Productivity in the beef cattle and slaughter lamb industries

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Executive Summary

Detailed estimates of productivity growth are presented for the beef cattle and slaughter lamb industries in this report. These estimates differ from previous ABARE estimates for two reasons. Firstly, this study is the first to include 2006-07 farm survey data, so the overall estimation period differs. Secondly, the beef and slaughter lamb industries are classified differently from previous ABARE estimates of productivity. In this report, the beef industry is classified as all survey farms with more than 50 head of cattle, while the slaughter lamb industry is classified as survey farms with more than 200 sheep and more than 100 slaughter lambs. These factors should be carefully considered when comparing these results with other productivity estimates.

Beef cattle Industry

- Between 1977-78 and 2006-07, total factor productivity (TFP) in the beef industry increased by 1.09 per cent a year on average, driven by a combination of moderate expansions in output, and some decline in input use. The droughts in 1982-83, 1994-95, 2002-03 and 2006-07 had negative impacts on productivity.
- Between 1977-78 and 1982-83, TFP declined by 2.29 per cent a year and, between 1983-84 and 2006-07, it increased by 1.28 per cent a year.
- Between 1977-78 and 2006-07, 'very large' and 'large' beef producers were able to increase TFP more rapidly (averaging 2.05 and 1.95 per cent a year, respectively) than 'medium' and 'small' producers (averaging 1.16 and 0.60 per cent a year, respectively). Economies of scale and greater use of lot feeding to finish cattle were among the main drivers of TFP growth in larger farms.
- Beef producers of different intensity (measured as the ratio of the estimated turnover and the number of cattle at the end of the financial year) were similar in TFP growth but differed in the underlying drivers. While the high intensity farms relied on improving input efficiency, medium intensity farms achieved higher productivity through strong output growth. Low intensity farms improved productivity by both increasing output and reducing input use.
- The northern beef industry achieved an average productivity growth rate of 1.05 per cent a year over the period 1977-78 to 2006-07. Over the same period, productivity growth in the southern beef industry averaged 1.16 per cent a year.
- The TFP growth of beef producers in the northern region was flat between 1977-78 and 1995-96 and accelerated at an average of 1.14 per

cent a year between 1995-96 and 2006-07. Expansion of operations in the northern industry, in response to live cattle trade, has facilitated steady productivity growth over the past decade. Again, larger farms have achieved the highest gains in productivity.

- The TFP growth in the southern region declined by 2 per cent a year between 1977-78 and 1981-82 and then increased to 3.74 per cent a year between 1981-82 and 1993-94. Productivity growth in the southern region has been volatile since 1993-94, partially reflecting the impact of drought.

Slaughter lamb Industry

- Between 1988-89 and 2006-07, TFP of the slaughter lamb industry increased by only 0.22 per cent a year on average.
- TFP performance in the slaughter lamb industry appears to have experienced three cycles between 1988-89 and 1993-94, 1994-95 and 2001-02 and from 2002-03 onwards. The increase in TFP in the first period occurred after the wool industry was deregulated in the early 1990s. Over the second period, the industry appears to have responded to the higher demand for lamb in the international market. The third period is characterised by recurring droughts and below average seasonal conditions.
- For the slaughter lamb industry, productivity trends for farms of different scale and intensity are difficult to determine given the small sample size and volatility in TFP estimates.

1 Introduction

Australia's livestock sector has had relatively strong productivity growth over the past few decades when compared with non-agricultural sectors. Even so, Australian agriculture is subject to the impacts of declining terms of trade in the long term, rising input prices, pressures of climate change and a degrading resource base. These factors provide an incentive for farmers to further improve productivity in order to offset these impacts and maintain long run profitability.

Under the Australian Government's new rural research and development (R&D) priorities, improving productivity and profitability of agricultural industries has been identified as a major objective (DAFF 2007). Priorities also include improving the skills to undertake and apply research findings, and promoting the development of new and existing technologies. The Australian Government, Meat and Livestock Australia and industry invest heavily in R&D designed to boost productivity in the livestock sector and continue to emphasise promotion and education to inform farmers of new technologies to boost adoption levels.

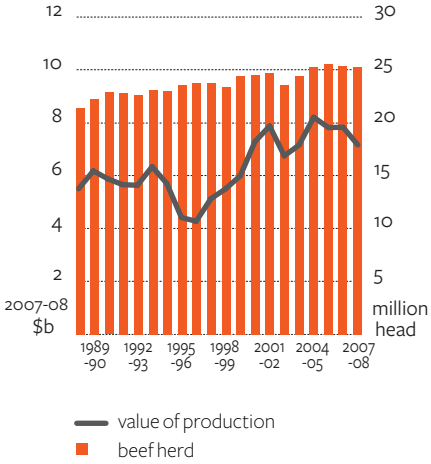
Over the past decade, the beef and slaughter lamb industries have expanded, with producers responding to higher prices. However, adverse seasonal conditions have affected the ability of farmers to maintain production levels in recent years. Productivity analysis enables the long-term trends in productivity to be determined and establish the potential impacts of changing market and seasonal conditions on industry performance.

In this report, detailed estimates of productivity growth are presented for the beef cattle and slaughter lamb industries. To investigate the impact of operating scale and intensity on the productivity of these industries, further estimates are made for farm groups, based on the size of their herd and annual turnover. Beef cattle producers in northern and southern Australia tend to run significantly different operations (in terms of area operated and cattle numbers). To provide further insight on the impact of these differences on performance, estimates of productivity between northern and southern beef cattle producers are compared.

2 Broadacre livestock industry in Australia

The livestock industry in Australia accounts for more than 45 per cent of Australia's total value of agricultural production. Within the livestock industry, beef cattle and slaughter lamb are the largest industries in value terms. Over the past three decades, beef cattle numbers have trended upwards and the industry has expanded in response to higher prices, despite higher turnoff occurring during drought years. Alternatively, the sheep flock has steadily fallen reflecting the declining profitability of wool production in Australia. In June 2007, cattle and sheep populations were around 25.4 million and 85.7 million head respectively.

a Beef herd and value of production



Australia's beef cattle industry is characterised by a wide range of farm sizes and production systems. More than half of the properties running more than 50 beef cattle in Australia engage mainly in an enterprise other than beef production. 'Specialist beef properties', that is, those farms with more than 50 per cent of their income from beef cattle, carry more than 60 per cent of Australia's beef cattle herd. The distribution of beef cattle producers based on the size of their operations is shown in table 1.

Beef cattle production is widespread across Australia. In the northern beef region (Queensland, Northern Territory and the northern pastoral regions of Western Australia), producers generally have larger properties and production is based mainly on native pastures. The expansion of the beef industry over the past two decades (figure a) has been driven by growth in the northern beef region in particular, largely because of the expansion of live export trade to South Asian markets.

1 Distribution of beef cattle producers, 2000-01 to 2006-07 by number of cattle at 30 June

	number of producers	share of producers	share of beef cattle	share of beef cattle value of production
	no.	%	%	%
Less than 100 head	13 115	30.4	3	4
100-400 head	18 240	42.2	17	19
400-800 head	6 458	14.9	16	17
800-1600 head	3 048	7.1	15	15
1600-5400 head	1 905	4.4	23	20
More than 5400 head	444	1.0	25	25
Total	43 211	100	100	100

Source: ABARE 2008a.

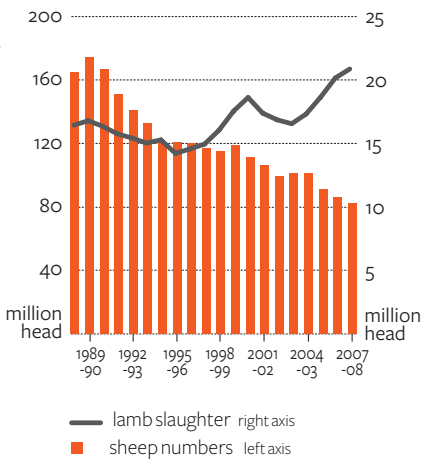
In the southern region (New South Wales, Victoria, South Australia, Tasmania, and the southern pastoral regions of Western Australia), the industry is characterised by smaller properties with a higher reliance on improved pastures. Southern beef producers have been more heavily affected by dry conditions and reduced feed availability resulting from drought across Australia. The impact of drought on southern beef producers has been particularly notable in the past few years with cattle numbers falling by an average of 4 per cent per farm in 2006-07. Small-scale producers in the northern beef region (particularly in southern Queensland) have also de-stocked intensively in recent years in response to drought. Over the past 12 months, pasture growth has improved and it is expected that producers will begin to slowly rebuild stock numbers. If conditions are favourable, expansion of the industry can be expected to continue (ABARE 2008a).

Many slaughter lamb producers have diversified farms producing a mix of wool, lambs, sheep, beef cattle and crops. Only a small proportion of farms have slaughter lambs as their only output, with the vast majority producing wool as a co-product. Less than one-quarter of producers have more than 1000 slaughter lambs (table 2).

Sheep producers have responded to the changing returns for wool and lamb. Despite declining sheep numbers, the production of slaughter lambs has continued to increase each year as producers respond to strong growth in international demand for Australian lamb (figure b). Over the past decade, domestic lamb prices have risen to historically high levels averaging 350 cents per kilogram between 2003-04 and 2007-08, compared with 194 cents per kilogram from 1993-94 to 1997-98.

Prior to 1994-95, the slaughter lamb industry was heavily concentrated in the high rainfall and wheat-sheep zones of New South Wales and Victoria as well as Tasmania, south-east South Australia and a small region north of Perth, Western Australia. Over the past decade, slaughter lamb

b Sheep flock and lamb slaughterings



2 Distribution of broadacre slaughter lamb producers, 2000-01 to 2006-07 by number of slaughter lambs sold

	number of producers	share of producers	share of slaughter lamb value of production
	no.	%	%
Less than 200 slaughter lambs	5 291	24	3
200-500 slaughter lambs	6 038	27	12
500-1000 slaughter lambs	6 100	27	26
1000-2000 slaughter lambs	3 423	15	27
More than 2000 slaughter lambs	1 436	6	32
Total	22 288	100	100

Source: ABARE 2008b.

production has expanded throughout these regions and into some pastoral regions such as the Gippsland region in Victoria, south-west Western Australia, the south western pastoral and Darling Downs regions of Queensland, and the North West Slopes and Central Tablelands in New South Wales (ABARE 2007b).

Although output of beef cattle and slaughter lambs is gradually increasing (figures a and b), domestic consumption of beef and lamb has been steadily declining because of changes in prices and consumer preferences. Consequently, the Australian beef and slaughter lamb industries are becoming increasingly export oriented. Exports of beef increased from 53 per cent of total production in 1988-89 to 64 per cent in 2007-08. More significantly, lamb exports rose from 14 per cent of production 1988-89 to 45 per cent in 2007-08. As a consequence, the Australian livestock industry is now influenced more by movements and trends in international markets.

Australia's major markets for beef are Japan, the United States and the Republic of Korea. Japan has become a major destination for Australian beef since the removal of beef import quotas in the early 1990s which led to a significant expansion of grain-fed beef production in Australia. Principal lamb export markets are the United States, the Middle East, Papua New Guinea, the European Union and Japan. The opening of the US market during the past decade has had a stimulatory effect on Australian sheep producers and contributed to a substantial rise in the number of specialist lamb producers.

Beef and slaughter lamb producers have benefited from strong prices in recent years. However, relative to the price of farm inputs, prices have declined over the longer term. In response to declining terms of trade, producers require improvements in productivity to maintain or improve profitability and international competitiveness. Productivity gains can be made via the use of new technology and better farm management practices which increase output or reduce inputs, or both.

3 Trends in productivity

Productivity growth in the livestock sector

Productivity reflects the ability to produce goods and services (outputs) given available resources (inputs). Total factor productivity (also known as multifactor productivity) measures overall productivity by comparing a ratio of total outputs relative to total inputs used in the production of output. TFP is a useful indicator for monitoring and analysing the performance of farm businesses and industries. The method used for estimating TFP in this study, along with the input and output variables included are presented in appendices A and B.

The data used in the productivity estimates are sourced from ABARE's Australian Agricultural and Grazing Industries survey (AAGIS) of broadacre industries. The data set is comprehensive and can facilitate the measurement of total factor productivity. However, the impact of 'missing' variables is sometimes captured in the analysis (Kokic, Davidson and Rodriguez 2006). For example, short-term influences such as the effect of climate variability on livestock production and deferring input expenditure in low-income years, have an impact on estimates, yet are not always accounted for in TFP measurement. To reduce the effect of these short-term fluctuations, long-term productivity trends are generally the focus in TFP studies.

Productivity trends are measured in terms of average annual growth in TFP. A high rate of growth could reflect an increase in the level of output relative to the resources used, or alternatively a reduction in inputs (resources) required to achieve a particular output level. Productivity growth can be influenced by structural adjustments, adopting improved technologies, better management practices, reduced input use because of efficiency improvements, and realising economies of scale. These factors are typically considered to be the drivers of growth in Australia's agricultural sector.

The beef industry, for the purposes of this study, is classified as all AAGIS farms with more than 50 head of cattle. For the slaughter lamb industry, the criterion is farms with more than 200 sheep and more than 100 slaughter lambs. Given these classifications, it should be clarified that a large proportion of beef and slaughter lamb producers in this study are 'mixed' producers, that is, beef or slaughter lamb may not be their only production activity, or even their dominant output. As TFP measures total

outputs relative to total inputs, the indices of 'output' estimated reflect not only output of beef or slaughter lambs, but output of all production activities within the sample.

Long-term growth in TFP is measured for the beef industry from 1977-78 to 2006-07 and for the slaughter lamb industry from 1988-89 to 2006-07. A consistent dataset for the slaughter lamb industry is not available for earlier years. Given the different estimation period and industry classifications used in the study, results are not directly comparable with previous estimates of TFP for the broadacre livestock industries. These differences are highlighted in appendix C.

As well as estimating overall TFP for the beef and slaughter lamb industries, additional productivity estimates were also made based on the scale and intensity of operations. Scale of production was determined by the average number of cattle or slaughter lambs at the end of each financial year. Farms were segregated into five categories based on their livestock production scale ranking from very small to very large scale operations. Intensity of operations was measured as the ratio of the estimated turnover and the number of cattle or lambs at the end of the financial year. Turnover is the sum of the number of cattle (or lambs) sold and the number of cattle (or lambs) transferred out. Producers with an intensity ratio in the top 30 per cent are considered to be high intensity, the bottom 30 per cent low intensity, and the remaining 40 per cent are classified under medium intensity.

As smaller beef producers often have other outputs dominating their production mix, estimates for small and very small producers are likely to be influenced more by outputs other than beef. Estimates for farms classed as larger beef producers are likely to be a fuller reflection of beef productivity. However, even these producers have other outputs in the majority of cases.

The same is not the case for the slaughter lamb industry. Nearly all slaughter lamb producers produce wool as a co-product and the vast majority also have other outputs such as crops or beef cattle. These estimates therefore reflect the productivity of farms producing beef or slaughter lamb, rather than the productivity of the production of beef or slaughter lamb.

Beef industry trends

Between 1977-78 and 2006-07, TFP in the beef industry increased by 1.09 per cent a year on average. This productivity growth appears to be driven mainly by moderate expansions in output (0.58 per cent a year), coupled with smaller declines in inputs (0.51 per cent a year) (table 3). This is lower than the overall productivity growth in the broadacre sector which averaged 1.5 per cent a year between 1977-78 and 2005-06 (Zhao et al. 2008).

3 Beef industry characteristics

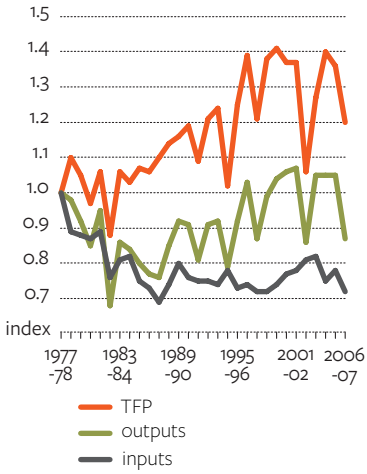
average 1977-78 to 2006-07

	average number of farms (share of total) %		TFP growth %	output growth %	input growth %
Total	732	(100)	1.09	0.58	−0.51
Scale					
Very large (more than 1600 head)	162	(22.2)	2.05	3.26	1.21
Large (800–1600 head)	86	(11.7)	1.95	2.12	0.18
Medium (400–800 head)	124	(16.9)	1.16	0.92	−0.23
Small (100–400 head)	275	(37.6)	0.60	−0.80	−1.40
Very small (less than 100 head)	85	(11.6)	1.44	−0.84	−2.28
Intensity					
High (more than 70 per cent)	220	(30.0)	1.28	−0.08	−1.36
Medium (30–70 per cent)	293	(40.0)	1.22	1.43	0.21
Low (less than 30 per cent)	220	(30.0)	1.02	0.59	−0.43

Downturns in productivity growth occurred in 1982-83, 1994-95, 2002-03 and 2006-07, mainly because of reduced output associated with drought during these years (figure c). Seasonal conditions are one factor that can affect output with substantial flow-on impacts on measuring productivity growth. If these factors were accounted for and removed, the estimated growth in productivity is expected to be considerably larger (Kokic et al. 2006).

There also appears to be a break in the trend of productivity growth during the early 1980s. Productivity growth was negative between 1977-78 and 1982-83, averaging -2.29 per cent a year. Productivity growth then improved to average 1.28 per cent a year between 1983-84 and 2006-07. However, the upward trend in productivity growth appears to be less clear between the early 1990s and 2006-07. Over this period, there is more notable volatility in productivity growth which is largely output driven and likely to also be a reflection of adverse seasonal conditions.

C Growth in total factor productivity, inputs and outputs beef industry



Scale and intensity of operation and productivity growth

Scale and intensity are two of many factors influencing productivity gains in the beef cattle and slaughter lamb industries. To investigate some underlying determinants of productivity improvements within the beef industry, additional TFP estimates were constructed based on scale and intensity. Between 1977-78 and 2006-07, 'very large' and 'large' beef producers were increasingly more productive (TFP growth averaging 2.05

and 1.95 per cent a year, respectively) than 'medium' and 'small' producers (averaging 1.16 and 0.60 per cent a year, respectively) (table 3). 'Very small' producers holding less than 100 cattle also had impressive TFP growth averaging 1.44 per cent a year.

Strong productivity gains among larger producers appear to be associated with strong improvements in output levels, accompanied by lesser increases in input use. These producers appear to have benefited from factors such as increasing economies of scale, greater use of lot feeding to finish cattle, and the development of the live cattle export trade. Larger producers also benefit from a larger breeding stock, including a higher proportion of females, enabling an increase in calf production.

Medium scale producers achieved productivity growth by more efficiently using fewer inputs to achieve a moderate increase in output, while smaller producers improved productivity only slightly by scaling back their operations altogether. More than other producers, small producers are likely to have had the most difficulty in maintaining cattle numbers given the adverse seasonal conditions in recent years (ABARE 2008a). Small producers appear to have turned-off stock and significantly reduced input requirements to at least partially avoid the consequences of higher input costs. These factors are likely to have inhibited the ability of smaller farmers to achieve any notable gains in productivity.

The performance of 'very small' producers could be driven by a number of factors. These producers are likely to operate mixed enterprise operations which could be driving their productivity growth. Alternatively, these producers may have de-stocked and in turn, significantly reduced their demand for purchased inputs. Because of low stocking rates, negative growth in output could be a result of relatively less pasture and lower calf production. However, as the reduction in output was outweighed by reduced input requirements, productivity growth was relatively strong.

When compared by the intensity of their operations, beef producers did not differ significantly in terms of productivity growth over the period. The most intensive farms averaged TFP growth of 1.28 per cent a year compared to 1.22 and 1.02 per cent a year respectively for 'medium' and 'low' intensity farms. However, the determinants of productivity growth differed in all three cases. High intensity farms relied on improving input efficiency, that is, reducing input use (by -1.36 per cent a year) while almost maintaining output. 'Medium' intensity farms achieved a similar growth in productivity via strong output growth (1.43 per cent a year) with only small additional input requirements (0.21 per cent a year). 'Low' intensity farms improved productivity by both increasing output and reducing input use.

Productivity across regions

Productivity growth has also differed between the northern and southern beef regions of Australia. Although both regions showed similar movements between 1977-78 and 2006-07, performance in the southern region was more volatile from year to year (figure d). Over the period, beef producers in the northern region achieved average productivity growth rates of 1.05 per cent, compared with 1.16 per cent by those in the southern region (table 4).

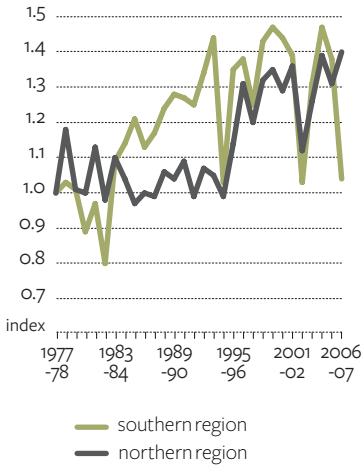
The northern beef industry is largely dominated by less diversified and larger farms with high stock numbers (ABARE 2007a). TFP growth was flat in this region between 1977-78 and 1995-96 (averaging 0 per cent a year), then accelerated at an average of 1.14 per cent a year between 1995-96 and 2006-07 (table 5). The turnaround in industry performance in the north was driven by strong output growth of 1.9 per cent with only moderate additional input requirements.

Between 1995-96 and 2006-07, output growth was particularly high for larger beef producers. Large producers (800-1600 head) increased output by 5.03 per cent a year and very large producers (more than 1600 head) increased output by 3.21 per cent a year. Smaller producers had negative output and TFP growth over the same period.

Productivity growth in the southern beef region has been driven by a combination of expanding output and contracting input use. There have been significant fluctuations in TFP growth, including periods where negative growth has occurred. Between 1977-78 and 1981-82, productivity growth declined by 2 per cent a year on average, mainly caused by declining output. Productivity growth was then strong between 1981-82 and 1993-94, averaging 3.74 per cent a year, as producers expanded output (by 1.85 per cent a year) while simultaneously contracting input use (by -1.89 per cent a year). Since 1993-94, the performance of the southern beef industry has been highly volatile with the overall trend difficult to gauge.

The estimate of TFP growth between 1993-94 and 2006-07 was -0.37 per cent a year on average. However, this estimate changes dramatically if a different start or end year within this period is selected. Because of

d Regional growth in total factor productivity
beef industry



4 Productivity growth in beef regions
average 1977-78 to 2006-07

	TFP growth %	output growth %	input growth %
Northern region	1.05	0.71	0.34
Southern region	1.16	0.48	-0.69

5 Decomposing TFP results for the northern beef industry, 1977-78 to 2006-07

	total number of farms (share of total) %		TFP growth %	output growth %	input growth %
Northern Australia (1977-78 to 2006-07)	10 174	(100)	1.05	0.71	0.34
By sub-period					
Between 1977-78 and 1995-96	5 696	(56.0)	0.00	-0.94	-0.94
Between 1995-96 and 2006-07	4 478	(44.0)	1.14	1.90	0.76
By scale					
Very large farm (more than 1600 head)	4 143	(40.7)	1.88	3.19	1.31
Large farm (800–1600 head)	1 396	(13.7)	2.00	1.84	−0.17
Medium farm (400–800 head)	1 538	(15.1)	0.24	−1.31	−1.55
Smaller farm (100–400 head)	2 445	(24.0)	0.05	−1.51	−1.56
Very small farm (less than 100 head)	652	(6.4)	2.14	−0.58	−2.72
By intensity					
High intensity (>70 per cent)	1 962	(19.3)	1.10	0.07	−1.03
Medium intensity (30–70 per cent)	3 838	(37.7)	1.22	1.62	0.40
Low intensity (<30 per cent)	4 374	(43.0)	0.89	0.34	−0.55
Northern Australia (1995–95 to 2006–07)	4 478	(100)	1.14	1.90	0.76
By scale					
Very large farm (more than 1600 head)	2 104	(47.0)	0.07	3.21	3.15
Large farm (800–1600 head)	639	(14.3)	2.23	5.03	2.90
Medium farm (400–800 head)	604	(13.5)	−0.30	−2.40	−2.00
Smaller farm (100–400 head)	875	(19.5)	−1.93	−0.30	1.66
Very small farm (less than 100 head)	256	(5.7)	−2.07	−0.18	1.72
By intensity					
High intensity (more than 70 per cent)	790	(17.6)	−3.53	1.46	4.97
Medium intensity (30–70 per cent)	1 790	(40.0)	−0.24	2.01	2.29
Low intensity (more than 30 per cent)	1 898	(42.4)	2.51	2.23	−0.25

the short timeframe and the volatility of TFP during this period, a reliable estimate of the overall productivity trend cannot be determined at this stage.

In the southern beef region, larger and high intensity beef producers achieved the greatest productivity growth over the whole period (table 6). Producers with more than 400 head (medium, large and very large farms) significantly expanded output with relatively less increases in the use of inputs. High intensity producers improved performance by scaling back output which declined at an average of -0.14 per cent a year while also improving input efficiency with input growth declining at a faster rate of -1.51 per cent a year.

The different patterns occurring across northern and southern Australia could reflect a number of factors specific to the beef industry in each

6 Decomposing TFP results for the southern beef industry, 1977-78 to 2006-07

	total number of farms (share of total) %		TFP growth %	output growth %	input growth %
Southern Australia (1977-78 to 2006-07)	11 777	(100)	1.16	0.48	−0.69
By sub-period					
Between 1977-78 and 1981-82	1 676	(14.2)	−2.00	0.10	0.10
Between 1981-82 and 1993-94	4 458	(37.9)	3.74	1.85	−1.89
Between 1993-94 and 2006-07	5 643	(47.9)	−0.46	-0.27	0.19
By scale					
Very large farm (more than 1600 head)	730	(6.2)	2.96	3.81	0.84
Large farm (800-1600 head)	1 173	(10.0)	1.55	2.43	0.88
Medium farm (400-800 head)	2 170	(18.4)	1.63	2.21	0.58
Small farm (100-400 head)	5 811	(49.3)	0.81	−0.54	−1.35
Very small farm (less than 100 head)	1 893	(16.1)	1.16	−0.91	−2.07
By intensity					
High intensity (>70 per cent)	4 627	(39.3)	1.37	−0.14	−1.51
Medium intensity (30-70 per cent)	4 940	(41.9)	1.31	1.29	−0.02
Low intensity (<30 per cent)	2 210	(18.8)	0.84	0.93	0.09

region. In recent periods, the northern industry has undergone significant developments in expanding operations in response to the emergence of the live cattle export trade, which has enabled smaller and younger animals to be turned off (ABARE 2004). Larger operations have also enabled farms to carry more cows in order to boost calf production. These adjustments to the northern beef industry have facilitated steady productivity growth over the past decade.

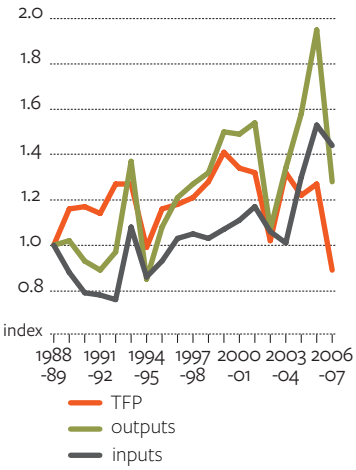
In contrast, productivity growth in the southern region has fluctuated significantly on a year-to-year basis. This volatility partially reflects the impact of drought (which was more notable than in the northern region), which led to destocking followed by extended periods of rebuilding. Fluctuations could also be a result of farmers altering their production mix in response to variable returns. This pattern is more prominent in the southern region because of a lower proportion of 'beef specialists' and a greater proportion of farmers engaged in mixed farming operations.

Slaughter lamb industry trends

Productivity estimates for the slaughter lamb industry are available from 1988-89 to 2006-07. Over this period, total factor productivity increased by 0.22 per cent a year on average (table 7). The improvement was a

result of a significant expansion of output averaging 2.99 per cent a year, while input increased at a slightly lesser rate of 2.77 per cent a year. The TFP growth was significantly lower in this industry than in beef and other broadacre industries (Zhao et al. 2008).

e Growth in total factor productivity, inputs and outputs
slaughter lamb industry



TFP performance in the slaughter lamb industry appears to be cyclical with three cycles occurring between 1988-89 and 1993-94, 1994-95 and 2001-02 and from 2002-03 onwards (figure e). The industry has not been able to sustain any long-term productivity improvements and at the end of each cycle, productivity has returned to the 1988-89 level. Analogous to the beef industry, these productivity movements appear to capture the impact of drought during 1994-95 ,2002-03 and 2006-07. These three cycles also reflect three distinct periods in the development of the slaughter lamb industry.

The first period (1988-89 to 1993-94) corresponds to the deregulation of the wool industry which occurred in Australia during the early 1990s. Prices fell as the industry shifted to a market-based system away from price support and many farmers exited the industry. Over the next period (1994-95 to 2001-02), TFP and output increased steadily as global demand for lamb increased to record levels and farmers shifted into slaughter lamb production. The third period, from 2002-03 to now, is characterised by recurring droughts and below average seasonal conditions. TFP has been variable over this period, reflecting stages of de-stocking and re-stocking. In general, drought can have a lagged effect on productivity. As producers need to rebuild stock numbers, input requirements are high relative to output levels.

7 Slaughter lamb industry characteristics

average 1988-89 to 2006-07

	average number of farms (share of total) %		TFP growth %	output growth %	input growth %
Total	404	(100)	0.22	2.99	2.77
Scale					
Very large (more than 2000 head)	46	(11)	−0.14	6.99	7.13
Large (1000–2000 head)	117	(29)	0.66	4.64	3.98
Medium (500–1000 head)	114	(28)	−0.14	2.97	3.11
Small (200–500 head)	81	(20)	−0.07	1.13	1.20
Very small (less than 200 head)	47	(12)	0.32	−1.47	−1.80
Intensity					
High (more than 70 per cent)	121	(30)	−0.20	3.92	4.13
Medium (30–70 per cent)	162	(40)	0.24	3.78	3.55
Low (less than 30 per cent)	121	(30)	0.24	0.70	0.46

Scale and intensity of operation and productivity growth

When classified by scale and intensity, growth in TFP in the slaughter lamb industry was low or negative between 1988-89 and 2006-07 (table 7). Very large, large and medium slaughter lamb producers, and those with high or medium intensity, incurred the largest expansions in output over the period. However, as increases in output were enabled by greater input use, there was no strong improvements in overall TFP.

Productivity trends in farms of different scale and intensity are difficult to determine given the smaller sample size and volatility in farm performance over the time period. In general, large slaughter lamb producers have greater input requirements and expansions in output are typically coupled with growth in inputs. Lower input and output growth is typical of smaller producers. It is possible 'small and 'very small' producers are farms with a higher share of wool production, relative to lamb, and hence lower input requirements.

Very small slaughter lamb producers have scaled back output and input use, possibly suggesting these producers have turned-off stock in response to poor seasonal conditions or may have diverted resources into other farm enterprises. Alternatively, these smaller producers may be less able to access financial capital to purchase additional land and inputs, compared with large farms, and therefore find it difficult to increase productive capacity and improve performance. The situation could also be similar for 'small' producers who demonstrated negative productivity growth of -0.07 per cent.

Slaughter lamb producers operating at low intensity increased output and input use only slightly. These producers could be responding to pressures similar to those described for 'small' producers, particularly because of drought. Medium and high intensity producers demonstrated strong output growth, however did not exhibit productivity gains. High intensity producers operated at a level where additional inputs did not give additional output, resulting in negative productivity growth. This is potentially a result of seasonal conditions or long-term investments which will have a lagged effect on output.

Long-term capital investments have an immediate effect on the measure of inputs but they can take many years to have an impact on the measure of outputs because of the time required to build productive capacity. As a result, long-term investments tend to create a downward bias in the TFP estimates in the short term. This phenomenon is often observed in the mining industry where capital investments typically take years before they start to produce outputs.

4 Drivers of productivity in the livestock industry

Productivity growth in the livestock industry has fluctuated significantly between 1977-78 and 2006-07, although there was an increasing trend overall. While the beef industry showed only moderate productivity gain relative to the wider broadacre industry, productivity in slaughter lamb has been highly cyclical with any clear trend in long-term overall performance difficult to determine. It is clear from the analysis that below average seasonal conditions have adversely impacted productivity estimates and restricted the ability of the livestock industry to exploit productivity gains. Poor pasture growth and tightening of on-farm feed availability has forced some farms to turnoff livestock to reduce numbers and limit fodder purchases, particularly in recent years (ABARE 2008b).

The broadacre livestock industries are likely to require larger productivity gains to sustain profits and export competitiveness in an operating environment characterised by declining terms of trade, increasing international competition, and growing pressures because of changing climate conditions. Nevertheless, the beef and slaughter lamb industries appear to be equipped with the means to achieve this.

The slaughter lamb industry continues to benefit from rising world lamb prices. Improved management practices, use of superior genetics (for example, the use of non-merino rams to produce first-cross lambs) and greater focus on finishing lambs prior to sale has increased slaughter weight in Australia by around 19 per cent over the past decade (ABARE 2008b). Other productivity drivers over the past decade include a greater reliance on improved pastures and supplementary feeding to enhance ewe fertility rates and reduce lamb mortality rates.

Beef prices have also been strong with high international demand from Japan and South Korea and the expansion of live export markets. However, international competition has also increased, particularly from South American beef and Indian buffalo meat in south-east Asian export markets. Australia's competitiveness has also been affected by a high Australian dollar. Productivity growth therefore needs to improve above current levels to assist beef producers in maintaining viability.

One factor likely to be affecting the productivity of the beef industry is the large number of small scale producers. More than three-quarters of beef producers have less than 400 head of cattle and often do not operate with the scale necessary to benefit from the latest herd or farm business management practices (ABARE 2006). The exception here was very small

producers who exhibited relatively strong productivity performance over the period, most likely because of the dominance of other activities such as cropping in their production mix. Compared to small scale producers, large beef producers have achieved more sizable productivity gains. These producers gradually expanded land holdings during the 1990s, leaving them better placed to increase productivity and incomes. During the 2000s, these producers have also increased capital investment, particularly in the northern beef region.

Productivity growth in the beef industry is likely to continue to be driven by larger farms with bigger land holdings and greater access to capital. These farmers are generally better equipped to increase farm performance and take advantage of recent industry development such as advanced breed genetics, greater ease in moving livestock and fodder, and better herd management, mustering techniques and disease response mechanisms.

appendix A

Construction of the TFP index

Total factor productivity is a ratio of all output quantities to all input quantities. When there is more than one input (or output) it is necessary to use prices to develop weights for aggregation. As the structure of inputs and outputs differ between farms, an indexing procedure is used to aggregate these diverse inputs (or outputs). Total factor productivity indexes were calculated using the Fisher procedure. The Fisher quantity index is defined as the geometric mean of the Laspeyres and Paasche quantity index:

A.1 $$Q_{ot}^{F} = \sqrt{Q_{ot}^{L} Q_{ot}^{P}}$$

where Q_{ot}^{F} is the Fisher index between the current period (t) and base period (o). Q_{ot}^{L} is called Laspeyres index and is defined as

A.2 $$Q_{ot}^{L} = \frac{\sum_{i=1}^{n} p_{io} q_{it}}{\sum_{i=1}^{n} p_{io} q_{io}}$$

Where p_{io} and q_{io} are respectively the price and quantity of i^{th} input or output, observed at the base period; q_{it} is the quantity of i^{th} input or output measured at the current period. Essentially, the Laspeyres index uses the values estimated for the base period as its weights.

Q_{ot}^{P} is called Paasche index and is defined as

A.3 $$Q_{ot}^{P} = \frac{\sum_{i=1}^{n} p_{it} q_{it}}{\sum_{i=1}^{n} p_{it} q_{io}}$$

where p_{it} is the i^{th} price of input or output observed at the current period. The Paasche index uses the values for the current period as its weights.

Further information on this methodology can be found in Davidson et al. (2006).

appendix B Variable definitions

Data used in this report is derived mostly from ABARE's Australian Agriculture and Grazing Industries Survey (AAGIS). The survey is conducted annually and covers broadacre farms engaged in the production of crop, mixed crop and livestock, beef and sheep. In this study, 21 951 observations collected between 1977-78 and 2006-07 are used to estimate TFP growth within the beef industry. For the slaughter lamb industry, 7685 observations for the period between 1988-89 and 2006-07 are used.

The data used to produce TFP estimates can be categorised into input or output components:

Total factor productivity inputs

Total inputs consists of 23 items that can be split into five major groups – land, capital, labour, livestock purchases and materials and services.

Land

Land is defined as the total area operated. The value variable of land is the opportunity cost of investing funds in land, calculated as the average value multiplied by a real interest rate.

Capital

Capital is divided into plant and machinery, structures and livestock (beef and slaughter lambs). The value variables for livestock are the opportunity costs of investing funds in those capital items. These are calculated as the average capital value (that is the average of the opening and closing values) multiplied by a real interest rate. The value variables for plant and structures are the opportunity costs plus depreciation.

The quantity variable used for livestock is the average value of capital stock deflated by the respective prices paid indexes for each.

Livestock purchases

Livestock purchases are split into beef and slaughter lambs. The value variables for each are equal to the purchases plus net operating gains. The quantity variables are derived from the respective value variables for beef and slaughter lamb.

Labour

Labour consists of four items – owner operator and family labour, hired labour, shearing costs and stores and rations. The value of the owner operator and family labour is imputed using weeks worked and an award wage. The value of hired labour is wages paid and the values of shearing and stores and rations.

The quantify variables for owner operator and family labour and hired labour are weeks worked. Expenditures deflated by a shearing prices paid index is the quantity variable for shearing.

Materials and Services

There are seven items in the materials group – fertiliser, fuel, crop chemicals, livestock materials, seed, fodder and other materials. There are five items in the services group – rates and taxes, administrative costs, repairs, contracts and other services. For each item in both groups, the value item is expenditure. The quantity variables were estimated by deflating the expenditure on each by the appropriate prices paid index.

Total factor productivity outputs

Outputs consists of 12 items that can be divided into four major crops – crops, livestock sales, wool and other farm income.

Crops

Crops are split into wheat, barley, oats, grain sorghum, oilseeds and other crops. The value variable for wheat is the quantity harvested multiplied by the Australian Wheat Board's average net return for that year's pool. For other grains and other crops, the value variable is net receipts in that year. The quantity variable for each of the grains is the quantity harvested. For the other crops, it is receipts deflated by the prices-received index for crops.

Livestock

For livestock, the value variable is livestock sales plus positive operating gains plus transfers from the farm. For the minor category of other livestock, the value variable is sales. The quantity variables for beef, sheep and lambs are derived from the respective value variables and the prices-received indexes for slaughtered beef, sheep and lamb meats. For the category of other livestock, the quantity variable is derived from the value of sales and a prices-received index for livestock products.

Wool

The value variable for wool is net receipts. The quantity variable is the amount of wool shorn in kilograms.

Other farm income

The value variable is receipts and the quantity variable is receipts deflated by the sector prices-received index.

appendix C Comparison with earlier studies

Total factor productivity estimates are highly sensitive to the data sample used and consequently results are expected to differ between studies. Comparisons with different TFP estimates are therefore difficult.

The results of this analysis are different to those reported in previous ABARE studies (Zhao et al. 2008, Andrews et al. 2004). For example, when three ABARE TFP estimates are compared for the Australian beef industry, productivity growth is lower in the present study (table 8).

The differences in TFP growth rates are likely to reflect a number of factors. Most significantly, the industry definition is different to that used in these earlier studies. While the present study estimates TFP using all survey farms with more than 50 cattle, both Zhao et al. (2008) and Andrews et al. (2004) include only farms classified as beef specialists. The present study therefore includes a much broader data sample (both specialist and non-specialist beef farms).

TFP growth estimates are also highly sensitive to the period of estimation used in analysis. For each of the comparison studies, the ending year differs, with later studies including additional data. As TFP is estimated using a different dataset, results for different time periods are unlikely to be the same. The present study is the first to include the impacts of the 2006-07 drought.

8 Comparison of TFP results with earlier studies

report	industry definition	period of estimation	TFP results		
			beef industry	northern region	southern region
			%	%	%
Productivity in the beef cattle and slaughter lamb industries (2008) – current report	Farms with more than 50 cattle (beef specialists and non-specialists)	1977-78 to 2006-07	1.09	1.05	1.16
Productivity growth: Australian broadacre and dairy industries (2008)	Beef specialists	1977-78 to 2005-06	1.4	1.2	1.3
Productivity in Australian livestock industries (2004)	Beef specialists	1977-78 to 2001-02	1.8	2.2	1.3

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10.08

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