difficult to achieve economies of size in some areas of the meat industry. Industry concentration and economies of size have strengthened in the poultry processing industry where the proportion of sales generated by the top 10 per cent of firms increased from around 40 per cent in 1995-96 to 70 per cent in 1998-99. In the abattoir sector there has been very little change in industry concentration, with the proportion of sales held by the top 10 per cent of firms rising from 55 per cent in 1995-96 to 63 per cent in 1989-90.

A key factor assisting the poultry processing industry has been market growth and increasing production levels. Poultry production has been consistently increasing by 4 per cent a year since the mid-1980s, reaching over 600 000 tonnes in 1998-99. Growth in production of other meats has been much slower with beef production increasing by 3 per cent and sheep meats by less than 2 per cent a year. The production of milk for manufacturing has increased by around 6 per cent a year while market milk production has been more stable.

Growth in the value of both the abattoir sector and manufacturing milk sector are constrained by the existence of barriers to efficient trading opportunities on overseas markets. Protectionist policies overseas decrease the volume of trade and reduce prices, disadvantaging the low cost efficient industries of freer trade oriented countries such as Australia.

Based on the results of this paper, there would appear to be a role for research in sustaining the growth in both industries. The results also serve to draw attention to the importance of achieving productivity gains across all aspects of processing dairy and meat.

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**Table 1: Food processing industry in 1999-2000: meat, dairy and total manufacturing**

	Number of establishments	Employment <sup>b</sup>	Sales turnover	Exports	Industry value added <sup>a</sup>
	no.	no.	\$m	% of turnover	\$m
<b>Food and beverage processing</b>	<b>3 419</b>	<b>163 695</b>	<b>50 321</b>	<b>22.1</b>	<b>13 916</b>
<b>Meat processing</b>	<b>607</b>	<b>47 781</b>	<b>10 958</b>	<b>36.4</b>	<b>2 626</b>
Meat processing	292	27 784	7 038	55.8	1 523
Poultry processing	155	13 241	2 543	0.7	750
Bacon, ham and smallgoods	160	6 756	1 377	2.6	353
<b>Dairy processing</b>	<b>206</b>	<b>17 233</b>	<b>8 348</b>	<b>19.5</b>	<b>1 872</b>
Milk and cream	57	6 114	3 027	4.4	640
Ice cream	32	2 505	728	6.2	172
Dairy products	118	8 614	4 593	31.5	1 060
<b>Total manufacturing</b>	<b>na</b>	<b>932.8</b>	<b>231 145</b>	<b>17.5</b>	<b>36 834</b>

<sup>a</sup> Industry value added is the total sales plus closing inventories less opening inventories minus selected operating expenses, not including labor and salary costs. <sup>b</sup> Employment at 30 June.

Source: ABS, *Manufacturing Industry 1999-2000*, cat. no. 8201.

**Table 2: Sources of growth in Australian dairy processing GDP**

	<b>GDP growth</b>	<b>Real price effect</b>	<b>Input contribution</b>	<b>TFP growth</b>
	% pa	% pa	% pa	% pa
1980–98	1.47	-0.60	1.41	0.66
1980–86	4.85	1.79	2.66	0.40
1987–92	0.21	-1.82	1.05	0.98
1993–98	-0.22	-1.41	1.43	-0.24

**Table 3: Contribution of inputs to dairy processing GDP growth**

	<b>Material inputs</b>	<b>Capital</b>	<b>Labor</b>	<b>Energy</b>	<b>Total input</b>
	% pa	% pa	% pa	% pa	% pa
1980–98	0.79	0.30	0.20	0.12	1.41
1980–86	-0.31	-0.24	0.51	2.7	2.66
1987–92	1.52	-1.39	0.35	0.57	1.05
1993–98	0.78	1.31	-0.12	-0.54	1.43

Material inputs are aggregation of expenses on raw materials. Energy inputs is an aggregation of expenses on coal, electricity GDP is equal to the sum of factor payments.

**Table 4: Sources of growth in Australian meat processing GDP**

	<b>GDP growth</b>	<b>Real price effect</b>	<b>Input contribution</b>	<b>TFP growth</b>
	% pa	% pa	% pa	% pa
1980–98	0.37	-0.27 (-1.99*)	0.93 (1.86*)	-0.29 (-1.97*)
1980–86	10.08	0.76 (1.39)	4.97 (1.94*)	4.35 (1.16)
1987–92	-6.23	-0.79 (-2.09*)	-1.52 (-2.26*)	-3.92 (1.89*)
1993–98	4.76	1.04 (2.41*)	1.86 (1.94*)	1.86 (1.96*)

All annual growth rate were obtained from logarithmic (base e) regression with time as the independent variable. Numbers in parentheses are the 't' value of the regression coefficient. Single asterisk means significant at the 0.025 level. Material inputs are aggregation of expenses on raw materials. Energy inputs is an aggregation of expenses on coal, electricity GDP is equal to the sum of factor payments.

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**Table 5: Contribution of inputs to meat to processing GDP growth**

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	<b>Material inputs</b>	<b>Capital</b>	<b>Labor</b>	<b>Energy</b>	<b>Total input</b>
	% pa	% pa	% pa	% pa	% pa
1980–98	0.95 (1.89*)	0.48 (1.80)	-0.54 (-6.15*)	0.04 (1.78*)	0.93 (1.86*)
1980–86	3.7 (1.98*)	-0.89 (-2.46*)	0.21 (1.49)	1.95 (1.80)	4.97 (1.94*)
1987–92	1.58 (1.95*)	-1.34 (-1.48)	-1.25 (-3.62*)	-0.51 (-1.76)	-1.52 (-2.26*)
1993–98	1.22 (1.79)	0.95 (6.0*)	0.44 (1.89)	-0.75 (-1.9)	1.86 (1.94*)

All annual growth rate were obtained from logarithmic (base e) regression with time as the independent variable. Numbers in parentheses are the 't' value of the regression coefficient. Single asterisk means significant at the 0.025 level. Material inputs are aggregation of expenses on raw materials. Energy inputs is an aggregation of expenses on coal, electricity. GDP is equal to the sum of factor payments.

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**Table 6: Partial productivity trends in the dairy processing industry**

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	<b>Labor productivity</b>	<b>Capital productivity</b>	<b>Capital-labor ratio</b>
	% pa	% pa	% pa
1980–98	3.1	4.8	-1.7
1980–86	2.3	5.3	-3.0
1987–92	5.7	8.0	-2.3
1993–98	2.2	1.0	1.2

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**Table 7: Partial productivity trends in the meat processing industry**

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	<b>Labor productivity</b>	<b>Capital productivity</b>	<b>Capital-labor ratio</b>
	% pa	% pa	% pa
1980–98	0.9	1.9	-1.0
1980–86	0.8	0.7	0.1
1987–92	2.0	6.6	-4.4
1993–98	1.4	3.7	-2.3

**Table 8: Farm level productivity growth and terms of trade**

Average annual rates of change 1977-78 to 1998-99, per farm basis

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	<b>Outputs</b>	<b>Inputs</b>	<b>Productivity</b>	<b>Terms of trade</b>
	% pa	% pa	% pa	% pa
All dairy farms	4.1	2.5	1.6	-1.1
Broadacre				
Wheat and other crops	4.8	1.3	3.6	-3.1
Mixed crops-livestock	3.6	1.0	2.6	-2.9
Sheep	1.2	0.6	0.6	-2.4
Beef	2.4	0.3	2.1	-2.1
Sheep-beef	0.4	-0.9	1.4	-2.2
All broadacre farms	3.3	0.7	2.6	-2.9

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*Note:* Columns of figures are independent of each other.*Source:* Martin, Riley, Lubulwa, Knopke and Gleeson (2000).