australian commodities

march quarter 08.1

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abare is a professionally independent
government economic research agency

editor andrew wright
abare project 1163

ISSN 1321-7844

abare.gov.au

productivity growth

australian broadacre and dairy industries

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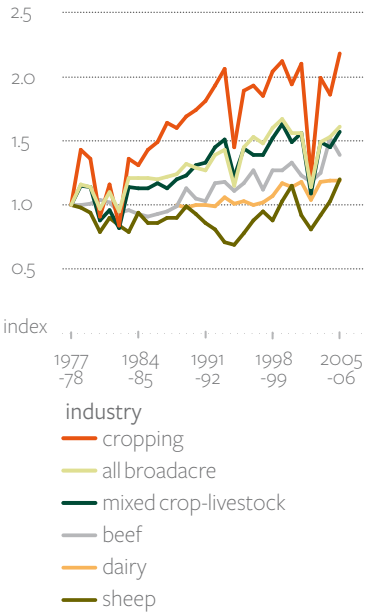
- *Total factor productivity growth in Australia's broadacre and dairy industries is highly variable on a year-to-year basis, but has generally trended up over the past several decades.*
- *Between 1977-78 and 2005-06, productivity growth in the broadacre sector averaged 1.5 per cent a year. Between 1988-89 and 2005-06, the dairy sector achieved average annual productivity growth of around 1.2 per cent.*
- *Growth in productivity appears to have slowed since the mid-1990s in the cropping and mixed livestock-cropping industries.*
- *Potential determinants of productivity growth can be inferred by examining the contributions of changes in input growth and output growth over time. Regional variability can provide further insights into potential drivers of productivity improvements.*

a growth in total factor productivity
broadacre and dairy industries



Australia's agricultural sector faces a number of pressures, including climate variability, declining terms of trade and increasing international competition. As the sector is highly export oriented — with around two-thirds of agricultural production exported — remaining profitable and sustainable is an increasing challenge for Australian farmers. In 2006-07, agricultural exports were valued at $27.6 billion and accounted for 16 per cent of merchandise exports (abare 2007b). To maintain export competitiveness in the medium and longer term, ongoing productivity growth is crucial for Australian farmers.

trends in broadacre and dairy productivity growth

Total factor productivity (TFP) growth in the broadacre sector averaged 1.5 per cent a year between 1977-78 and 2005-06 (box 1). As shown in figure a, productivity estimates fluctuate on a year-to-year basis. Consequently, long term average trends are generally a more useful indicator of farm industry performance.

Within the broadacre sector, performance has been mixed. Over the past three decades, the cropping industry has achieved the highest productivity gains while productivity improvements in the beef and sheep industries have been lower. The dairy industry has achieved fairly consistent productivity growth over the period for which data are available (1988-89 to 2005-06).

Between 1977-78 and 2005-06, cropping specialists achieved annual productivity growth of around 2.3 per cent. Strong productivity gains are likely to have been a result of advances in plant breeding over the longer term as well as the introduction of direct drilling and minimum tillage techniques that have simplified crop management and improved moisture retention — a key productivity determinant (Kokic et al. 2006). Increased specialisation of farmers into cropping, increases in land area and more intensive land use could also have influenced long term productivity growth (Kokic et al. 2006). Qualitative research by Knopke et al. (2000) identified additional factors such as improved farm management, crop rotations, better pest and weed control methods, efficient herbicide use and advances in tractor and machinery design as potentially contributing to productivity growth in the cropping sector.

box 1 measuring total factor productivity growth

Productivity reflects the ability to produce goods and services (outputs) given the available resources (inputs). Total factor productivity (TFP), also known as multifactor productivity, compares total outputs relative to the total inputs used in production of the output. Growth of TFP is derived by dividing an index of total outputs by an index of the total inputs used to produce this output combination. Alternatively, partial factor productivity (PFP) measures output relative to a single input factor such as labour, capital or land.

Growth in TFP over time is frequently used as a measure of technological progress (OECD 2001). TFP growth reflects either an increase in output volume relative to the level of resources used, or a reduction in input (resources) volume required to achieve a particular level of output. The driving forces of TFP growth include better applications of science and technology, improved management practices, efficient exploration of economies of scale and allocative efficiency (efficiency improvements achieved by shifting resources into more productive businesses or industries).

Productivity is a key determinant of the growth, sustainability and competitiveness of businesses in a market economy. As such, TFP is frequently used as an indicator of economic performance at national, industry and business levels. abare derives productivity estimates from data collected through its farm surveys. Statistics on both TFP and PFP are produced for the broadacre sector — including broadscale cropping, mixed cropping–livestock, beef and sheep — and the dairy sector. These estimates are typically produced at the national and state or territory levels.

abare's TFP measurement uses a ratio of gross output and total inputs, where total inputs are a combination of capital, labour, land, purchased inputs and services. Productivity estimates are reported in this paper in the form of TFP growth (percentage change over time), rather than the level of TFP, to enable productivity improvements to be compared across states or territories, regions and industries.

Over the period 1977-78 to 2005-06, the beef industry achieved average productivity growth of 1.4 per cent a year. Factors contributing to these productivity gains have included advanced breed genetics, improved herd management and disease management, and greater ease in moving livestock and fodder. Farmers also have a greater variety of options available for turning off cattle, including lot feeding and the development of live cattle export trade (abare 2004).

Many of the factors influencing cropping and beef productivity gains are likely to have also influenced the growth in productivity achieved by mixed crop-livestock farmers. These farmers achieved robust average productivity growth of 1.7 per cent a year over the same period.

Farmers within the sheep industry produce a variety of outputs — including sheep meat and wool — and productivity performance is likely to vary between these. However, when the sheep industry is considered as a whole, long term productivity growth has been relatively low (0.3 per cent a year) over the period 1977-78 to 2005-06. Slow growth in productivity has resulted in a long term reduction in the size of the sheep industry, with farmers shifting to industries such as grain production where returns have been more favourable. However, in recent years, productivity growth has improved in the sheep industry. Improvements in lamb and sheep prices are likely to have stimulated productivity growth with farmers adopting new technologies and more efficient farm management practices. Increasing turnoff and the use of objective measurement in selecting breeding stock have also driven productivity growth (abare 2006).

The dairy industry has achieved moderate productivity growth of around 1.2 per cent a year between 1988-89 and 2005-06. New technologies and improved farm management practices have led to consistent improvements in labour productivity and increased milk yields. The shift toward larger farms and increased intensity on dairy farms, including higher stocking rates and more intensive feeding practices, have also improved productivity over the past two decades. In particular, pasture improvement, the expanded use of fodder harvesting technologies as well as increased purchase of off-farm feed, are likely to have contributed to productivity gains (abare 2005).

decomposing productivity growth

The underlying causes of productivity improvement are likely to vary significantly between industries. For example in the cropping sector, observed productivity gains have been a result of industry expansion of both inputs and outputs, while in the beef sector, output expansion has been achieved with inputs remaining relatively constant (table 1). In the mixed crop-livestock sector, productivity gains have been a result of increased efficiency in input use with fewer inputs required to achieve a relatively similar level of output.

It is possible to further decompose productivity growth to observe how input and output compositions have changed over time. This often provides additional insights into possible determinants of changes in TFP. Across the broadacre sector, outputs are estimated to have grown by around 1 per cent a year between 1977-78 and 2005-06, while inputs declined by 0.5 per cent a year over the same period (tables 1 and 2). These changes resulted in a 1.5 per cent a year increase in TFP.

A major factor contributing to strong productivity growth is the increase in the scale of individual farming operations. Farms have become larger since the 1980s with average cropping area increasing by 58 per cent from 450 hectares to 710 hectares between 1985-86 and 2005-06 (abare and MAF

1 average annual input, output and total factor productivity growth in broadacre and dairy industries 1977-78 to 2005-06

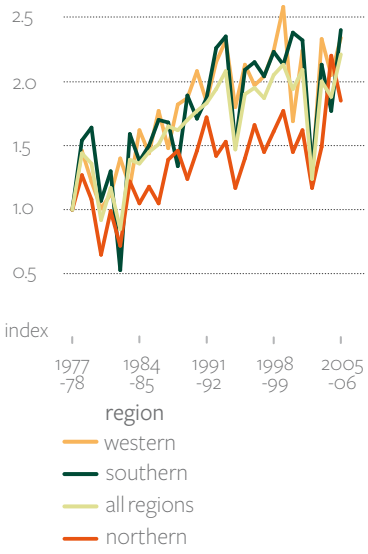
	input growth %	output growth %	total factor productivity growth %
total broadacre	–0.5	1.0	1.5
cropping	1.4	3.7	2.3
mixed crop–livestock	–1.3	0.3	1.7
beef	0.0	1.4	1.4
sheep	–1.6	–1.3	0.3
dairy*	4.0	5.1	1.2

* Dairy industry estimates are for the period 1988-89 to 2005-06 as data are not available for earlier years.

2 decomposition of total factor productivity in the broadacre sector 1977-78 to 2005-06

	growth rate	share		
		1977-78	1991-92	2005-06
	%	%	%	%
total factor productivity	1.5			
total outputs	1.0	100	100	100
crops	2.7	28	31	34
livestock	0.3	44	42	51
wool	–1.5	24	21	9
other outputs	3.4	4	6	6
total inputs	–0.5	100	100	100
capital & land	–1.0	41	50	42
labour	–1.7	29	21	18
purchased material	2.6	9	13	18
– chemical (for crops)	8.4	1	2	5
– fuel	–0.2	4	4	6
– fertiliser	3.1	3	4	7
services	–0.4	21	17	22

b growth in total factor productivity
cropping industry



3 annual growth in the cropping industry
1977-78 to 2005-06

	input growth %	output growth %	total factor productivity growth %
northern region	−0.7	1.7	2.3
western region	2.4	4.8	2.4
southern region	2.2	4.7	2.4

4 annual growth in the beef industry
1977-78 to 2005-06

	input growth %	output growth %	total factor productivity growth %
northern region	0.1	1.3	1.2
southern region	0.2	1.6	1.3

2006). This has enabled farmers to capture economies of scale that allow them to produce more output using relatively fewer inputs.

Changes in the relative size of different broadacre industries are also likely to have played a role in improving farm performance. For example, the expansion in cropping output (from 28 per cent to 34 per cent of total broadacre output) and the contraction in wool production (from 24 per cent to 9 per cent of total broadacre output) indicates that the Australian agriculture sector is flexible and able to adapt to suit market conditions. Accordingly, the farm sector has shifted resources from less productive activities (sheep) into more productive industries (cropping), thereby increasing allocative efficiency in order to remain profitable.

Over the past three decades there have also been significant changes in farm technology. Farmers have significantly reduced inputs of capital, land and labour, while increasing other inputs such as chemicals (8.4 per cent) and fertiliser (3.1 per cent). Chemicals as a share of total input costs increased from 1 per cent in 1977-78 to 5 per cent in 2005-06. Similarly, fertiliser use increased from 3 per cent of total input costs in 1977-78 to 7 per cent in 2005-06. In the cropping industry, this shift is consistent with the increased adoption of conservation tillage practices.

differences across regions

Productivity growth has also been variable when decomposed on a regional basis. In the cropping sector, the annual growth rate only varied slightly between the northern, southern and western agro-ecological regions defined by the Grains Research and Development Corporation (GRDC) (figure b). However, the changes in inputs and outputs contributing to productivity growth were notably different across regions (table 3). The southern and western regions achieved strong growth in outputs as well as some input growth. In the northern region, productivity gains were a result of more modest increases in output accompanied by a reduction in overall input use.

Productivity growth in the northern and southern beef regions of Australia demonstrated similar movements between 1977-78 and 2005-06, however productivity growth in the southern region was more volatile (figure c). Over the period, beef specialists in the southern region of Australia achieved average productivity growth rates of around 1.3 per cent a year, compared with 1.2 per cent by those in the northern region (table 4).

The northern beef industry — defined as all of the Northern Territory, Queensland and the northern pastoral zone of Western Australia — is characterised by less diversified and larger farms with high stocking and branding numbers than in the southern beef industry (abare 2007a). These factors are potential drivers of the long term productivity growth in this region. In addition, productivity growth in the northern region has

increased steadily from the mid-1980s (figure c), averaging 2.1 per cent a year between 1985-86 and 2005-06. This growth is likely to have been stimulated by the opening of live export trade with Asia in the late 1980s.

Productivity growth in the southern region was driven by stronger output growth, with inputs also increasing over the period. In the northern region, output growth was also the principal driver of productivity growth, with virtually no increase in the use of inputs. More detailed investigation of the reasons behind these regional productivity differences remains an area for further analysis.

There was strong growth in both inputs and outputs in the dairy industry between 1988-89 and 2005-06, resulting in moderate TFP growth of 1.2 per cent a year (table 5). However, changes in productivity were notably different across states. Productivity growth in New South Wales was 2.4 per cent a year — significantly higher than the rest of Australia. The lowest productivity growth was in Victoria and Tasmania.

During the 1990s, Australian Government price supports for the dairy industry were gradually phased out. The eventual removal of price supports and the abolition of quota entitlements occurred in 2000 as part of a structural reform package (abare 2001). New South Wales was particularly affected, with the exit of many small and inefficient farms from the industry and a shift of dairy farmers from coastal to inland areas. These changes appear to have had a notable influence on dairy industry productivity growth.

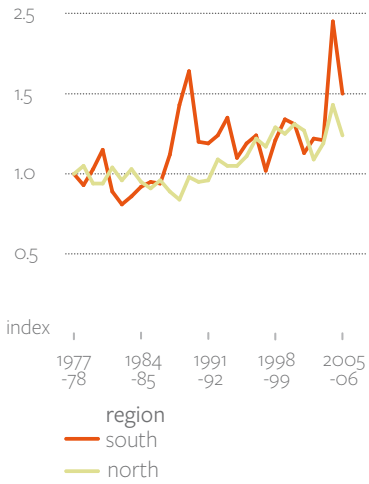
In all regions of Australia, dairy productivity growth has been a result of an expansion in both input and output use. Output growth was around 5 per cent for most states over the period, however the dairy specialists in South Australia achieved much faster output growth — more than 8 per cent a year. Input growth in South Australia also outpaced other states resulting in similar growth in overall productivity.

is productivity growth slowing?

There appears to have been a slowing of the productivity growth trend from the mid 1990s in the cropping and mixed livestock-cropping industries (figure a). Average annual productivity growth in the cropping sector was 4.1 per cent between 1977-78 and 1993-94, compared with 0.9 per cent between 1994-95 and 2005-06.

It is possible that external factors beyond farmer's control, such as drought, may have contributed to declining productivity growth. However, abare research has indicated that productivity growth may still be declining even after differences in moisture availability are taken into account (Kokic et al. 2006). Further inquiry into this issue remains an area for future study.

C growth in total factor productivity
beef industry



5 annual growth in the dairy industry
1988-89 to 2005-06

	input growth	output growth	total factor productivity growth
	%	%	%
australia	4.0	5.1	1.2
new south wales	3.1	5.5	2.4
victoria	4.2	4.7	0.5
queensland	2.9	4.6	1.7
south australia	6.2	8.1	1.9
western australia	3.1	5.0	1.8
tasmania	4.9	5.7	0.8

Analysing total factor productivity growth provides a valuable insight into industry performance and the efficiency with which farms utilise resources to produce outputs. Productivity growth within the agriculture sector over the past three decades has shown high variability, but has continued on an upward trend. Notably, there have been significant differences in the contribution of inputs and outputs to productivity growth, across industries, regions and time periods. Further analysis into the determinants of these changes is important to determine the drivers of productivity growth and to better target research and development within the agricultural sector.

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