Australian Government
Productivity Commission

Trends in Australian Agriculture

Productivity Commission Research Paper

ISBN 1 74037 178 X

This publication is available in hard copy or PDF format from the Productivity Commission website at www.pc.gov.au. If you require part or all of this publication in a different format, please contact Media and Publications (see below).

Publications Inquiries:
Media and Publications
Productivity Commission
Locked Bag 2 Collins Street East
Melbourne VIC 8003

Tel: (03) 9653 2244
Fax: (03) 9653 2303
Email: maps@pc.gov.au

General Inquiries:
Tel: (03) 9653 2100 or (02) 6240 3200

An appropriate citation for this paper is:

Productivity Commission 2005, *Trends in Australian Agriculture*, Research Paper, Canberra.

JEL code: D, J, Q, R

The Productivity Commission

The Productivity Commission, an independent agency, is the Australian Government's principal review and advisory body on microeconomic policy and regulation. It conducts public inquiries and research into a broad range of economic and social issues affecting the welfare of Australians.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Information on the Productivity Commission, its publications and its current work program can be found on the World Wide Web at www.pc.gov.au or by contacting Media and Publications on (03) 9653 2244.

Foreword

Australian agriculture has undergone considerable change over the last few decades. Thanks to rapid productivity growth, agricultural output has more than doubled in this period. Nevertheless, with the even faster growth of the services sector, agriculture's share of the economy has declined. At the same time, there have been marked changes in the make up of the sector, driven by a variety of domestic and international forces.

This report examines some of the key trends in Australia's agriculture sector over the last 20 years or so. The report is part of a series tracing developments in different sectors of the Australian economy. Previous studies have looked at trends in manufacturing (PC 2003) and services (McLachlan et al. 2002).

The Commission is grateful to all those who provided assistance in the preparation of this study and welcomes further feedback on it.

Gary Banks
Chairman

June 2005

Contents

BOXES

FIGURES

TABLES

Acknowledgments

The Commission is grateful for the assistance of the following staff in the preparation of this report. The research team comprised Rosalie McLachlan, Colin Clark and Shellie Davis under the general direction of Ian Monday. The development of the paper was guided by Commissioner Mike Woods and benefited from comments and suggestions from Herb Plunkett, Garth Pitkethly, Dean Parham and Geoff Edwards. The report benefited from data on productivity, input-output tables and rates of assistance from Paul Roberts, Terry Maidment and Robert Wells. Tracey Horsfall provided administrative and production support.

The Commission is also grateful for helpful comments on an earlier draft provided by Dave Barrett, Troy Podbury and Colin Mues of the Australian Bureau of Agricultural and Resource Economics.

Abbreviations

ABARE	Australia Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AMS	Aggregate Measurement of Support
ANZSIC	Australia and New Zealand Standard Industrial Classification
ASEAN	Association of South East Asian Nations
ASGC	Australian Standard Geographical Classification
ASIC	Australian Standard industrial Classification
BOP	Balance of Payments
BTRE	Bureau of Transport and Regional Economics
DFAT	Department of Foreign Affairs and Trade
EVAO	Estimated Value of Agricultural Operations
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
IAC	Industries Assistance Commission
IC	Industry Commission
MFP	Multifactor Productivity
NCC	National Competition Council
NEC	Not Elsewhere Classified
NFF	National Farmers' Federation
NLWRA	National Land and Water Resources Audit
OECD	Organisation for Economic Cooperation and Development
PC	Productivity Commission
PPP	Purchasing Power Parities
PSE	Producer Support Estimates
RBA	Reserve Bank of Australia
RIRDC	Rural Industries Research and Development Corporation

SITC	Standard International Trade Classification
SMAs	Statutory Marketing Arrangements
TREC	Trade Export Classification
VET	Vocational Education and Training
WTO	World Trade Organization

OVERVIEW

Key points

- Agriculture has undergone much change over the last few decades. Key drivers have been shifts in consumer demand, changes in government policies, technological advances and innovation, emerging environmental concerns and an unrelenting decline in the sector's terms of trade.
- While historically agriculture played a dominant role in the economy — its *relative* importance has declined in recent decades.
- That said, in *absolute* terms, real agricultural output has more than doubled over the four decades to 2003-04. And agricultural exports have almost tripled in value (real terms) since the mid 1970's.
- In 2003-04, the sector directly generated 4 per cent of GDP and employed 375 000 people or 4 per cent of the workforce. It looms larger in Australia's exports, accounting for around 22 per cent of total exports in 2003-04.
- Farms are much fewer and larger than twenty years ago. Production is increasingly concentrated on larger farms, accentuating the dual nature of the sector (with a few large commercial farms accounting for the majority of output and many farms accounting for a small share of output).
- Agriculture has become increasingly export oriented over the last two decades — around two-thirds of production is now exported. Exports have also become more diverse, with less reliance on traditional commodities such as wool and more on processed products such as wine, cheese and seafood.
- The agricultural workforce has a number of distinctive features, including: a high proportion of self-employed, family and casual workers; long job tenure; and a relatively old workforce with relatively low education levels and employee wages.
- The last two decades have seen an increase in the number of employees and a fall in employers and contributing family workers. The educational attainment of workers has also improved.
- Off-farm employment has become increasingly important to maintaining family farm incomes. Since 1990, the proportion of farm families deriving income from off-farm wages and salaries increased from 30 to 45 per cent, with average earnings rising from $15 000 to $33 500 per year.
- Agricultural productivity has exhibited strong growth over the last three decades — more than twice the rate achieved in Australia's market sector as a whole.
- Productivity growth has accounted for the entire increase in output by the agriculture sector over the last 30 years.
- Performance within the sector has been mixed — over the last three decades the cropping industry recorded the highest productivity gains, and the sheep and sheep-beef industries the lowest.

Overview

Australia's agriculture sector has undergone considerable change over the last few decades. While continuing to grow in absolute terms, the size and importance of agriculture has declined relative to the rest of the economy. Within the sector, there have been marked changes in the number and size of Australian farms, the make-up of agricultural activities and the production and marketing strategies employed by farmers.

Some of the key factors shaping these trends have been changes in consumer demands and government policies, technological advances and innovation and emerging environmental concerns. The unrelenting decline in the sector's terms of trade (that is, the ratio of prices received to prices paid) has been an important source of pressure for adaptation and change by Australian farmers. The sector has also had to respond to the continuing challenge of variations in seasonal conditions.

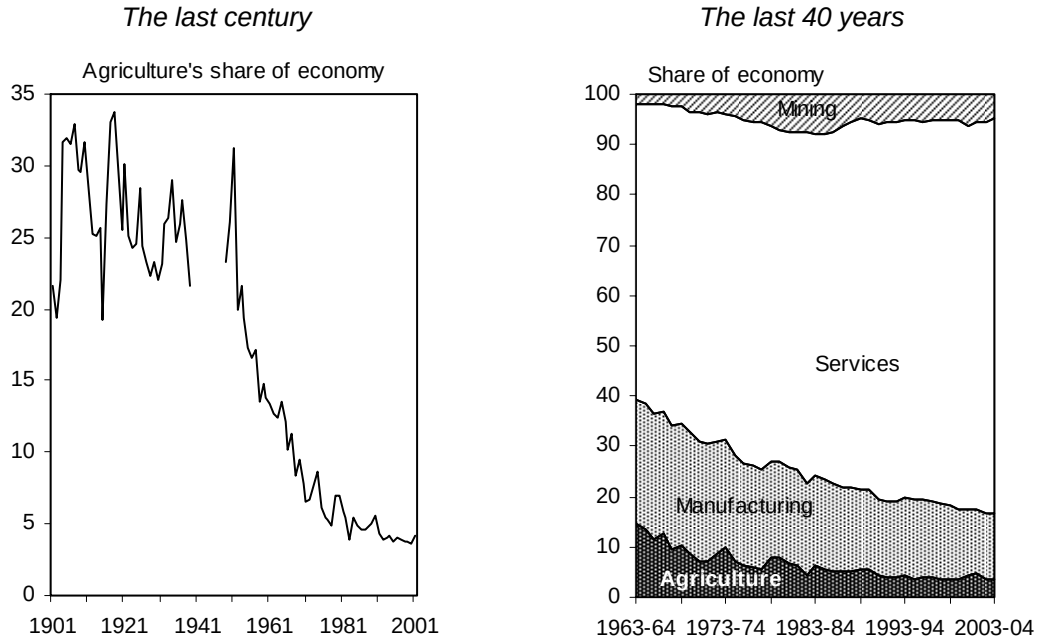
The importance of agriculture to the economy

Historically, agriculture has played an important role in the Australian economy. In the first half of the 20th century, it accounted for around a quarter of the nation's output and between 70 and 80 per cent of Australia's exports. There was then considerable force in the old saying that the Australian economy 'rode on the sheep's back'.

Since then, however, agriculture's *relative* importance within the economy has been in steady decline.

- Agriculture's share of GDP fell from around 14 per cent in the early 1960s to 6 per cent in the early 1980s. Over the last two decades, it has ranged from between 4 and 6 per cent (figure 1).
- Agriculture's share of employment has more than halved since the late 1960s when it accounted for around 9 per cent of the workforce.
- Australia's reliance on agricultural exports declined from over two-thirds of total exports in the early 1960s to just over one-fifth in 2003-04.

Figure 1 **Agriculture has declined in *relative* terms**



The relative decline in agriculture has several causes, notably:

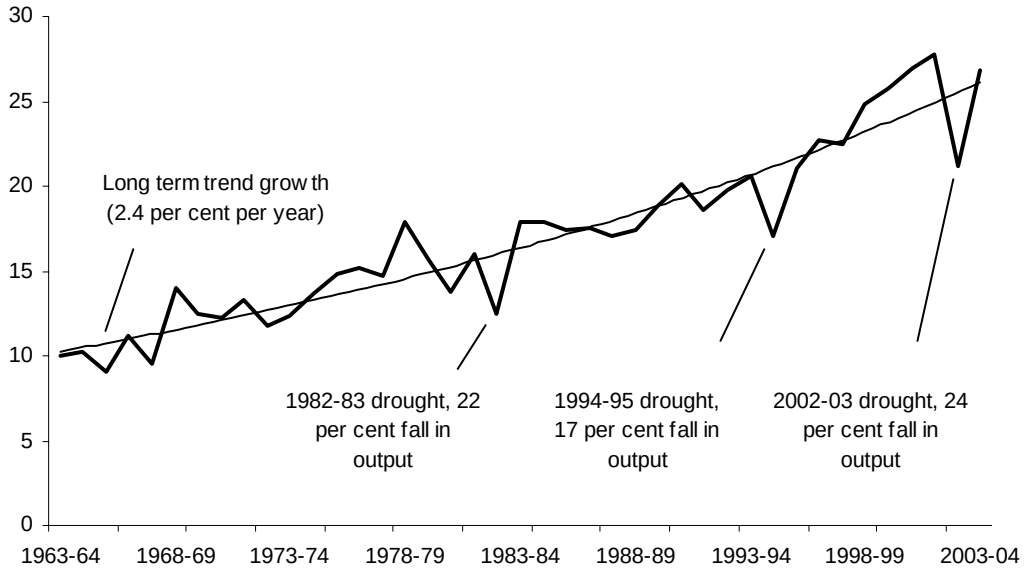
- the growth in consumer expenditure being directed predominantly to services as national income has risen;
- a decline in the price of agricultural commodities relative to other goods and services; and
- relatively high productivity growth in agriculture, which has been critical to the sector's performance, but also facilitated the release of resources to other sectors of the economy.

As such, the declining share of agriculture is more a reflection of success rather than any systemic weakness. It is consistent with the experiences of other developed countries — there is a strong inverse relationship between per-capita income, GDP and employment shares accounted for by agriculture. That said, Australia's agriculture sector's share of output remains one of the highest in the OECD.

Output has increased in absolute terms

The decline in agriculture output is a relative phenomenon. Real output in agriculture actually increased by around two and half times over the four decades to 2003-04 (figure 2).

Figure 2 **Growth in agriculture output, 1963-64 to 2003-04**
Value-added ($ billion, constant 2002-03 prices)



This increase in output was achieved without an increase in the number of agricultural workers, reflecting strong productivity growth in the sector. In fact, in trend terms, agricultural employment has been relatively flat over the last forty years — declining by less than half of one per cent a year.

Agricultural exports have also grown in real terms — since 1974-75 they have almost tripled in value, increasing at a trend annual rate of 3.5 per cent a year.

…and agriculture continues to play an important role

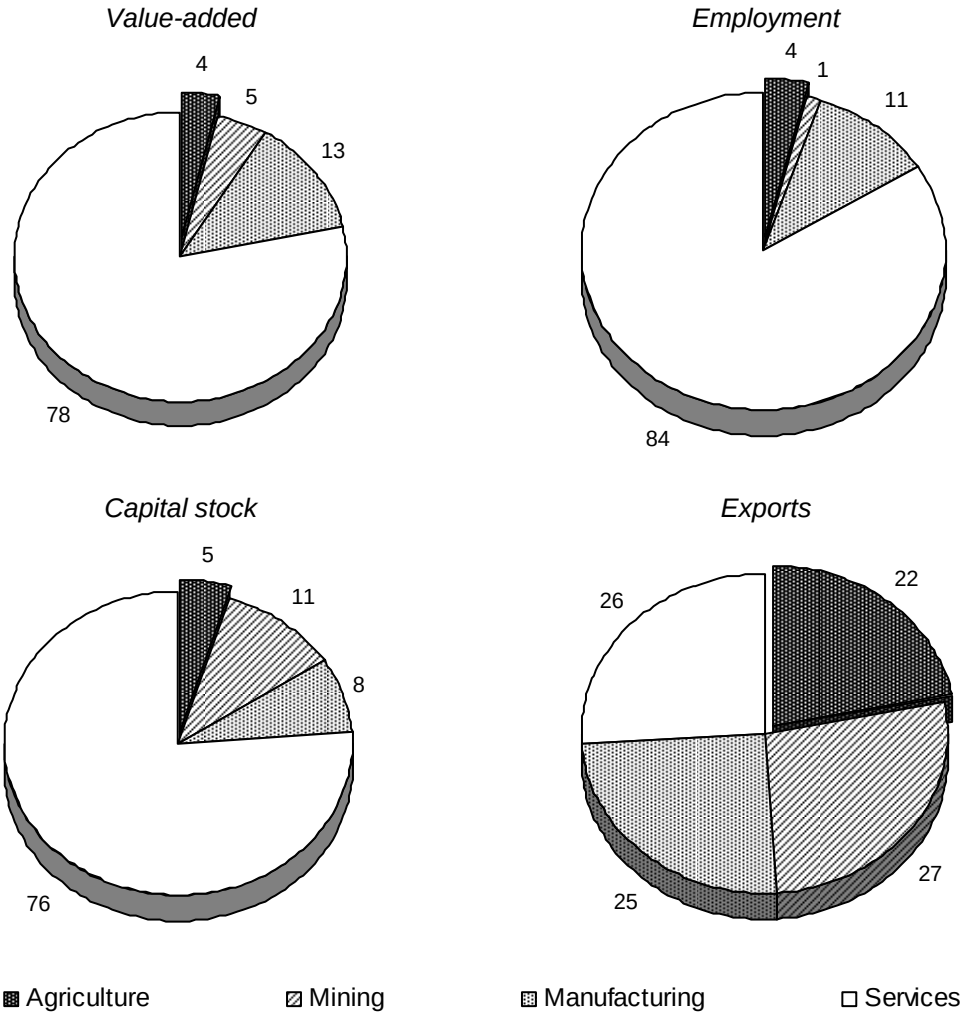
While declining in relative importance, agriculture's contribution to the Australian economy remains substantial (figure 3). In 2003-04, agriculture directly:

- contributed 4 per cent or $25 billion of the total output of the economy;
- employed 375 000 people or around 4 per cent of the workforce; and
- accounted for around 5 per cent of Australia's investment effort and employed a similar proportion of Australia's net stock of capital.

Agriculture plays a much bigger role in Australia's exports than might be expected given its output share. In 2003-04, it directly accounted for around 22 per cent of Australia's total goods and service exports.

Figure 3 **Agriculture's contribution to Australian economic activity, 2003-04**

Per cent



Agriculture is characterised by substantial volatility in output over time, with fluctuations in climatic conditions, such as droughts, substantially impacting on output in some years. Over the last three decades, agriculture has recorded the highest level of volatility in year-to-year output growth of all industries (more than two and a half times higher than the average for all industries).

And, variations in the sector's fortunes can have significant flow-on effects for the economy. The 2002-03 drought, for example, saw agricultural output and exports decline by almost one-quarter and employment fall by around 15 per cent (box 1). This in turn reduced Australia's GDP and employment growth by around 1 percentage point. In the same year, agriculture multifactor productivity (MFP) declined by around 17 per cent, thus reducing aggregate MFP growth by around 1 percentage point (or around half of the market sector MFP growth).

Box 1 **Impacts of drought on employment, exports and GDP**

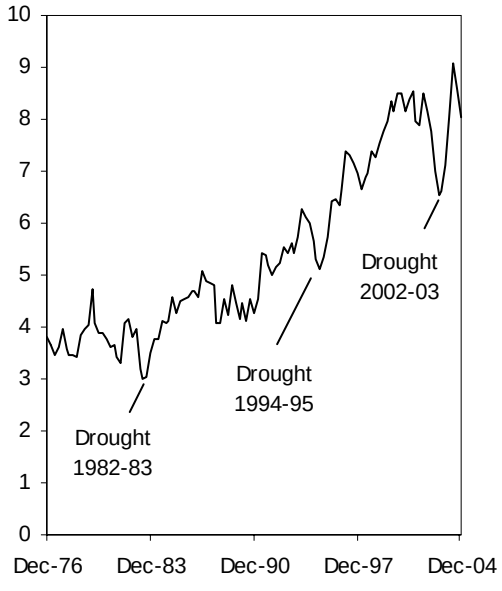
Droughts periodically have a substantial impact on agricultural output, with flow-on effects for employment and exports (figure 4). The 2002-03 drought, for example, saw the loss of around 70 000 agricultural jobs, or a decline of around 15 per cent. This represents the largest employment shock of any drought since the 1960s (when reliable statistics became available). By comparison, both the 1982-83 and 1994-95 droughts resulted in job losses of around 6000, or a decline of around one per cent.

The 2002-03 drought also had a substantial impact on agricultural exports — a fall of around 23 per cent (or $2 billion) between the June quarter of 2002 and the June quarter of 2003. As with other droughts, however, recovery was rapid, with increases in export volumes of almost 40 per cent ($2.5 billion) between the trough in the June quarter of 2003 and the June quarter of 2004. Latest export data indicate that agricultural exports have been declining over the course of 2004-05 — with a 10 per cent fall between the peak in the June quarter 2004 and the December quarter 2004.

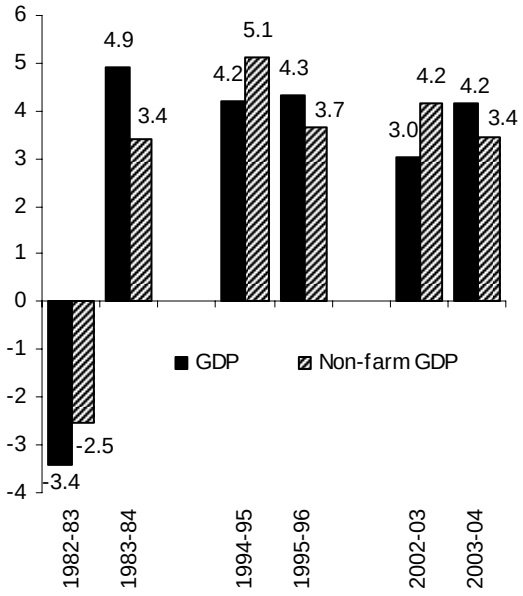
Droughts can also impact on measured growth rates for the economy (figure 4). A comparison of growth rates for GDP and non-farm GDP shows that during the last three droughts agriculture shaved around one percentage point off GDP growth.

Figure 4 **Droughts, agricultural exports and GDP growth**

Exports ($ billion, constant 2002-03 prices, quarterly seasonally adjusted)



Drought impacts on GDP growth (per cent growth on previous year)

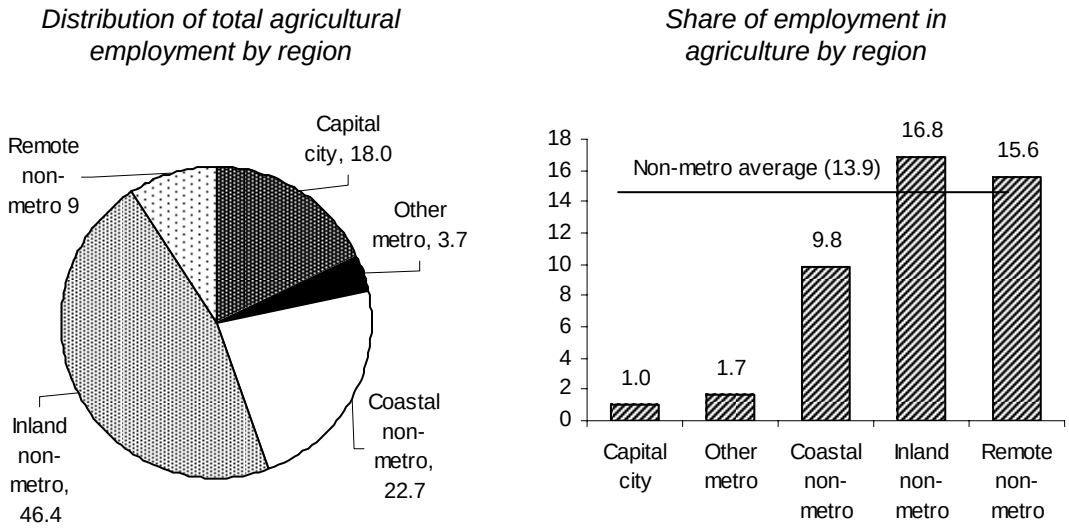


An important employer in rural and regional Australia

Agriculture remains a dominant employer in rural and regional Australia. In 2001, almost 80 per cent of agricultural employment was in non-metropolitan regions.

Almost 10 per cent of those employed in coastal non-metropolitan regions and more than 15 per cent of those employed in inland and remote regions were employed in agriculture (figure 5). In the same year, over a third of all employment in the food processing industry was located in non-metropolitan regions.

Figure 5 **Agricultural employment shares by region, 2001**
Per cent



For 207 of Australia's 425 labour regions, agriculture accounted for over 25 per cent of total employment in 2001.

Changes *within* agriculture have been profound

Fewer and larger farms

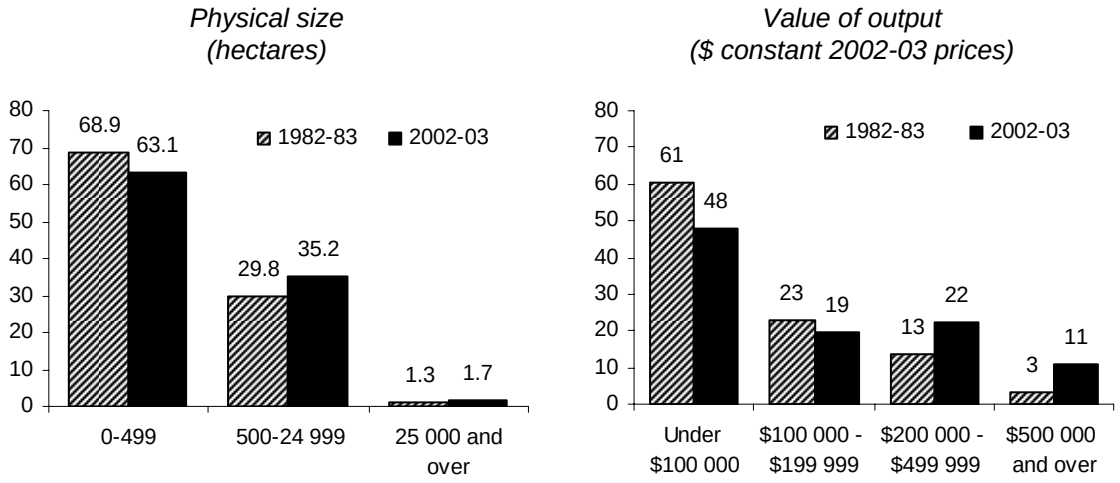
Consistent with global trends, farm numbers in Australia declined by around one-quarter (or by almost 46 000 farms) over the twenty years to 2002-03.

Accompanying this decline has been a reduction in the area of land in agricultural production and an increase in the average size of farms. Over the twenty years to 2002-03:

- the area of land under agricultural production declined by around 9 per cent;
- the average farm increased in size from 2720 hectares to 3340 hectares — an increase of some 23 per cent;
- the proportion of farms in the 'small' farm size category declined, while the share of medium sized farms increased; and

- the proportion of farms with a value of operations of less than $100 000 declined, while the proportion of farms with a value of operations over $500 000 increased (figure 6).

Figure 6 **Distribution of farms by size, 1982-83 and 2002-03**
Per cent



The increase in farm size — in terms of both physical size and value of output — has been most evident in the cotton, grains and pig industries.

... but there are many more small farms

Notwithstanding the trend towards larger farms, small farms continue to dominate the count of farms in Australian agriculture (figure 6, box 2).

Intensive production system industries, such as nurseries, egg and poultry meat farming, have a relatively high proportion of farms occupying small amounts of land. Farms using large areas of land are those based on the grazing of livestock and extensive grain production.

Beef cattle and sheep farms, however, make up a high proportion of the farms with a value of output of less than $22 500. Other industries with a relatively high proportion of farms in this category include fruit and vegetables, grape growing, horse farming, nurseries and cut flowers. In contrast, farms engaged in cotton growing, poultry raising, egg production and pig farming have a high proportion of farms with a value of output of more than $500 000.

Box 2 **Facts about the size of Australian farms**

Australian farms range in size from small hobby and horticultural properties to large grazing and cropping farms.

In 2002-03:

- farms under 50 hectares accounted for around 20 per cent of farms (25 400);
- 33 per cent of farms were sized between 100 and 499 hectares;
- farms over 2500 hectares accounted for 11 per cent of all farms;
- the median estimated value of operations (EVAO) of all Australian farms was $109 000; and
- around 17 per cent of farms (21 600) had an EVAO below $22 500, while around 11 per cent (14 100) had an EVAO of more than $500 000.

Increased concentration of output

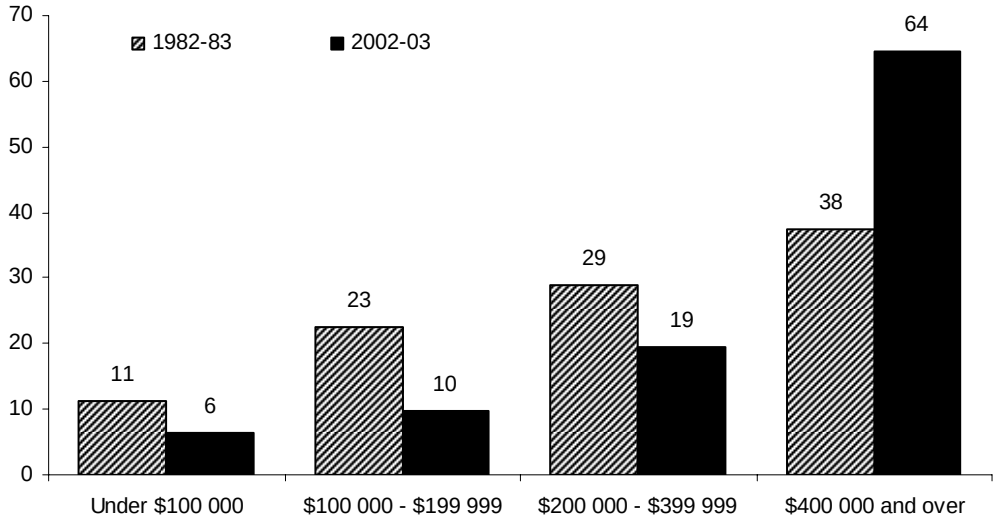
Agricultural production has also become more concentrated on large farms. It is estimated that 10 per cent of Australian farm businesses now produce over 50 per cent of output. In contrast, the smallest 50 per cent of farms account for just 10 per cent of gross farm output.

ABARE data covering broadacre farming provide clear evidence of this development. Over the last two decades:

- the proportion of farms in the largest size category (based on value of operations, at constant prices) increased by 10 percentage points to 20 per cent; and
- the share of value of farm production produced by these farms increased from 38 to around 64 per cent — almost three times the increase in the proportion of farms in this category (figure 7).

Figure 7 **Share of the value of broadacre farm production by value of output, 1982-83 and 2002-03**

Per cent (constant 2002-03 prices)



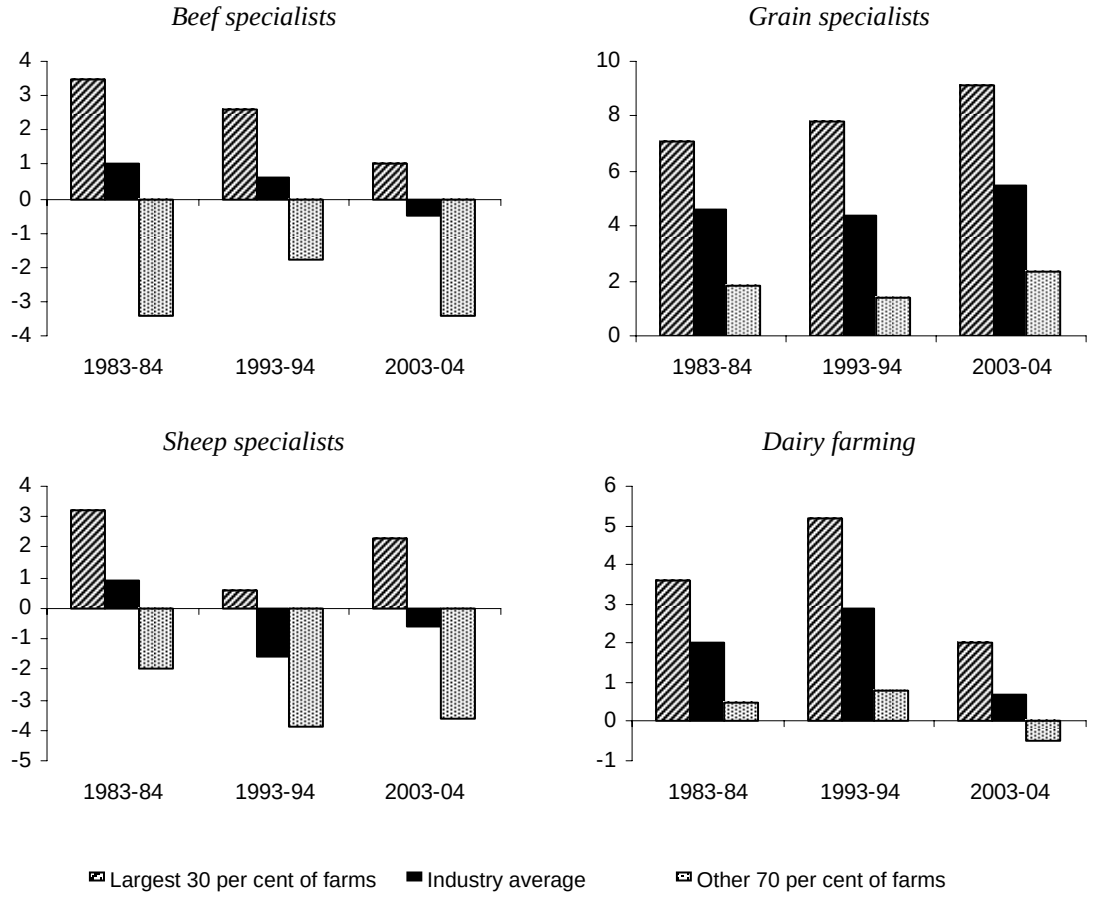
There is, however, some variation in the level of concentration across different industries. In the beef industry, for example, in 2003-04, the top 30 per cent of farms (in terms of value of output) produced more than 80 per cent of industry output, while in the grains and dairy industries the top 30 per cent produced around 60 per cent of output.

The trend towards increased concentration of output has accentuated the dualistic nature of Australia's agriculture sector — where a small number of large scale commercial farms produce the majority of agricultural output, while small-scale or niche farms (which make up an overwhelming majority of farms) account for only a small proportion of output. Many of these smaller farms tend to be operated by 'lifestyle farmers' and are particularly prevalent on the fringes of major metropolitan and regional centres.

… and performance varies by farm size

Similarly, while average rates of return vary across agricultural industries (and between years), they hide significant divergences (figure 8). In particular, relatively low average rates of return mask the strong performance of large commercial farms (and those that generate the majority of output). Average rates of return generated by larger broadacre farms are generally comparable with investment returns elsewhere in the economy.

Figure 8 **Farm size and rate of return, 1983-84, 1993-94 and 2003-04**
Per cent

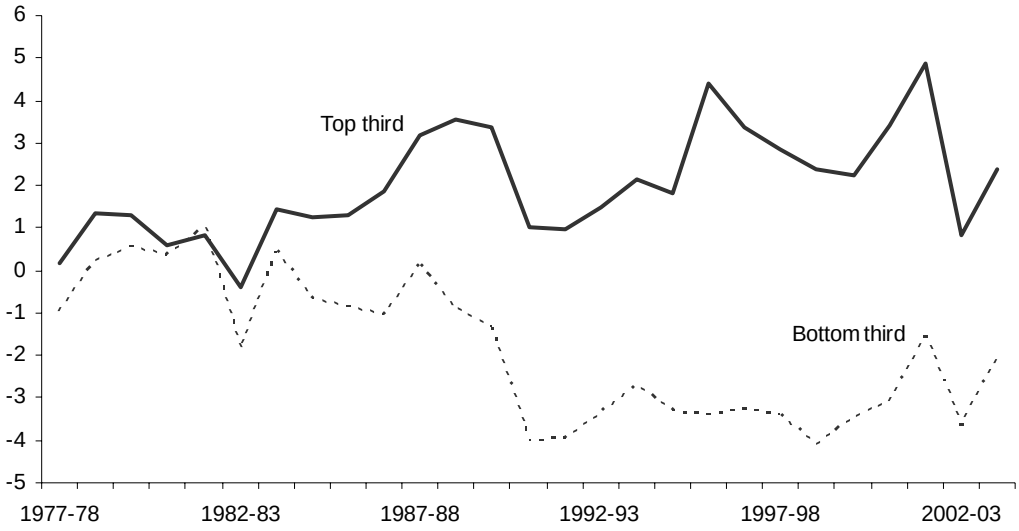


And, when farms are ranked using sheep equivalents[1], the gap between the rates of return generated by the top and bottom third of farms has increased over the last 25 years (figure 9). With such financial outcomes, the continued prevalence of small farms can in part be attributed to the increasing importance of off-farm income.

1 The sheep equivalent measure is widely accepted as an indicator of the productive capacity of farms in different industries. It allows comparisons on an equivalent basis of the size of a farm by reflecting the differing feed requirements of various livestock and/or the equivalent potential capacity of land used for cropping purposes.

Figure 9 **Divergent rates of return for broadacre farms, 1977-78 to 2002-03**

Per cent

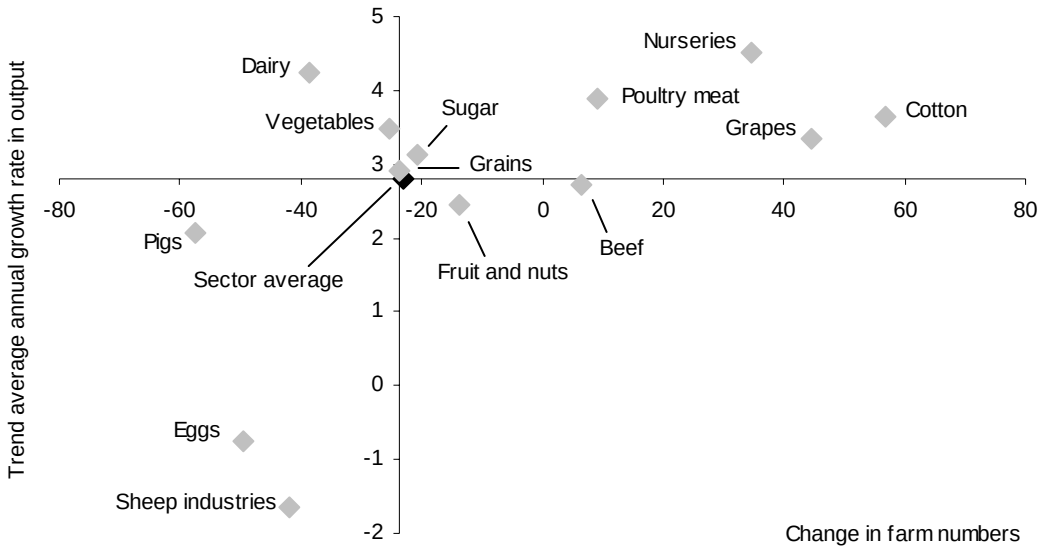


Diversity in industry trends

An examination of output growth rates and changes in farm numbers by industry since the mid-1980s reveals considerable diversity across the agricultural sector. Three broad groups can be identified:

- average performing industries (recording output growth rates and changes in farm numbers broadly in line with the sector average) — beef, grains, fruit and nuts, vegetables and sugar;
- slow or declining growth industries — pigs, eggs and sheep; and
- high growth industries — poultry, grapes, cotton, nurseries and dairy. With the exception of dairy, industries in this group also recorded increases in farm numbers (figure 10).

Figure 10 **Value of output and farm number growth, 1985-86 to 2002-03**
Per cent



Other notable trends within agriculture

The last twenty years have also seen a shift towards more intensive farming. This trend is reflected in both a structural shift to enterprises using more intensive production systems (such as poultry, grapes, cotton and nurseries) and the adoption of more intensive production techniques (increased use of feed, chemicals and irrigation).

Agriculture has also become more closely integrated within the agri-food chain. An increasing proportion of agricultural output, for example, is now supplied to processors or major retailers under comprehensive pre-arranged contracts. In part, this shift has been facilitated by the unwinding of statutory marketing arrangements in many agriculture industries, allowing farmers greater control and choice in the management and marketing of their output.

More demand-responsive production is also evident in terms of greater output diversification, with Australian farmers now producing a wider range of commodities than previously. There has also been an increase in the number of varieties of the same crop and breeds of livestock produced for different markets.

Agricultural trade

While the economy's reliance on agricultural exports has been declining, with little or no domestic consumption growth, Australia's agricultural industries have become more heavily export oriented over the last twenty years (figure 11).

Around two-thirds of agricultural production is now either directly or indirectly exported. The dependence on exports, however, varies among industries. The wool industry, for example, currently exports around 95 per cent of its production. The beef, sugar and wheat industries export around 65-75 per cent of their production, while the sheep meat, wine and dairy industries export around 50-60 per cent. With the exception of the wool industry — which has always been highly export oriented — these shares have all risen steadily in recent decades.

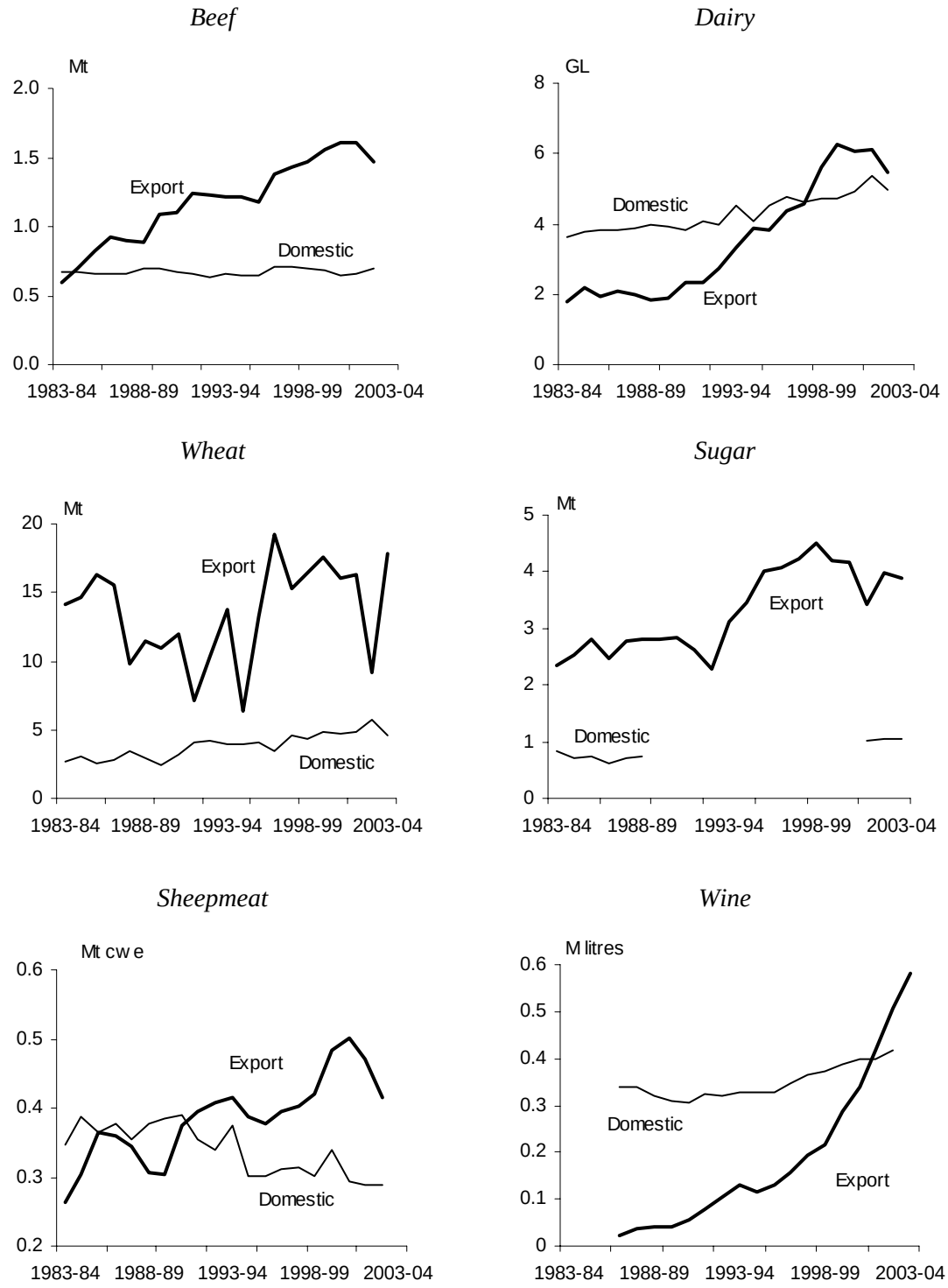
The changing industry mix of agricultural exports

Australia's agricultural export profile has become more diverse in recent decades with less reliance on traditional commodities, such as wool, and more reliance on processed agricultural products (such as wine, cheese and seafood, box 3).

In 1969-70, the 'big three' agricultural exports — wool, cereals and meat — accounted for almost four-fifths of the value of agricultural exports. By 2003-04, their combined share had fallen to around half. This largely reflects the sharp fall in the share of wool and sheepskin exports — from almost 40 per cent of agricultural exports in 1960-70 to 10 per cent in 2003-04.

Other rural exports — which include a range of processed foods such as dairy products, tinned and frozen food as well as animal feed, wood chips and other inedible products — increased from 16 to 39 per cent of agricultural exports over the same period. Beverage exports (of which wine comprised 95 per cent of total exports in 2003-04) increased from less than half of one per cent in 1969-70 to over 9 per cent in 2003-04.

Figure 11 **Australian domestic and export markets for selected commodities, 1983-84 to 2003-04**



Box 3 **Some facts about agricultural trade**

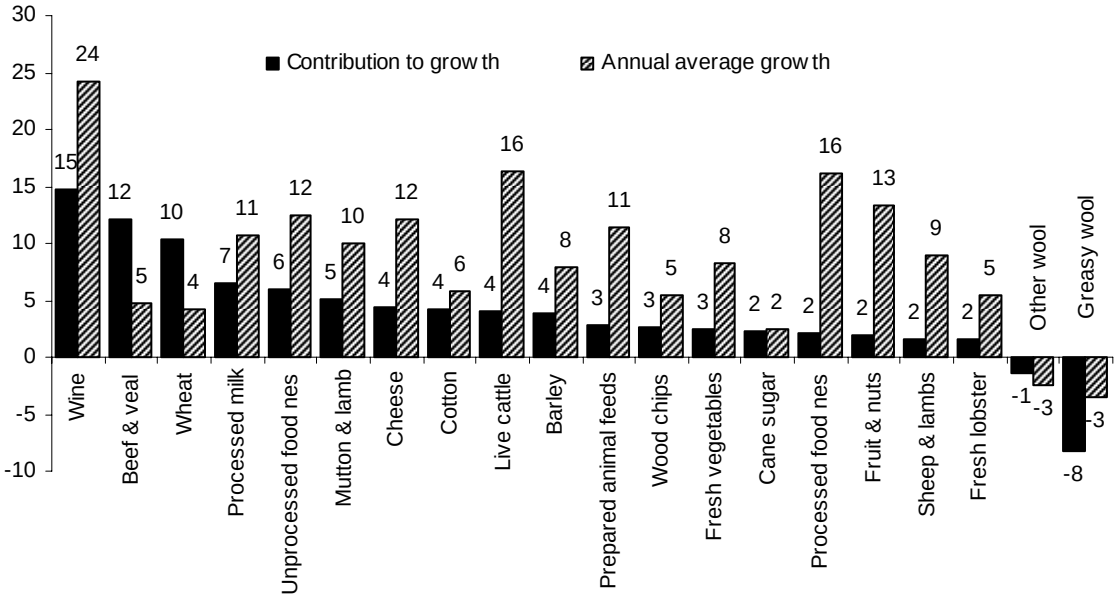
- In 2003-04:
  - agricultural exports earned $28.2 billion — amounting to 22 per cent of the value of total goods and services exports;
  - agricultural products made up 7 of Australia's top 20 export earners;
  - the top five agricultural export earners were beef and veal ($3.9 billion), wheat ($3.4 billion), wine ($2.5 billion), wool ($1.9 billion) and processed milk ($1.1 billion). Combined, these industries accounted for 45 per cent of total agricultural exports. This compares with 65 per cent for the top five agricultural export commodities in 1988-89; and
  - imports of agricultural commodities into Australia amounted to almost $8 billion, around one-quarter of the value of agricultural exports and around 7 per cent of total merchandise imports.
- Australia is now the fourth largest exporter of wine in the world after France, Italy and Spain. The value of Australian exports increased from $116 million in 1988-89 to $2.5 billion in 2003-04 — an annual rate of growth of 24 per cent.
- In 2002, Australia was the 6th largest exporter of agricultural products, accounting for around 3 per cent of global agricultural exports. By comparison, Australia was the 16th largest exporting nation overall, accounting for only 1 per cent of world merchandise exports.
- Australia is an important global player in a number of agricultural commodities. In 2002, Australia accounted for 65 per cent of global wool exports (greasy and scoured); 15 per cent of wheat exports; 15 per cent of bovine meat exports and 9 per cent of wine exports.

Annual average growth rates and commodity contributions to growth between 1990-91 and 2003-04 indicate considerable diversity in the performance of the top 20 agricultural exports (figure 12). The five largest contributors to overall growth accounted for half of total growth — comprising wine (15 per cent), beef and veal (12 per cent), wheat (10 per cent), processed milk (7 per cent) and unprocessed food (6 per cent).

A number of smaller industries — including mutton and lamb, cheese, live cattle, prepared animal feeds, processed food and fruit and nuts — also made strong contributions. All these industries recorded double digit annual growth rates with small, albeit growing, contributions to overall growth. Combined, they accounted for almost one-fifth of total export growth.

Figure 12 **Top 20 agricultural export commodities — contribution to growth and growth rate, 1990-91 to 2003-04**

Per cent, average three years ended (value terms)



The only industries to record substantial falls in export values over the period were greasy wool and other wool products, with annual average falls of around 3 per cent.

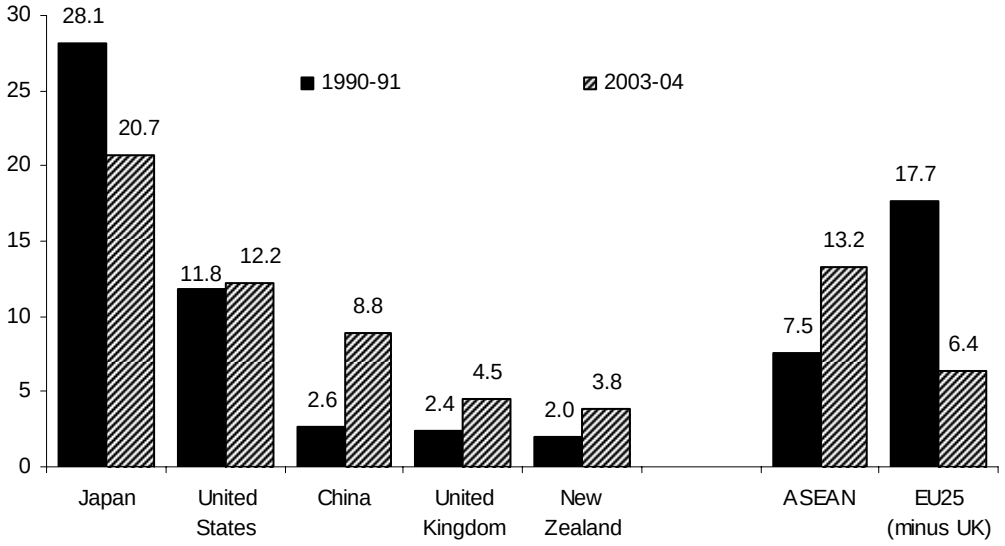
Changes in export markets

Australia's trade in agriculture is heavily influenced by sales to three key markets — Japan, the United States and China. Collectively, these markets accounted for 42 per cent of agricultural exports in the three years to 2003-04 (figure 13). Beyond these markets, trade in agriculture is dispersed among a wide range of countries. For example, the next 17 largest markets accounted for a further 42 per cent of agricultural exports.

Despite growth in agricultural exports to Japan (Australia's largest agricultural export market), the country's share of Australian agricultural exports declined by more than 7 percentage points over the period 1990-91 to 2003-04. This was largely due to a combination of declining wool prices and volumes and slow growth in the Japanese economy. The United States, China, the United Kingdom and New Zealand increased their share of Australian agricultural exports over the period. The stand out was China, which more than tripled its share over the period.

Figure 13 **Australia's top export markets, 1990-91 and 2003-04**

Per cent, average three years ended (value terms)



Australia has increasingly directed its agricultural exports to Pacific rim countries and away from European markets. The key factors driving these changes were the formation of the European common market and the loss of preferential access for Australian farmers when the United Kingdom acceded to the European Economic Community in 1973. The move away from European Union countries has, with the exception of the United Kingdom, continued in recent decades. Not only did the European Union's share (excluding the United Kingdom) of Australian agricultural exports fall 11 percentage points between 1990-91 and 2003-04, but the overall value fell by almost $0.6 billion.

In contrast, exports to ASEAN countries increased strongly. Driven by strong growth in exports to Indonesia, Thailand and the Philippines, ASEAN's share of Australian agricultural exports increased from 7 to 13 per cent.

Barriers to growth in agricultural trade

With only limited scope for domestic consumption growth, the agriculture sector's future growth is highly dependent on increasing its sales to world markets. There are, however, significant institutional impediments to growth in agricultural trade arising from the agricultural support policies of many countries.

Despite some progress in reducing these impediments in recent decades, worldwide, agriculture continues to be the most highly protected sector. Producer support as a share of gross farm receipts among OECD countries is highest in Switzerland, Norway, Iceland, Korea, Japan and the European Union. In contrast, Australia provides the second lowest levels of support to agriculture, after New Zealand, among OECD countries (box 4).

Box 4 Government assistance to agriculture

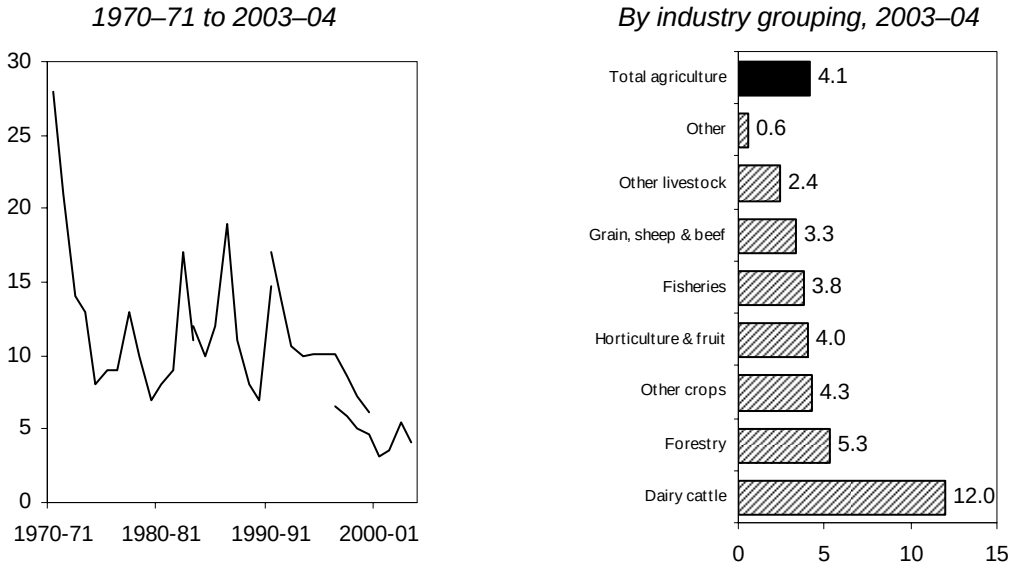
Australian Governments have employed a wide range of measures to assist agricultural activities. These include statutory marketing arrangements, tariffs and budgetary measures such as adjustment assistance, R&D support, drought relief and tax concessions. From the mid-1980s, governments began to dismantle statutory marketing and price support schemes which provided the bulk of measured assistance to agriculture as part of a wider program of microeconomic reform. Key industries affected by these changes included dairy, sugar, eggs and tobacco.

The Commission's effective rates of assistance (ERAs) estimates reveal that assistance to agriculture is inherently volatile due largely to fluctuations in world commodity prices. Nevertheless, average ERAs for agriculture declined from around 13 per cent in the 1970s to an average of 5 per cent in the seven years to 2003-04 (figure 14), although this figure excludes 'exceptional circumstances' drought payments.

The latest data series reveals that agriculture's ERAs have declined by 0.3 percentage points a year, on average, since 1997-98 to reach 4.1 per cent in 2003-04. Dairy cattle farming remains the most highly assisted industry with an ERA of 12 per cent in 2003-04, followed by forestry (5.3 per cent) and other crops (4.3 per cent).

Figure 14 Average effective rates of assistance to agriculture[a]

Per cent



a The effective rate of assistance is the dollar value of measured assistance divided by unassisted value-added. For agriculture, this includes tariff assistance, most budgetary assistance and, the main component, assistance provided by domestic regulatory and pricing arrangements. Breaks in the series reflect the effects of periodic revisions to reference data covering industry inputs and outputs.

Although Australian and international studies have identified substantial potential gains from further liberalisation of agricultural trade, the full benefits are unlikely to be realised for some time. In the face of pressures from newly emerging suppliers and farmers' declining terms of trade, productivity improvements remain crucial in maintaining the viability of the sector.

Agriculture's workforce

While in absolute terms employment in agriculture has remained relatively stable over the last four decades, there have been changes in the structure of agriculture's workforce. Industries gaining employment share over the last two decades included horticulture and fruit growing, services to agriculture, poultry farming and commercial fishing. Industries losing employment share included grains, sheep and beef cattle farming, dairy, other livestock farming and forestry and logging.

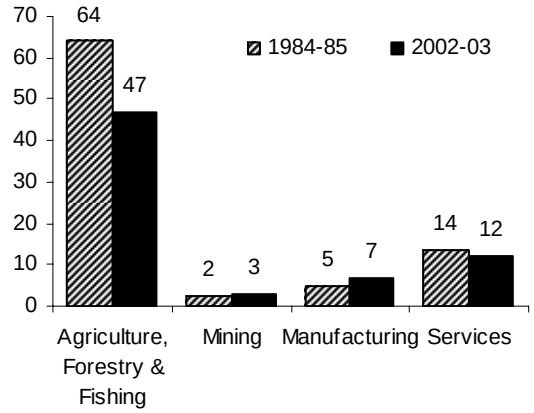
Agriculture's workforce has a number of distinctive features (figure 15). Compared with other sectors of the economy, agriculture has:

- a high proportion of self-employed, family and casual workers;
- long job tenure. Almost half of agriculture's workers have been in their current job for 10 years or more;
- a relatively old workforce. Just over 70 per cent of agriculture's workers were aged 35 years or older in 2003-04; this compares with around 58 per cent for the rest of the economy;
- a low incidence of post-school qualifications. The proportion of the agriculture workforce without post-school qualifications is around 20 percentage points higher than for the workforce generally, while for university training it is more than three times lower than that for the workforce in general; and
- low employee wages. In 2003, median weekly earnings for full-time paid employees in agriculture were around one third lower than those for all full-time employees, making agriculture workers the lowest paid workers in the economy on average.

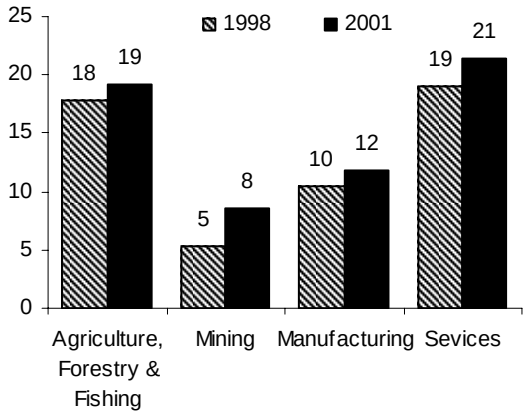
Many of these features arise from the continuing dominance of family operated businesses in this sector — 99 per cent of Australian farms are family owned and operated. This has provided flexibility in the use of labour in terms of hours worked and engagement in off-farm work.

Figure 15 **Distinguishing features of agriculture's workforce**

Proportion of workforce self-employed

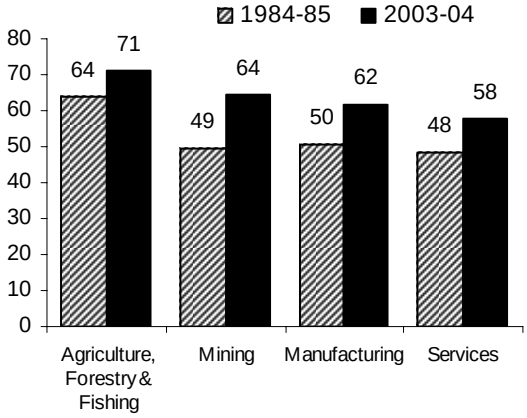


Proportion of casual employment

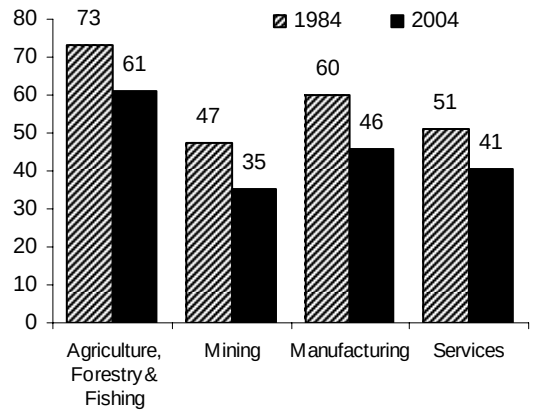


Proportion of workforce by length of job tenure, 2004

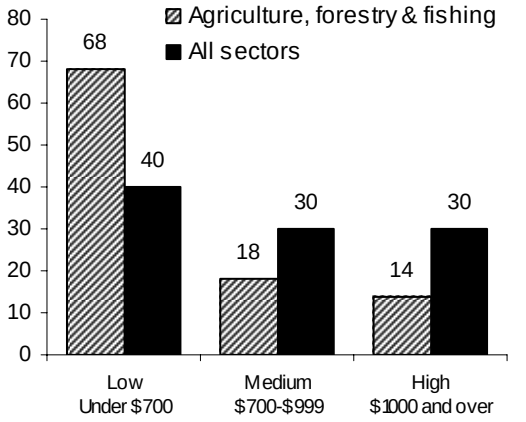
Proportion of workforce aged 35 and over



Proportion of workforce without post-school qualifications



Proportion of employees by weekly full-time earnings in main job, 2003



The last twenty years, however, have seen a decline in the proportion of employers, own account workers and contributing family workers employed in agriculture, and an increase in the proportion of employees. This can be partly explained by the trend towards larger farm sizes. Demographic changes such as smaller family sizes (fewer children to help on the farm) and other influences, such as more family members working off-farm, have also reduced the supply of family labour and, hence, increased the need for hired labour.

An old and ageing workforce

Not only is the agriculture workforce older than the workforce in general, but the average age of farmers has increased significantly over the last two decades — from 44 in 1981 to 50 years in 2001. Factors contributing to this trend include:

- fewer young people entering farming; and
- low exit rates at traditional retirement age, possibly compounded by the limited interest of young people in taking over the family farm.

There are, however, different age profiles among agriculture industries. The horticulture and dairy industries stand out as having younger age profiles, while the beef and sheep industries have the oldest workforces.

Low employee earnings, but farm family incomes broadly comparable

While real earnings per employee for agriculture are low relative to other sectors, these data only relate to full-time employees and as such exclude around half of the agricultural workforce (own account workers, employers and family labour).

The distribution of incomes in agriculture on a family income basis more closely resembles that in the rest of the economy. In 2001, around 29 per cent of farming families had relatively low incomes (less than $600 per week) — the same proportion of low income families as the rest of the economy.

Growing importance of off-farm income

Off-farm employment has become increasingly important to maintaining family farm incomes. While the relative importance of farm income to household income varies between years (reflecting seasonal conditions), off-farm income has, on average, accounted for around 65 per cent of all household income on broadacre farms since 1989-90.

Over the period 1989-90 to 2002-03:

- the proportion of farm families deriving a share of their income from off-farm wages and salaries increased from 30 to 45 per cent; and
- average broadacre farm incomes earned from off-farm wages and salaries more than doubled in real terms — from $15 000 to around $33 500 per year.

The increasing importance of off-farm employment reflects, in part, the increased participation of women in the workforce, as well as the increasing incidence of multiple job-holdings by farmers.

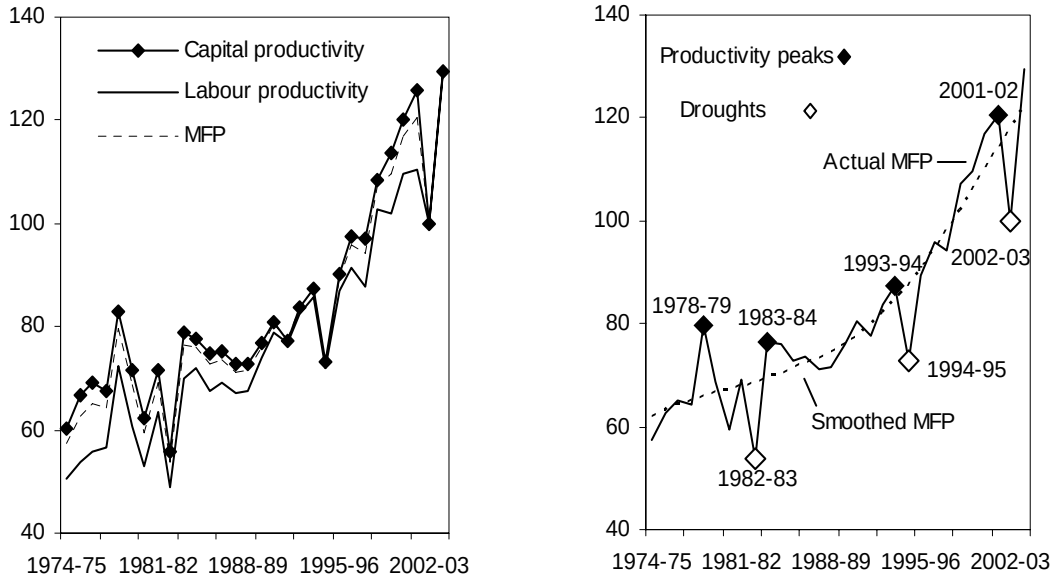
Agriculture's productivity performance

Agriculture's productivity, while quite volatile because of seasonal variations, has exhibited strong growth over the longer-term (figure 16). Multifactor productivity (MFP) growth averaged almost 3 per cent a year over the period 1974-75 to 2003-04 (or 2.3 per cent in trend terms). This was considerably stronger than that achieved in Australia's market sector (1 per cent in trend terms).

Growth in labour and capital productivity for the agriculture sector largely mirror growth in MFP. Over the period 1974-75 to 2003-04, labour productivity and capital productivity increased by 3.3 and 2.7 per cent a year respectively (figure 16).

Figure 16 **Labour, capital and multifactor productivity in the agriculture sector, 1974-75 to 2003-04**

Index 2001-02 = 100



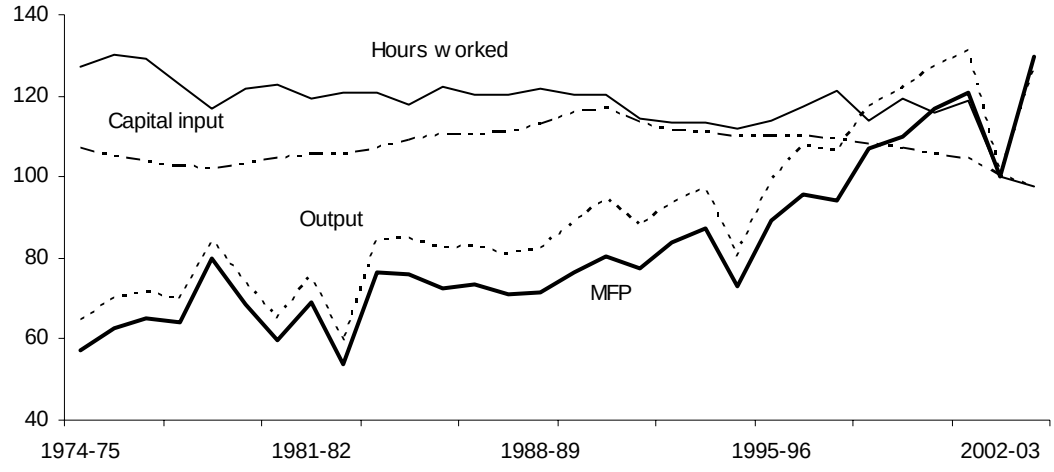
MFP growth in the agriculture sector has also been stronger over the last fourteen years than in the 1970s and 1980s. In trend terms, MFP increased at an annual average rate of 1.3 per cent between 1974-75 and 1989-90. This compares with 3.7 per cent per year between 1989-90 and 2003-04.

Agriculture is a strong contributor to the economy's overall MFP growth. Over the period 1974-75 to 2003-04, agriculture accounted for around 16.4 per cent of market sector MFP growth, or more than double its value-added share of the market sector. Indeed, over this period agriculture was the second highest contributor of the twelve market sector industry divisions after manufacturing (31 per cent of MFP growth).

Productivity — the driver of output growth in agriculture

Productivity growth has accounted for the entire increase in output of the agriculture sector over the last thirty years. Over the period 1974-75 to 2003-04, the quantities of both labour and capital inputs used in agriculture declined, while total agriculture output increased at an annual average rate of around 2.4 per cent (figure 17).

Figure 17 **Growth in inputs, outputs and multifactor productivity for agriculture, 1974-75 to 2003-04**
Index 2002-03



By comparing the actual growth in output over the period with that which would have been observed had there only been changes in inputs (that is, no MFP growth), it is possible to estimate an agricultural productivity 'dividend'. Applying the trend MFP growth rate of 2.3 per cent, the cumulative annual difference in value added

over the period (in constant 2002-03 prices) generated a 'dividend' of just over $170 billion over the period.

Productivity trends within agriculture

Productivity growth is far from uniform within the agriculture sector. Over the last three decades, the highest productivity gains in broadacre agriculture have been achieved by the cropping industry (3.3 per cent a year over the period 1977-78 to 2001-02). Mixed crops/livestock farms recorded the next highest growth of 2.5 per cent per year followed by beef and dairy farms with growth rates of 1.8 and 1.7 respectively. Productivity growth in the sheep and sheep-beef industry has been rather modest and insufficient, on average, to offset the deteriorating terms of trade for this industry.

Productivity growth has been closely related to farm size in the broadacre industries, with larger farms typically outperforming smaller farms. For example, in the beef industry over the period 1977-78 to 2001-02, the largest third of beef farms enjoyed strong productivity growth (2.2 per cent a year), while the smaller two-thirds recorded little or no growth. Similarly, large producers of prime lamb recorded growth of 1.4 per cent compared with 0.8 per cent for small producers.

The lumpy nature of many new technologies, such as advanced mechanical harvesters and automated feeding systems, means that they are often better suited to larger scale farming. Also, larger farms are often better placed to finance the use of new management and farming practices.

Drivers of productivity growth in agriculture

A key source of productivity growth in agriculture has been the generation and adoption of new knowledge or technologies. Some examples include:

- the development of more sophisticated farm machinery and equipment;
- the development of improved herbicides, fertilisers and other chemicals that have enhanced yields; and
- genetic modification involving the manipulation of the genetic structure of living organisms (more directly than through conventional plant and animal breeding), which has created opportunities for raising the productive potential of plants or animals by, for example, enhancing their resilience to disease.

Productivity growth has also come about as farmers have made better use of available technologies and management practices. Key influences in this context have been pressures from competing overseas producers, the enabling effects of

new process technologies such as IT and the internet, as well as changes to various institutional and regulatory arrangements (including reforms to statutory marketing arrangements for several industries).

In addition, productivity growth within the agriculture sector has been shaped by structural changes such as increases in farm size, shifts in the industry mix of the sector and the exit of lower performing farmers.

International comparisons

International data suggest that, in terms of MFP growth, Australian agriculture has performed relatively strongly compared with most other OECD countries over the last two decades — recording a growth rate similar to the United States, but lower than Canada and Denmark.

That said, as noted, there is considerable variation in farm productivity within Australian agriculture. While such variations reflect to some extent differences in climate and soil quality between farms (factors outside the control of farmers), they also reflect differences in the uptake and use of best practice management and technologies. The latter points to scope for lifting the productivity performance of the sector as well as the desirability of undertaking research to better understand the drivers of performance differences between farms.

1 Introduction

Agriculture has historically played an important role in the Australian economy. In the first half of the 20th century, agriculture accounted for around a quarter of the economy's output. And, in the 1950's, its importance as a source of export revenue was such that the Australian economy was commonly described as 'riding on the sheep's back'.

The last few decades, however, have seen considerable changes to the agriculture sector and its contribution to the Australian economy. Agriculture now accounts for less than 5 per cent of the economy's output and for less than a quarter of Australia's total exports. Changes are also evident in terms of the number and size of Australian farms, the composition of the sector's output and the production and marketing strategies employed by farmers.

Some key factors driving change in the sector include globalisation, trade liberalisation, changing consumer tastes, technological advances and innovation and environmental constraints. The unrelenting decline in farmers' terms of trade (that is, the ratio of prices received to prices paid) has also been an important source of pressure for change.

1.1 Objectives of the study

The main objective of this study is to contribute to a better understanding of Australia's agriculture sector and the role that it plays in the economy by identifying and analysing key trends in the sector over the last 20 years or so. The study looks at:

- the changing role of agriculture in the economy (in terms of output, employment and trade);
- the sector's links with other sectors of the economy and how these have changed;
- changes within the sector in terms of activity mix, farm businesses, trade and employment; and

- similarities and differences between the productivity performance of the agriculture sector and other Australian sectors, as well as with agriculture in other OECD countries.

While the focus is on key changes over the last 20 years, the study sometimes uses longer periods to provide a historical perspective or place developments in a broader context.

Given the complexity and breath of issues affecting the agriculture sector, the study does not attempt to cover all issues, but rather focuses on key changes.

Important reasons for studying trends in agriculture

There are a number of important reasons for examining trends in the agriculture sector over the past few decades.

- Because agriculture is a diverse sector, aggregate data tends to hide important changes that are occurring at a more disaggregated level. For example, while the importance of the sector as a whole has declined over time, some commodities, such as grapes and cotton have experienced rapid output growth and thereby captured an increasing share of agricultural output and trade. A study of this nature provides the opportunity to better appreciate the diverse nature of the sector and to gain a better understanding of the significant changes that have occurred within the sector.
- While extensive research has been undertaken on Australia's agriculture sector, particularly for specific commodities and industries, there does not appear to be a trend study of this nature.
- The Commission has previously undertaken studies of trends in Australia's manufacturing (Clark et al. 1996 and PC 2003) and service sectors (McLachlan et al. 2002) This study adds to the set.

1.2 Agriculture — what does it cover?

The term 'agriculture' is used broadly in this report and describes the activities making up the *Agriculture, Forestry and Fishing* division of the Australian and New Zealand Standard Industrial Classification (ANZSIC). The activities under this division include:

> Agriculture — the breeding, keeping or cultivation of all kinds of animal or vegetable life. Forestry — afforestation, harvesting and gathering of forest products. Fishing — the catching, gathering, breeding and cultivation of marine life from ocean, coastal and inland waters. Hunting — the catching or taking of all types of animal wildlife on land (ABS 1993, ANZSIC, Cat. no. 1292.0).

This broad definition has been adopted partly for completeness (in view of the strong affinity between the industries within the division), but also because some of the ABS data covering 'agriculture' is only available at this divisional level. That said, with forestry, fishing and hunting accounting for less than 5 per cent of the sector's output, the focus of the study is on what is traditionally known as 'agriculture'.

… but there is blurring of the boundaries

The boundaries between what is included under 'agriculture' and what is included under other sectors of the economy are blurred. For example, while the growing and sun-drying of grapes is included as agriculture, the preserving of grapes and the production of wine are included as part of the manufacturing sector. Similarly, while cattle feedlot operations are classified as agriculture, the slaughter and freezing of carcases is classified as manufacturing. Food processing activities, such as the canning of fruit and vegetables, are also categorised as manufacturing. A key factor influencing the sector in which activities are placed is the degree of transformation of raw or semi-processed materials (ABS 1993).

There is a similar blurring of the boundaries between some agriculture and service industries. Services to agriculture such as aerial crop spraying, shearing and cotton ginning, for example, are grouped within 'agriculture' while activities such as bulk wool classing and veterinary services are included as part of the service sector.

'Grey' areas on the boundaries of sectors are not unique to the ANZSIC — similar difficulties arise with other classifications (for example, commodity and trade classification systems), both in Australia and overseas. As such, they do not materially detract from the merits of the ANZSIC framework for describing and analysing variations in the performance of different sectors. For a discussion of the blurring of boundaries between the manufacturing sector and other sectors of the Australian economy (see PC 2003, pp. 3–4).

1.3 Agricultural production systems

The agriculture sector is characterised by a wide range of different production systems with varying input usage. The spatial distribution of these systems is heavily influenced by physical aspects of the operating environment of Australian farms, namely — climatic conditions, water availability, soil and topographical conditions and proximity to markets.

Farms raising beef cattle and sheep, for example, generally use relatively extensive production techniques — so called dryland farming practices — involving a large input of land relative to other inputs. Other activities, such as horticulture, rice and cotton growing are typically smaller in scale and involve a higher use of non-land inputs such as water and labour.

Poultry and pig farming, on the other hand, represent much more intensive forms of production where non-land inputs tend to be dominant and production processes display more in common with processing activities in manufacturing. In such industries, farmers essentially provide 'sheds' to processors who supply the main inputs into the production process (including, for example, poultry/pigs, feed and medications).

Agricultural activities, because they generally have a larger environmental component, are different to production systems elsewhere in the economy. Many of these physical and biological factors, such as variations in rainfall and the onset of disease, are largely outside the control of farmers, yet they can have a significant effect on the level of production, input use, prices and the performance of farms. The 2002-03 drought, for example, saw agricultural output decline by around a quarter and real agricultural income fall by over 50 per cent (Lu and Hedley 2004, pp. 26-27). Reflecting such influences, the National Farmers Federation (NFF) has observed that around 80 per cent of farm profit in Australia is made in around 30 per cent of years (Corish 2004, p. 7).

Because most agricultural production systems rely heavily on the condition and productivity of the natural resource base, the management practices of farmers (including soil, fodder and water management) can exert an important influence on the sustainability of Australia's natural resource base. As the NFF President recently said:

> With Australian farmers responsible for the management of over 62 per cent of the Australian landscape and over 80 per cent of our water resources, farmers are central players in natural resource management (Corish 2004, p. 9).

A number of studies have also demonstrated that policies that encourage sustainable farm and environmental management practices are likely to be important for the future performance of the agricultural sector (see, for example, PC 2004b).

1.4 Structure of the report

In outlining key developments and trends occurring in the agriculture sector over the past 20 years, the report is divided into six chapters.

Chapter 2 examines the role of agriculture in the Australian economy. It looks at agriculture's contribution to output, employment, trade and investment and examines the sector's linkages with other parts of the economy. The changing role of the agriculture sector over the past few decades is also discussed.

Chapter 3 explores key trends within the agriculture sector and the underlying drivers of the changes occurring within the sector.

Chapter 4 looks at key trends in Australia's agricultural trade over recent decades and comments on some of the factors affecting patterns of trade.

Chapter 5 takes a look at jobs in the agriculture sector, highlighting differences with other sectors of the economy. The extent to which jobs in the sector have changed over time and the factors influencing such changes are also discussed.

Chapter 6 examines the productivity performance of agriculture over time compared with other sectors of the economy, as well as productivity trends within the sector. The chapter also compares the productivity experience of Australia's agricultural sector with those of other advanced OECD countries.

2 Role of agriculture in the economy

Key points

- Agriculture plays a small but important role in the Australian economy. In 2003-04, it accounted for less than 5 per cent of the nation's output and employment.
- The sector plays a much bigger role in Australia's exports, accounting for over one-fifth of total goods and services exports in 2003-04.
- The economic contribution of the agriculture sector varies across the States and Territories — its share of output is considerably higher in South Australia, Tasmania, Western Australia and Queensland than it is in New South Wales or Victoria.
- Agriculture plays a significant role in regional Australia. In 2001, almost four-fifths of all agricultural employment was in non-metropolitan regions. Agriculture accounted for more than 25 per cent of total employment in 207 of Australia's 425 labour market regions.
- Agriculture is highly integrated with the rest of the economy, drawing on inputs from the manufacturing and service sectors as well as from imports.
- While agriculture accounts for a relatively small proportion of the economy, variations in the sector's output can have significant flow-on effects for the economy. The 2002-03 drought, for example, saw agricultural output decline by around one-quarter reducing Australia's GDP and employment growth by around 1 percentage point.
- Between the early 1960s and early 1980s, agriculture's share of GDP fell from 14 to around 6 per cent. However, over the past two decades agriculture's share has been relatively stable at 4–6 per cent of GDP. That said, in real terms, the value of agricultural output increased two and a half times over the four decades to 2003-04.
- Agriculture's share of total employment has also fallen, albeit at a slower rate — from 9 per cent in 1966-67 to 4 per cent in 2003-04.
- The relative decline of agriculture reflects improved productivity and falling relative prices for food, coupled with stronger consumer demand for services as incomes rise. As such, the diminishing share of agriculture largely reflects positive or success-related factors and is not a sign of systemic weakness.
- Australia's experience is also consistent with that of other developed countries — there is a strong inverse relationship between national per-capita income and the GDP-share accounted for by agriculture — although the sector's share of output in Australia remains one of the highest in the OECD.

This chapter looks at the role that agriculture plays in the Australian economy. In addition to canvassing the direct contribution of agriculture to output, employment, trade and investment, the chapter examines linkages between agriculture and the rest of the economy. Key trends in the agriculture sector are examined with a focus on the sector's changing role in recent decades. Some of the reasons for the decline in the relative importance of the sector are explored, as is the question of how Australia's experience compares with other countries.

2.1 The contribution of the agriculture sector

Agriculture's contribution to the economy can be measured in a number of ways (figure 2.1). In 2003-04, the agriculture sector:

- contributed 4 per cent, or $25 billion, of the total output of the economy (industry gross value added);
- employed just under 4 per cent of the workforce, or 375 000 people;
- accounted for around 6 per cent of Australia's investment spending and employed 5 per cent of Australia's net stock of capital[1]; and
- represented around 22 per cent of Australia's total exports[2] (merchandise exports plus overseas income from services).

Whilst agriculture's output, employment and investment shares are broadly comparable, its share of exports is considerably greater, being more than five times greater than its output share (figure 2.1).

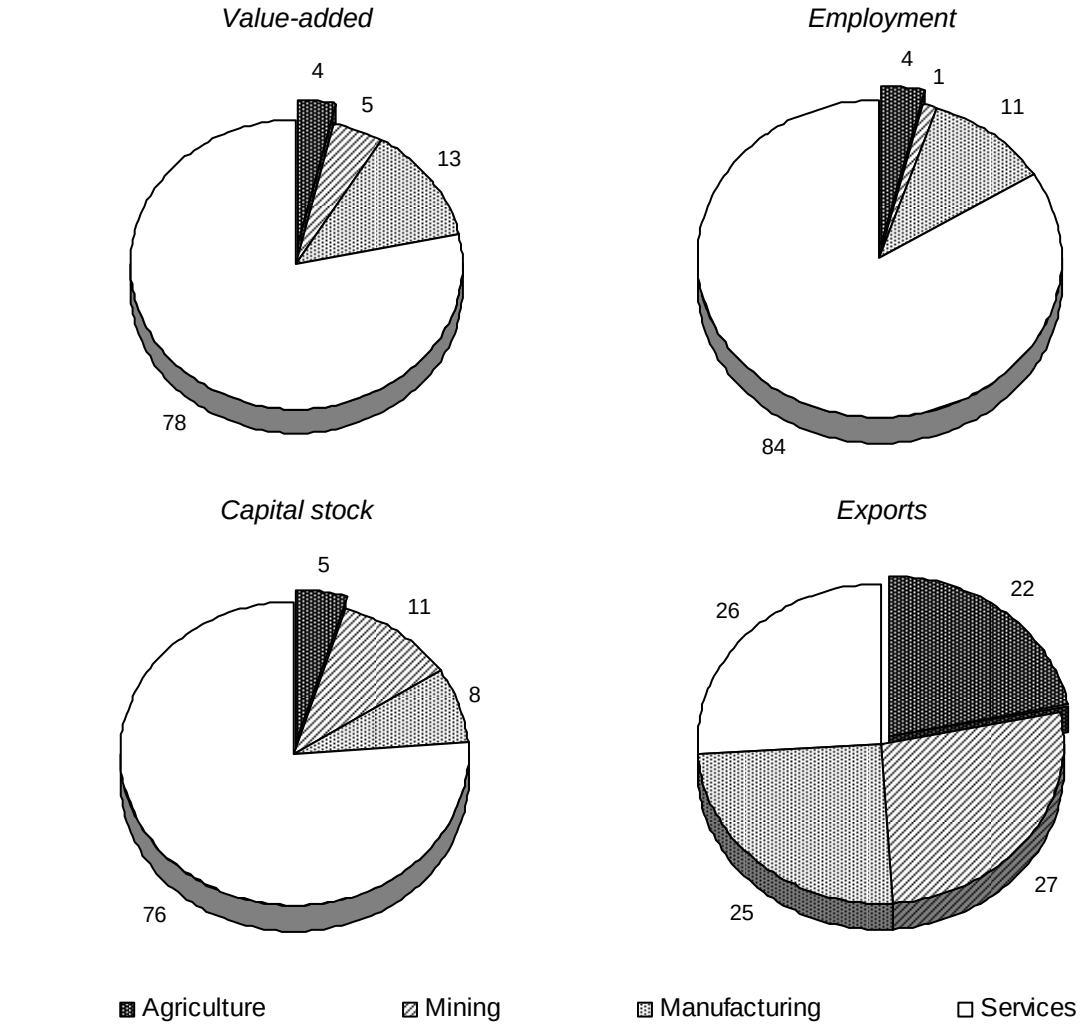
Agriculture firms employ large quantities of capital equipment. In 2003-04, agriculture firms invested $8.0 billion — $4.5 billion on machinery and equipment and the remainder predominantly on livestock, buildings and other structures. With its heavy reliance on machinery and equipment, the sector's investment profile differs from most industries in the Australian economy where the bulk of investment is in buildings and structures.

1 This refers to the depreciated value of Australia's private and public stock of capital and includes all buildings, structures, machinery and equipment for all ANZSIC industries, excluding ownership of dwellings (ABS Cat. no. 5204.0).

2 TREC/SITC basis (see chapter 4).

Figure 2.1 **Agriculture's[a] contribution to Australian economic activity, 2003-04[b]**

Per cent



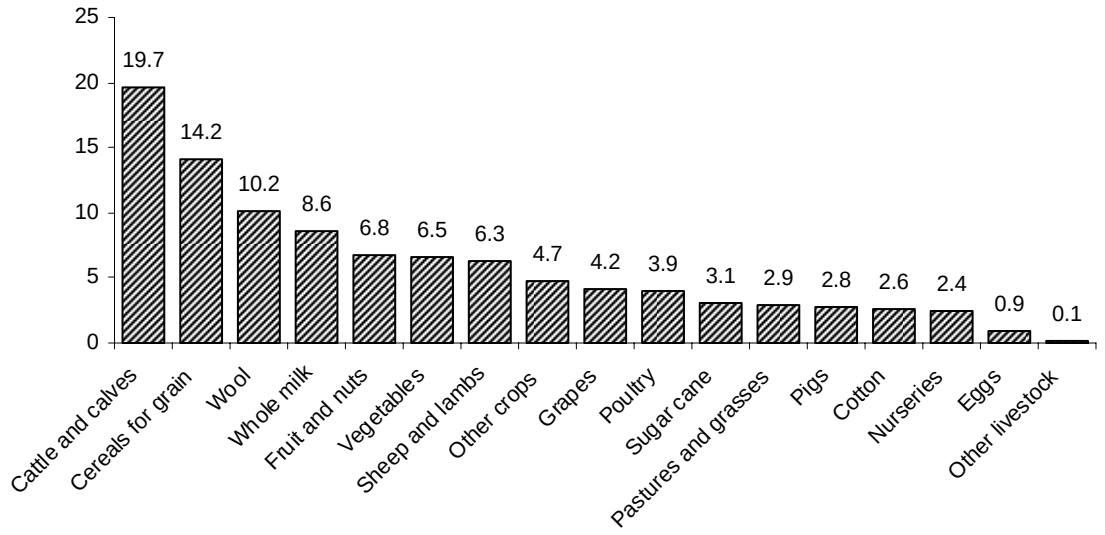
a 'Agriculture' covers the activities making up the Agriculture, forestry and fishing division of the ANZSIC. **b** 'Ownership' of dwellings is omitted to allow value added shares to sum to 100.

Data sources: ABS (Cat. nos. 6204.0 5, 6203.0 and 5302.0).

In terms of gross value of output, in 2002-03[3], Australia's largest agriculture industries were beef cattle and calves (20 per cent of total agriculture output), cereals for grain (14 per cent), wool (10 per cent) and milk (9 per cent). Other large industries included fruit and nuts, vegetables, sheep and lambs, and grapes (figure 2.2).

3 Latest available detailed ABS industry data (ABS Cat. no. 7503.0).

Figure 2.2 **Industry contributions to agriculture[a] output, 2002-03**
Per cent



a No consistent data are available on the output of the forestry and fishing industries. However, the industries included comprise the overwhelming majority of the output of the Agriculture, forestry and fishing division of the ANZSIC — combined, these industries have, on average, accounted for 94 per cent of the agriculture sector's value-added since 1974-75.

Data source: ABS (Cat. no. 7503.0).

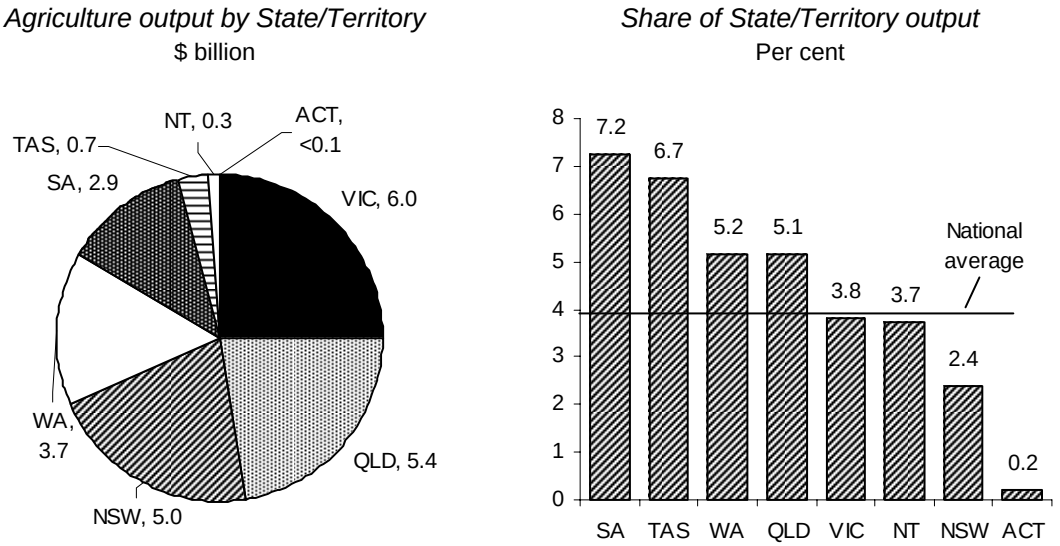
In terms of farm numbers, beef cattle farming was also the major agricultural activity, accounting for 25 per cent of all farms in 2002-03. Grain growing and mixed farming (grain-sheep/beef cattle) were the next largest, both accounting for around 12 per cent of Australian farms.

Agriculture in the States and Territories

About 25 per cent of agriculture output is produced in Victoria and just over 20 per cent in each of Queensland and New South Wales. The Northern Territory and the Australian Capital Territory combined account for just over 1 per cent of total agriculture output (figure 2.3).

The relative economic importance of the agriculture sector varies significantly across Australian States and Territories. Agriculture's share of State output is stronger in South Australia (7.2 per cent), Tasmania (6.7 per cent), Western Australia (5.2 per cent) and Queensland (5.1 per cent), than the larger States (Victoria and New South Wales). Its importance to the Northern Territory (3.7 per cent of output) is slightly below the national average of 3.9 per cent, and it plays a negligible role in the Australian Capital Territory (figure 2.3).

Figure 2.3 **Agriculture output[a] in the States and Territories, 2003-04**



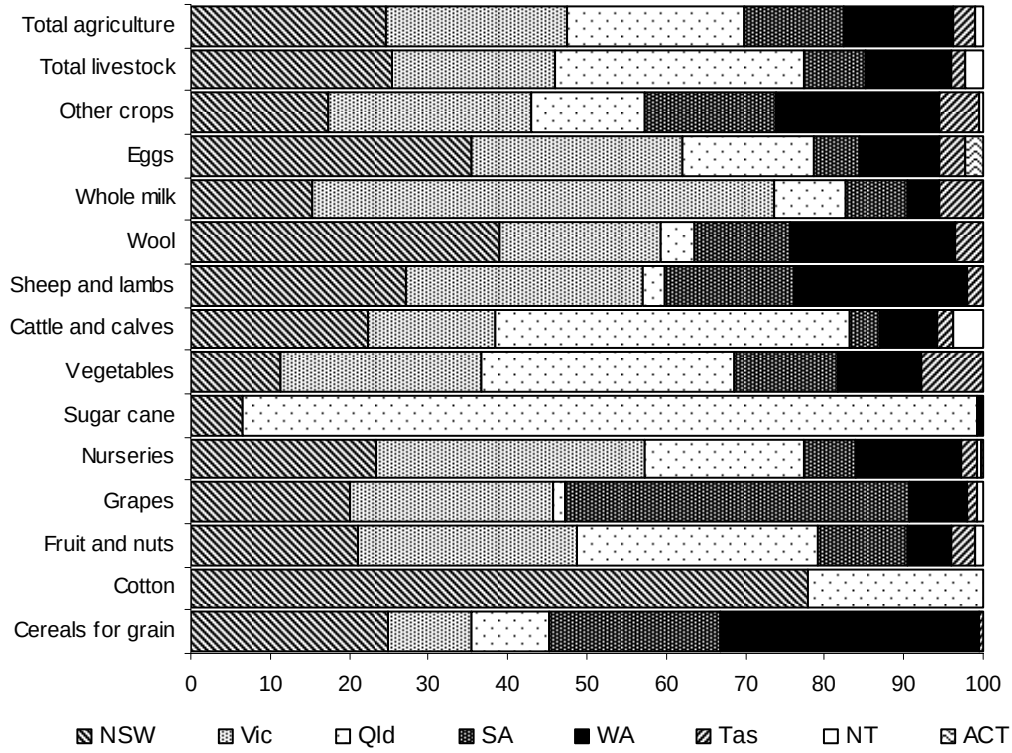
a The data are based on current price factor income measures of output derived from State National Accounts. This is close, but not identical to, direct measures of value added. Total production excludes general government and ownership of dwellings, so the measures shown here are different from GDP shares. In 2003-04, total factor income for the agriculture sector was $24.0 billion compared with $24.8 billion in value-added.

Data source: ABS (Australian National Accounts: State Accounts 2002-03, Cat. no. 5220.0).

An examination of the relative contributions of different agriculture industries to agricultural output in the different States and Territories reveals that (figure 2.4):

- almost 60 per cent of Australia's milk is produced in Victoria;
- almost half (45 per cent) of Australia's beef cattle and over 90 per cent of all sugar is produced in Queensland;
- South Australia produces 44 per cent of the nation's grapes and 22 per cent of its cereal grains;
- around 80 per cent of the nation's cotton production, 40 per cent of wool production and over one-third of all egg production is in New South Wales;
- Western Australia produces almost one-third of Australia's cereal crops and over one-fifth of sheep, lamb and wool production;
- Tasmania contributes a disproportionately large share of total vegetables and milk output; and
- The Northern Territory specialises in cattle production, with a small but significant production of fruit and nuts.

Figure 2.4 **Agricultural output shares[a] by State and Territory, 2002-03**
Per cent



a Based on gross value of production data for 2002-03 (current prices, latest available data).

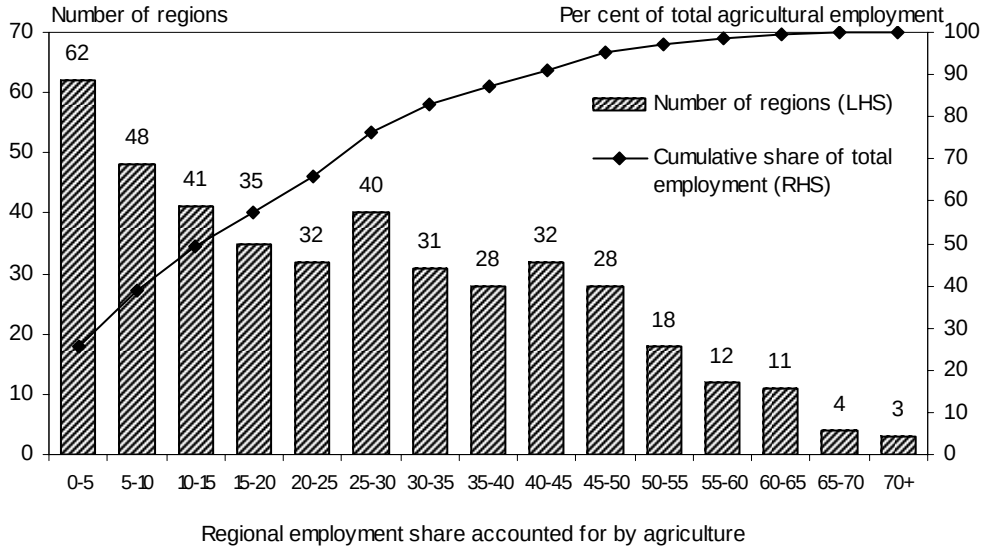
Data source: ABS (Cat. no. 7503.0).

The importance of agriculture to regional Australia

Agriculture plays an important role in regional Australia. In 2001, almost four-fifths of all agricultural employment was in non-metropolitan regions. Agriculture directly accounted for more than 25 per cent of total employment in 207 of Australia's 425 labour market regions.

Employment shares for agriculture differed markedly across regions, with shares ranging from zero to over 70 per cent (figure 2.5). As expected, agriculture's employment share was highest in the smaller regions. For example, 49 per cent of agricultural employment was distributed among 151 regions with agricultural employment shares of less than 10 per cent. These regions had a median employment level, for all sectors, of just under 7000 persons. The remaining 51 per cent of agricultural employment was distributed among 274 regions with agricultural employment shares ranging from 10 to over 70 per cent. The median employment level, for all sectors, for these regions was under 1500 persons.

Figure 2.5 **Distribution of regions by share of employment in agriculture and by contribution to total agricultural employment[a], 2001**



a Data are based on BTRE data which divides Australia into 425 regions — 8 capital cities, 6 other metropolitan regions (comprising Gold Coast/Tweed, Townsville-Thuringowa, Sunshine Coast, Newcastle, Wollongong and Geelong), 89 coastal non-metropolitan regions, 199 inland non-metropolitan regions and 123 remote non-metropolitan regions.

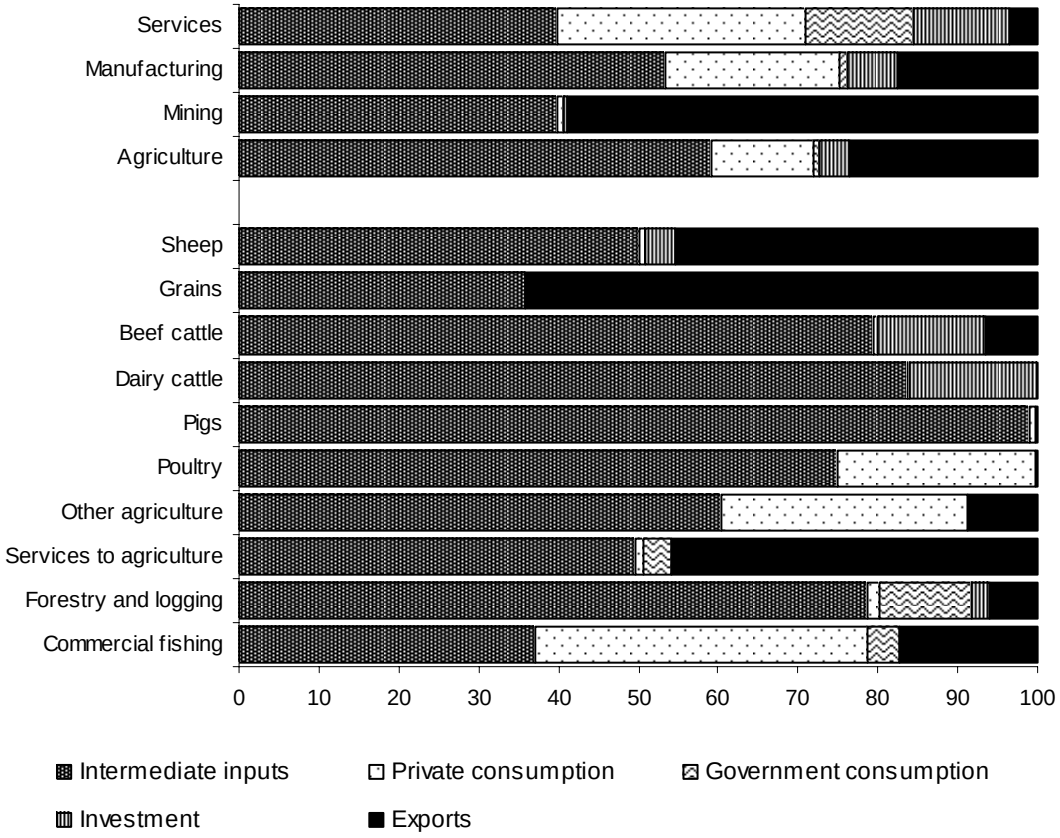
Data source: BTRE (2004) Industry Structure Database.

Linkages to other sectors

The measures presented above do not fully capture the role of agriculture in the economy because they fail to take into account the strong linkages between sectors. Input-output tables reveal these interdependencies. For example, analysis of these tables reveals that the agriculture sector provides the highest proportion of its output as intermediate input for use in other sectors. In 1998-99, around 60 per cent of the total value of agricultural output was used as intermediate inputs in either the goods or service sectors — for example, in processed foods and restaurant meals (figure 2.6).

Around one-quarter of the agriculture sector's output was exported directly — making it the most export-oriented sector after mining. There was considerable diversity with grains, sheep/wool and services to agriculture directly exporting the highest proportion of their output. The pigs, dairy and beef cattle industries provide the highest proportion of their output to other Australian industries (predominantly for processing or packaging in the manufacturing sector). The industries with the highest proportions of direct sales to final consumers (households) are commercial fishing, other agriculture (including fruit and nuts and vegetables) and poultry (see appendix A).

Figure 2.6 **Distribution of output by demand category[a], 1998-99**
Per cent



a Data are based on input-output industries and exclude changes in inventories.

Source: ABS (Cat. no. 5209.0).

Input-output data presented in table 2.1 show inputs as a proportion of output for the various agriculture industry groupings and illustrate the high degree of interdependence between agriculture and other industries.

Reading *across* the first row we see that, to produce $100 of output in 1998-99, firms in the agriculture sector required, on average, $42.10 worth of intermediate inputs, of which services accounted for $19.40. The most important service industries to the agriculture sector are: wholesale trade ($2.90 worth of intermediate inputs); transport and storage ($3.70 of inputs, with road transport being particularly important to the beef, dairy and grains industries); and banking, finance and business services ($3.80 of inputs).

Electricity and water supply are important intermediate inputs for some agriculture industries, accounting for around 3 per cent of the combined output of the dairy cattle and poultry industries. Communications also account for around 1 per cent of output for most agricultural industries.

Table 2.1 **Direct requirements coefficients[a], by sector, 1998-99**

Per cent

		These sectors provide inputs ...							
		Ag	*Mining*	*Mfg*	*Services*	*Total intermed. inputs*	*Value-added*	*Imports*	*Total*
. . . to the output of these sectors	Agriculture	**11.1**	**0.1**	**11.4**	**19.4**	**42.1**	**49.6**	**5.9**	**100.0**
	Mining	**0.1**	9.2	8.0	22.7	40.0	53.2	5.4	100.0
	Services	**0.3**	0.6	7.8	31.0	39.8	54.3	4.1	100.0
	Manufacturing	**6.5**	3.7	21.7	21.2	53.3	31.1	14.7	100.0
	Processed food	***26.5***	*0.6*	*20.4*	*20.9*	*68.4*	*26.5*	*4.3*	*100.0*
	Meat and dairy products	***41.2***	*0.1*	*13.9*	*19.7*	*74.9*	*21.9*	*2.5*	*100.0*
	Beverages	***15.6***	*0.2*	*20.0*	*25.6*	*61.6*	*32.4*	*2.7*	*100.0*
	Tobacco products	***3.5***	*0.1*	*5.5*	*31.8*	*41.2*	*43.3*	*15.0*	*100.0*
	Textiles, clothing and footwear	***9.7***	*0.4*	*23.3*	*19.1*	*52.6*	*28.8*	*15.7*	*100.0*
	Wood and paper products	***4.7***	*0.6*	*20.8*	*27.4*	*53.7*	*30.1*	*15.3*	*100.0*

a Based on direct allocation of competing imports. This means that all flows recorded in the first four columns of figures refer only to the use of domestic inputs and do not reflect the technological input structure of the sectors. The individual items do not add to 100 because the input-output column on indirect taxes is not shown.

Source: ABS (*Australian National Accounts: Input-output Tables 1998-99*, Cat. no. 5209.0).

Given the tight margins on many agriculture products arising from high levels of international competition, efficiently provided infrastructure services are important in allowing farmers to contain production costs.

Around one-quarter of all intermediate inputs required by the agriculture sector are sourced from within the sector — mainly from agricultural services and grain producers (who provided substantial inputs such as seed or feed products to most agriculture industries). The remaining inputs are mostly manufactured items, with $100 of output by the agriculture sector drawing on $11.40 worth of manufactured inputs.

Imports account for around $6 of every $100 of output for the agriculture sector. This is above that of the mining ($5.40) and service ($4.10) sectors, but less than half that for manufacturing ($14.70). The agriculture industries with the highest import shares include dairy and commercial fishing. The lowest are grains and poultry.

A recent study undertaken by Econtech (2005) for the Australian Farm Institute and Horticulture Australia sought to quantify the extent of economic activity associated with the agricultural sector — including activity within the sector as well as within industries in other sectors providing goods and services to farmers or using farm

produce to manufacture or market product for consumption. The study estimated that 'farm-dependent' industries accounted for around 12 per cent of Australia's GDP (box 2.1). The 'farm-dependent' economy, however, was broadly defined and included, for example, the output and employment of industries such as accommodation, cafes and restaurants, food retailing and textiles, clothing and footwear.

Box 2.1 **Australia's farm dependent economy**

There are a number of different ways in which the direct and indirect role agriculture plays in the economy can be measured. A recent study by Econtech for the Australian Farm Institute and Horticulture Australia concluded that 'farm-dependent' industries account for around 12 per cent of Australia's GDP for the six years up to and including 2003-04. Farm-dependent industries comprised:

- the agriculture sector (3 per cent[4]);
- the farm-input sector (1 per cent) — comprising industries that supply inputs to agriculture such as chemicals (fertilisers), transport, storage, wholesale trade and business services; and
- the farm-output sector (8 per cent) — comprising industries that are deemed to rely on agriculture for a large proportion of their inputs, such as food retailing, accommodation, cafes and restaurants and food and clothing manufacturing.

Estimates of shares of GDP and employment accounted for by the agri-food chain are highly sensitive to assumptions made about what industries are included. For example, the largest component of the farm output sector was the accommodation, cafes and restaurants industry. This industry accounted for 2.6 per cent of GDP and employed over 434 000 people in the comparison year (1998-99), amounting to just under one-third of the farm-output sector. On average, accommodation, cafes and restaurants sourced 17 per cent of their inputs from either the agricultural sector or the food manufacturing industries.

Similar studies have been undertaken for the United Kingdom, the United States and Canada (Department for Environment, Food and Rural Affairs 2004, Agriculture and Agri-Food Canada 2003 and Lipton et al 1998). Although the methodologies and findings of these studies vary considerably, they all suggest that there are strong links between agriculture and other sectors of the economy.

Sources: Econtech (2005), Department for Environment, Food and Rural Affairs (2004), Agriculture and Agri-Food Canada (2003) and Lipton et al. (1998).

4 This is smaller than the measure used throughout this chapter (4 per cent in 2003-04) due largely to the treatment of ownership of dwellings in the PC's estimates of sector shares (see note b to figure 2.1).

An examination of changes in inter-industry linkages between 1980-81 and 1996-97 (the longest consistent series available) reveals that, whilst the proportion of agricultural intermediate inputs supplied to the rest of the economy has declined slightly, agriculture firms have been drawing increasingly heavily on a range of service industries. Over the period, service inputs almost doubled in importance with an increase of around 9 percentage points (table 2.2).

Table 2.2 **Changes in input-output relationships, 1980-81 to 1996-97[a]**
Percentage point changes

		These sectors provide inputs . . .			
		Agriculture	Mining	Manufacturing	Services
… to the output of these sectors	**Agriculture**	**3.3**	**0.0**	**-1.0**	**8.9**
	Mining	**-0.2**	-2.9	-1.3	-1.0
	Manufacturing	**-1.6**	-0.2	-2.2	5.9
	Services	**0.2**	-0.2	-4.6	9.3

a Data are based on the absorption matrix of the ABS input-output tables (with indirect allocation of competing imports so that the table reflects the changing technological input structure of agriculture and other sectors). The original 1996-97 and 1980-81 input-output tables were adjusted to increase their consistency with each other. This involved using a concordance between ANZSIC and ASIC and the use of the earlier SNA68 conventions for the treatment of transport margins. The input-output coefficients for 1980-81 were subtracted from those for 1996-97 to derive the figures reported in the table.

Source: ABS (*Australian National Accounts, Input-Output tables 1980-81 and 1996-87* Cat. no. 5209.0), PC (2003).

In addition, intermediate inputs supplied by agriculture firms to other agriculture firms increased strongly — up 3.3 percentage points. Increases in supply of inputs from the 'Other agriculture'[5] industry contributed almost all (2.9 percentage points) of this growth.

2.2 Trends in agriculture

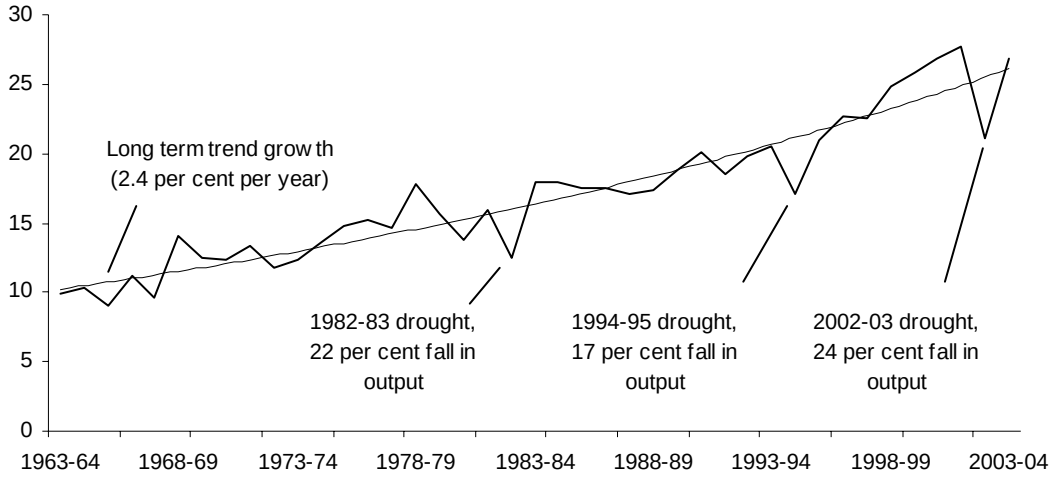
The agriculture sector's output has grown considerably in recent decades, increasing two and a half times in real terms, from around $10 billion in 1963-64 to $27 billion in 2003-04 (constant 2002-03 prices, figure 2.7).

The agriculture sector is characterised by substantial volatility in output over time, with fluctuations in climatic conditions, such as droughts, substantially impacting

5 'Other agriculture' comprises cotton, sugar, grapes, fruit and vegetables, plant nurseries, horse studs and all other crops with the exception of the traditional agricultural commodities of sheep, beef, grains, dairy, pigs and poultry (ABS, *Australian National Accounts: Input-Output Tables (Product Details) 1996–97*, Cat. no. 5215.0).

on output in some years. For example, output declined by around one-fifth in the droughts of the early-eighties and the mid-nineties (figure 2.7). The most recent drought has been the harshest on record, with output declining by almost one-quarter in 2002-03. However, as with previous downturns, output rebounded strongly in 2003-04 to levels slightly above the sector's long-term growth path — which has seen real output growth (in trend terms) of 2.4 per cent a year.

Figure 2.7 **Growth in agriculture output[a], 1963-64 to 2003-04**
Value-added ($ billion, constant 2002-03 prices)



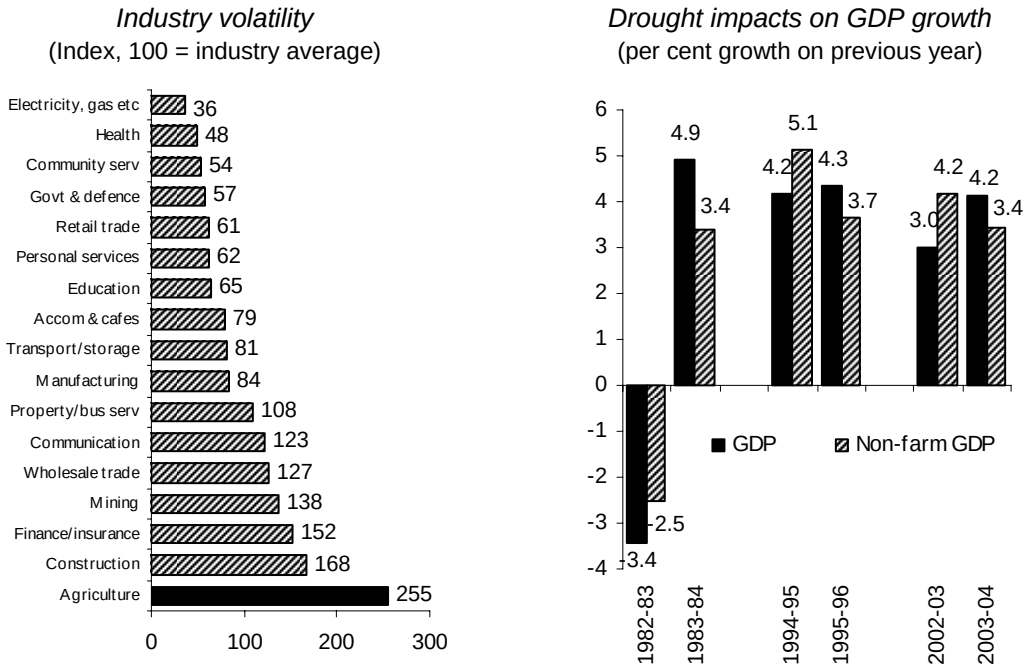
a Annual trend growth rates presented here (and throughout this report) are calculated by regressing the log of the relevant variable (in this case value-added) against a constant and a time trend.

Data source: ABS (Cat. no. 5204.0) and RBA (1996).

Over the period 1974-75 to 2003-04, agriculture registered the highest volatility in year-to-year output growth of all ANZSIC industry divisions — with an index of volatility more than two and a half times greater than the average for all industries (figure 2.8). Output volatility in agriculture was also substantially higher than the next most volatile industries (construction, finance and insurance and mining).

Volatility in agriculture output can have a substantial impact on measured growth rates for the economy as a whole, particularly during drought-recovery cycles. A comparison of growth rates for GDP and non-farm GDP reveals that agriculture has shaved around one percentage point off GDP growth during the last three droughts. For example, GDP growth in 2002-03 was 3 per cent compared with non-farm growth of 4.2 per cent. Similarly, rebounding agriculture output in 2003-04 meant that GDP increased by 4.2 per cent, 0.8 percentage points higher than non-farm GDP (figure 2.8).

Figure 2.8 **Industry volatility[a] and GDP growth, 1974-75 to 2003-04**



a Industry volatility is calculated by taking the standard deviation of the percentage difference between actual and trend annual output (chain-volume index, 2002-03 prices) for every year from 1974-75 to 2003-04 for all 17 ANZSIC industry divisions. Data are indexed to the industry average and ranked. Trend data are estimated using a Hodrick-Prescott smoothing filter (see appendix D and PC 2003).

Data source: ABS (Cat. no. 5204.0).

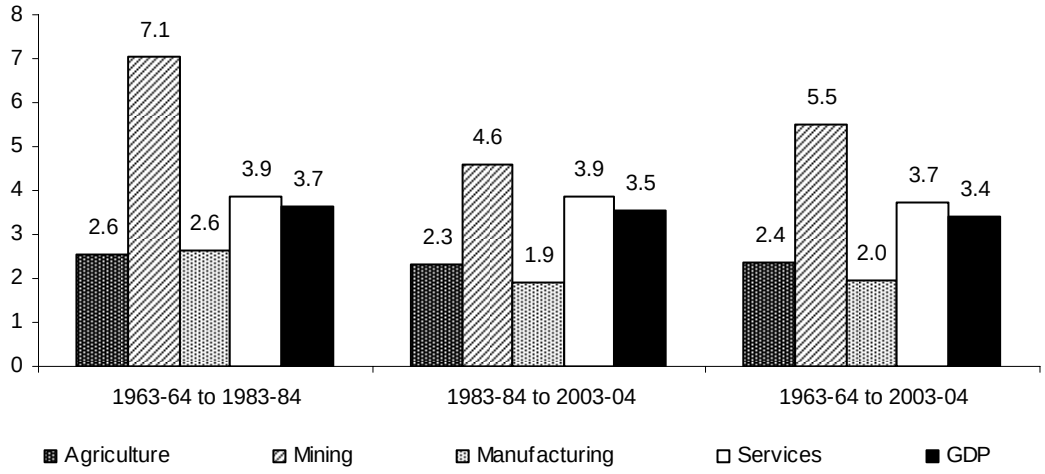
Ongoing drought conditions, in New South Wales and Victoria in particular, have seen agricultural output decline steadily over the past twelve months, with four consecutive declines in quarterly output since the peak in the March quarter 2004. Overall, agricultural output declined 6.7 per cent in the first three quarters of 2004-05 compared with the corresponding period for 2003-04 (constant 2002-03 prices, seasonally adjusted). Although the falls are not as large as those registered in the 2002-03 drought, they indicate that agriculture is having a substantial negative impact on GDP growth in 2004-05. For example, Treasury budget forecasts (produced in May 2005) indicated that farm GDP is expected to fall 8 per cent in 2004-05 as a result of dry conditions in many areas, although farm GDP is expected to increase by 5 per cent in 2005-06 assuming a return to average seasonal conditions (Treasury 2005).

However, more recent ABARE (2005a) crop forecasts suggest that farm GDP growth in 2005-06 could be lower than this, with an expected fall in crop production of around 17 per cent in 2005-06. Strong growth in wheat production in Western Australia is expected to be more than offset by substantial falls for the eastern States, such as in New South Wales — which is expected to fall 55 per cent — and South Australia.

Growth relative to other sectors

While agriculture has continued to grow in absolute terms, faster growth in other sectors (predominantly service industries) has seen the relative importance of agriculture decline steadily. For example, in the two decades to 2003-04 real agriculture output increased in trend terms at 2.3 per cent a year. This was slightly stronger than growth in the manufacturing sector over the period (1.9 per cent per year), but below the 3.5 per cent annual growth recorded for the economy as a whole. The economy-wide result was largely driven by rapid growth in services (3.9 per cent a year) and, to a much lesser extent, by rapid growth in mining output (4.6 per cent a year). Agriculture's growth performance was broadly similar in the two decades to 1983-84, with agriculture recording slower growth than services and mining (figure 2.9).

Figure 2.9 **Sectoral growth rates[a], 1963-64 to 2003-04**
Trend annual average growth (constant 2002-03 prices)



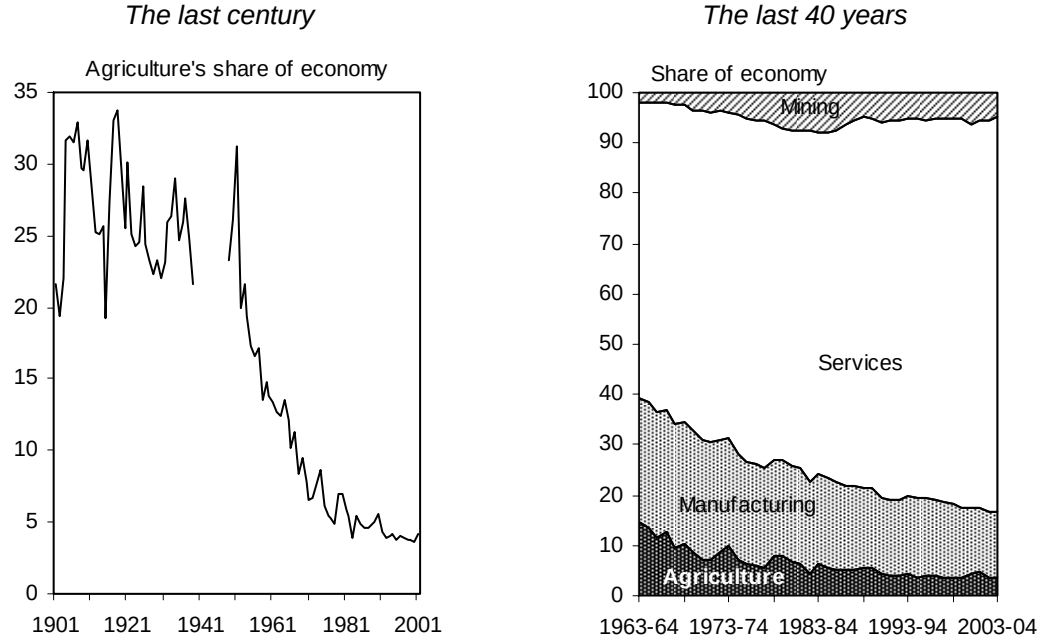
a Due to the way trend growth rates are estimated (see note a in figure 2.7), growth estimates for the full period are not directly comparable to the estimates for the two sub-periods. For example, trend growth for GDP for the four decades was 3.4 per cent a year, which was slightly lower than the estimates for each of the two sub-periods (3.7 and 3.5 per cent). An alternative would be to calculate point-to-point annual average growth. But, although these data are additive across time periods, the resulting growth rates can be highly misleading as they are greatly affected by choice of start and end years. Hence, only trend growth estimates are reported here.

Data sources: ABS (Cat. no. 5204.0) and PC (2003).

Due to a combination of slower growth rates and shifts in relative prices (discussed below), agriculture's share of GDP in current prices fell from around 14 to 6 per cent between the early 1960s and the early 1980s. This followed sharp declines in the 1950s, where agriculture's share fell 12 percentage points over the decade — from 26 per cent in 1950 to 14 per cent in 1960. This contrasts with the experience

of agriculture in the first half of the 20th century, where its output share oscillated around 25 per cent of GDP (figure 2.10). Over the past two decades, agriculture's shares of GDP and employment have declined at a much slower rate — with shares ranging from 4 to 6 per cent of GDP.

Figure 2.10 **Agriculture's share of GDP[a]**
Per cent, current prices



a 1962-63 is the earliest year for which data are available on a comparable basis with recent data. Data from two sources have been spliced to form a continuous serious. ASIC current price industry gross value-added shares are used the period 1963-64 to 1989-90, while shares from 1990-91 are based on ANZSIC current price industry gross value data. Although relative industry shares are affected by choice of splicing year the overall trends are unaffected. Services exclude gross operating surplus from dwellings.

Data sources: ABS (Cat. no. 5204.0), RBA (1996), Butlin (1962), Wonder and Fisher (1990), PC (2003).

Agriculture's employment share has followed a similar trend to its output share. In 1966-67, 443 000 people were employed in the agriculture sector — accounting for around 9 per cent of total employment. Employment in the sector remained relatively stable over the next three and a half decades, with 438 000 people working in the sector in 2001-02. However, as with GDP, agriculture's *share* of total employment fell steadily to around 5 per cent in 2001-02 due to strong employment growth in the service sector. The drought of 2002-03 also had a substantial impact on agricultural employment, with a peak to trough fall in the order of 70 000 jobs. However, unlike output, agricultural employment remains substantially below pre-drought levels (discussed further in chapter 5).

The fall in the agriculture sector's output share of around 20 percentage points since the early 1950s, has meant that agriculture has contributed more to compositional

change in the Australian economy over the past half century than the manufacturing sector (which fell from a peak of around 27 per cent in the 1950s to 13 per cent in 2003-04). The significance of this change is accentuated by the fact that the overwhelming majority of agricultural activity is based in regional Australia, where alternative industries and job opportunities are not as readily available as in the cities. In these circumstances, pressure can be placed on adjustment mechanisms as workers and resources seek out alternative opportunities. However, most of the decline in the sectoral output share of agriculture occurred between the 1950s and the 1970s. The substantial and ongoing changes within manufacturing since the early-1980s have seen it take over from agriculture as the major source of structural adjustment in Australia over the past two decades (PC 2003).

Due to the relatively small size of the Australian agriculture sector, substantial changes within the sector now have less impact on the structure of the economy than in previous decades. For example, ABARE (2005b) forecasts suggest that the gross value of farm production will decline at a rate of 1.6 per cent a year in real terms between 2003-04 and 2009-10. Based on current Treasury (Budget 2005) projections[6] for GDP growth over this period, this would translate into a fall in agriculture's GDP share of less than one percentage point.

Comparisons with other countries

The relatively small share of economic activity directly accounted for by agriculture is not unique to Australia. It is a common phenomenon among OECD countries. In 2001, agriculture accounted for less than 5 per cent of GDP for almost all OECD countries — the exceptions being Greece (7 per cent) and New Zealand (6.7 per cent) (figure 2.11).[7]

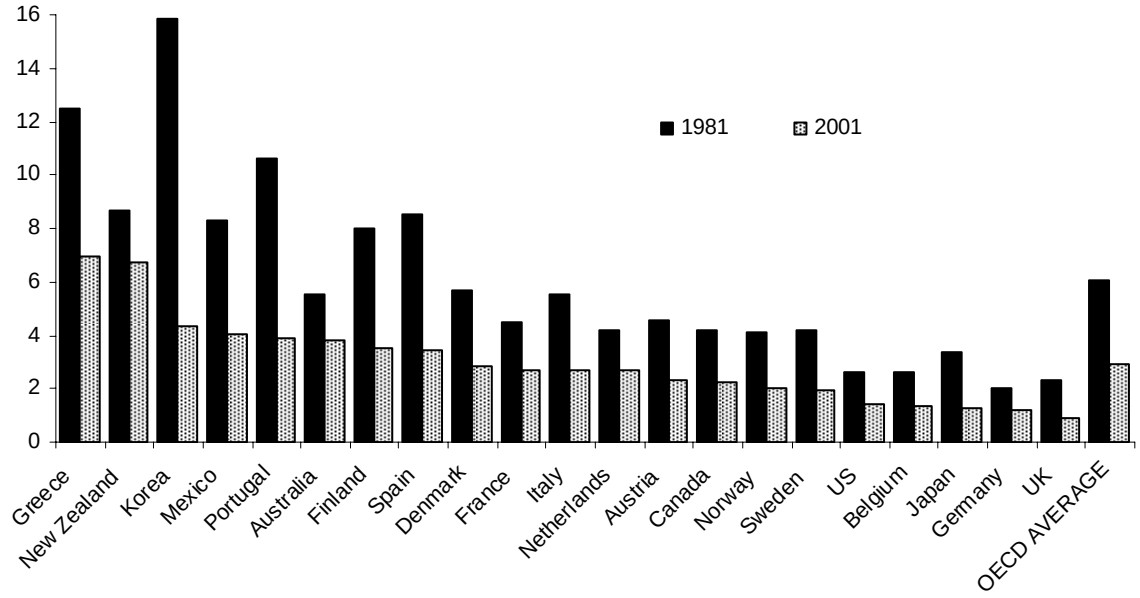
A notable feature of the OECD data is the extent of diversity — with output shares ranging from a high of 7 per cent in Greece to under 1 per cent for the United Kingdom in 2001. Australia's share (3.8 per cent) is above the OECD average, and was nearly three times that of our two largest trading partners, the United States and Japan, with agricultural shares of 1.4 and 1.3 per cent of output respectively.

6 GDP is forecast to increase 2 per cent in 2004-05 and 3 per cent in 2005-06. It is then projected to increase at 3.5 per cent a year in 2006-07 and 2007-08 and 3.25 per cent in succeeding years (Treasury 2005).

7 Data refer to the 21 OECD countries for which data are available (excludes the Slovak Republic, Czech Republic, Hungary, Poland and Switzerland).

Figure 2.11 **OECD countries share of output contributed by agriculture, 1981 and 2001**

Per cent, share of gross value added (basic prices)



Data source: OECD Stan Database (2004).

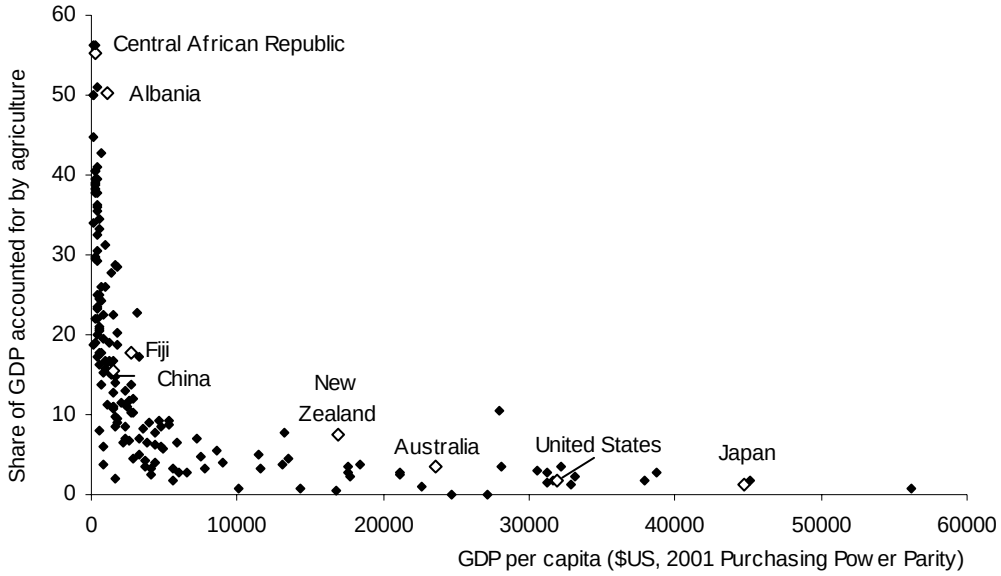
A declining trend in the average output share accounted for by agriculture was evident for the OECD for the period 1981 to 2001, decreasing by 3 percentage points — from 6.1 to 2.9 per cent. All countries for which data are available recorded decreases.

The trends in agricultural employment are similar to that of output. In 2001, agriculture accounted for, on average, 4 per cent of total employment in the OECD. Australia had one of the higher agricultural employment shares at 4.8 per cent.

An examination of a broader set of countries reveals a clear inverse relationship between per capita income levels and the share of the economy accounted for by agriculture (figure 2.12).[8] A similar relationship is evident when shares of employment are examined. Likewise, trend increases in GDP per capita in a given country are inevitably mirrored by a declining share of agriculture in the economy.

8 When log values were taken the following relationship was evident: Ln (agriculture share of GDP) = -0.6409 Ln (per capita GDP) + 7.1869, R^2 = 0.7226, N = 165, t-stat = -20.6, indicating that a 10 per cent rise in GDP per capita is associated with a 6.4 per cent decline in agriculture's share of GDP.

Figure 2.12 **GDP share of agriculture and per capita income, 2000-01[a]**
Per cent



a Where data for 2000-01 were unavailable for some countries (15 of the 165 countries employed), the closest available year was employed as follows: Switzerland, Canada, Nicaragua, Hungary and Kiribati — 1998, New Caledonia and Iceland — 1997, New Zealand — 1996, Kuwait and Brunei — 1995, Cyprus and Saudi Arabia — 1994, United Arab Emirates and Malta — 1993, and Oman — 1992.

Data source: World Bank (World Tables 2004).

This relationship is also evident over time, with all countries exhibiting falls in agriculture's GDP share as their per capita income rises. Also, the largest declines were evident in those developing countries with the fastest overall growth rates in GDP per capita. This well established relationship[9] reflects a number of demand and supply factors, including changes in consumption patterns as incomes rise and productivity improvements. These are discussed below.

2.3 Reasons for the relative decline of agriculture

Three factors are commonly considered to account for the declining relative importance of agriculture. They are:

- shifts in consumer demand away from agricultural products towards services as incomes rise;
- changes in the relative prices of goods and services as economies grow; and
- technological change/innovation and its impact on agricultural productivity.

9 See, for example, Maddock and McLean 1987, Taylor (2001).

Changing patterns of consumer demand

A common explanation for the steady decline in the relative importance of agriculture in advanced economies is changing consumer demand patterns as incomes rise.

International evidence shows that, as economies develop, the relative proportion of people's income spent on food declines[10] — while the share devoted to manufactures and (more importantly) services, increases. This implies an income elasticity of demand below unity for food and above unity for services. As discussed by McLachlan et al. (2002, pp. 25–7), the international evidence on income elasticities is mixed, although most Australian studies confirm that elasticities for many services exceed one. More recent evidence from abroad also suggests that income effects have been a significant force for structural change in developed economies.

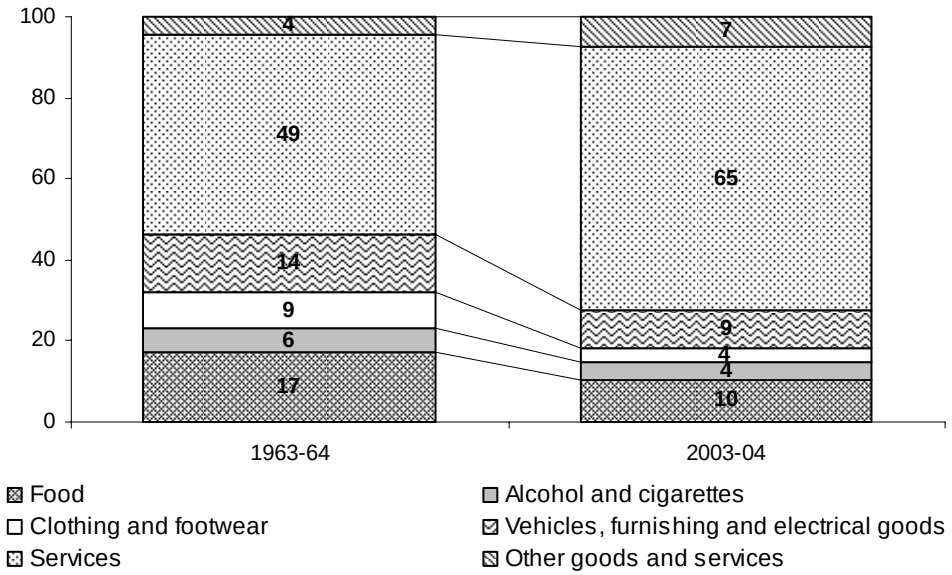
Australian household consumption data confirm that a decreasing proportion of household income is now spent on food and other agriculture-intensive products. In 1963-64, over 23 per cent of the consumption expenditure of the average Australian household went towards food (17 per cent), and alcohol and tobacco (6 per cent) (figure 2.13). By 2003-04, it had fallen substantially (to just over 14 per cent) — with food comprising 10 per cent and tobacco and alcohol 4 per cent. Share declines were also registered for clothing and footwear (from 9 per cent of household expenditure to under 4 per cent). This industry also draws on wool and certain other outputs of the agriculture sector (discussed in section 2.1). These falls reflect the rapid growth in household demand for services. In real terms, household expenditure on services has increased by about 450 per cent over the past four decades, leading to an increase in the share of household income spent on services of around 16 percentage points. In contrast, household spending on food increased by a more modest 160 per cent over the same period.

The broad pattern indicated by the household expenditure data suggests that shifting consumer preferences are likely to have been a key determinant of the relative decline in agriculture output and the growth of services. These trends are also reflected in most of Australia's trading partners. Hence, although the majority of the output of the agriculture sector is sold overseas, the same patterns of consumption have moderated global demand growth for agricultural commodities.

10 This relationship is one of the best established empirical regularities in economics and was first observed by the 19th century German statistician, Ernst Engel. Engel's Law states that the lower a family's income, the greater is the proportion of it spent on food (Rowthorn and Ramaswamy 1997).

Figure 2.13 **Australian household final consumption expenditure shares, 1963-64 and 2003-04[a]**

Per cent, current prices



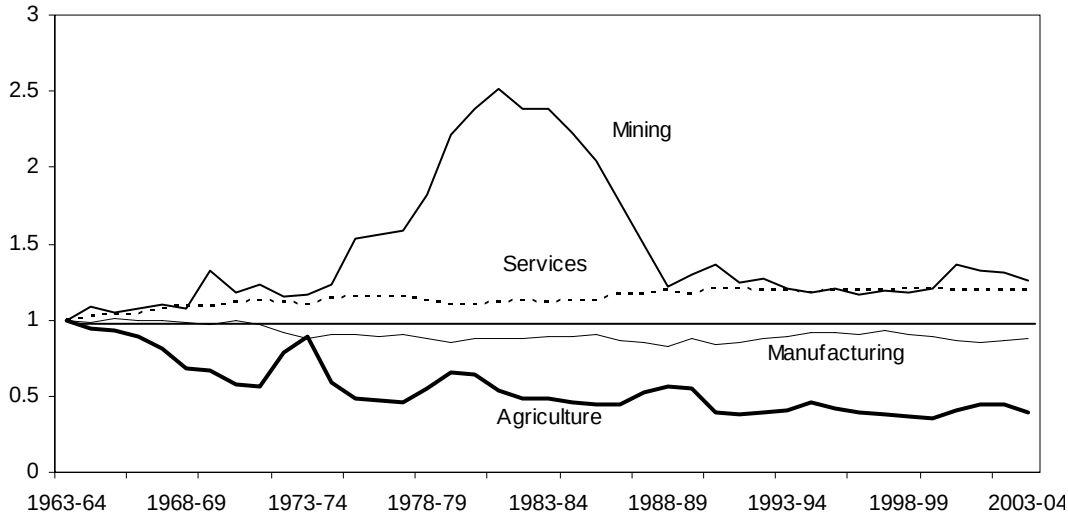
a 'Services' comprise household expenditures on: health; education; insurance and other financial services; hotels, cafes and restaurants; recreation and culture; electricity, gas and other fuels; rent and other dwelling services; transport and communications. Totals do not sum to 100 due to rounding.

Data source: ABS (Cat. no. 5206.0).

Changes in the relative prices of goods and services

The relative prices of goods and services produced by different sectors of the economy have changed significantly over time. These changes can have large effects on sectoral incomes and substantial impacts on the relative sector shares of GDP. Overall, the prices received for agricultural commodities more than halved relative to prices received for the products for all industries over the past four decades (figure 2.14). Along with mining (particularly during the minerals boom of the 1970s and 1980s), prices for agricultural commodities have also been highly volatile. Over the same period, prices for the goods produced by the manufacturing sector also declined by around 15 per cent relative to prices for all industries. In contrast, the prices of services rose steadily (both in absolute and relative terms).

Figure 2.14 **Relative prices by sector[a], 1963-64 to 2003-04**



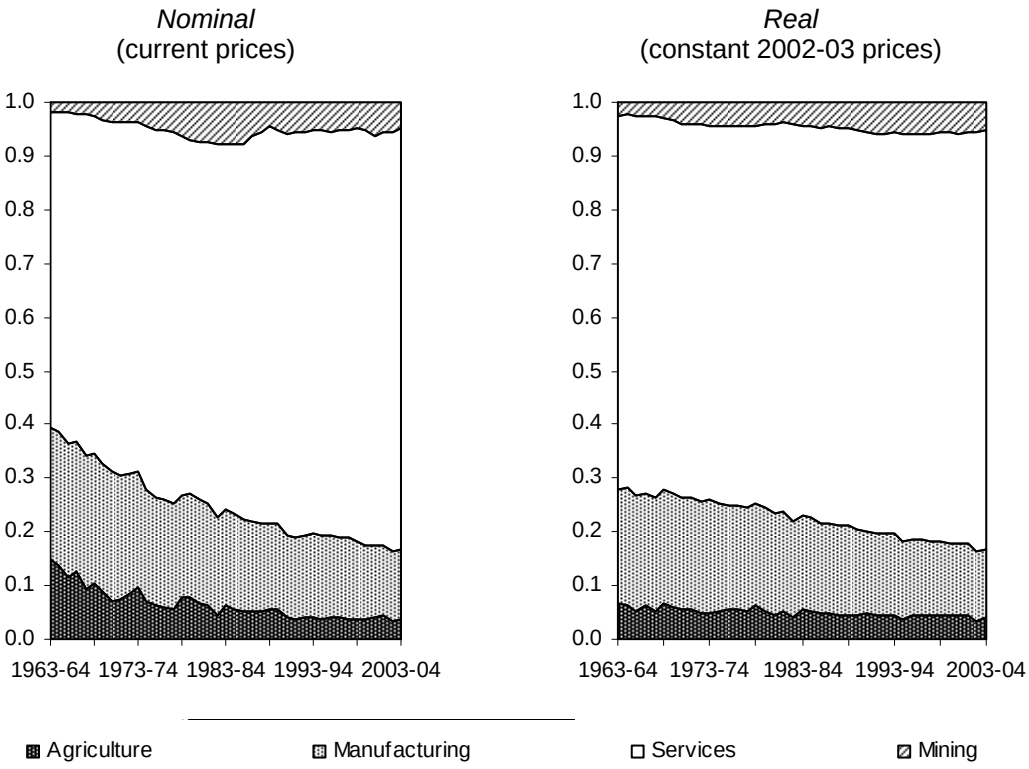
a The figure shows the ratio of prices for each sector to an all industries price index. Prices were derived by dividing nominal output by real output. 1963-64 is the base year.

Data sources: ABS (Cat. no. 5204.0) and PC (2003).

These changes in relative prices have contributed to the decline in the share of GDP accounted for by agriculture discussed earlier. For example, when constant price shares of GDP are employed, the share of GDP accounted for by agriculture falls by only 2 percentage points over the past four decades, compared with a fall of 10 percentage points when current prices are used (figure 2.15). In other words, around 80 per cent of the decline in agriculture's output share can be accounted for by the decline in its prices relative to that of other goods and services.

Caution should be exercised in comparing the changes in relative prices of goods in different sectors due to a number of problems including those associated with measuring the output of the service sector and significant changes in the composition of manufacturing and service sector outputs over the period (McLachlan et al. 2002). Nevertheless, the magnitude of the differences in price trends between services and the goods sectors indicates that changes in relative prices have played an important part in the declining output share of the agriculture sector. However, the sharp decline in the employment share noted earlier cannot be solely attributed to price/demand factors.

Figure 2.15 **Nominal and real[a] sectoral share changes, 1963-64 to 2003-04**



a The choice of base year affects the magnitudes of constant price sector shares. For example, using a base year at the beginning of the period results in higher agriculture GDP shares for all years. Nevertheless, the relative *changes* in sector shares are largely unaffected by the chosen base year.

Data sources: ABS (Cat. no. 5204.0) and PC (2003).

Technological change/innovation and its impact on agricultural productivity

Australia's agriculture sector has a history of innovation. Examples include the introduction of the stump jump plough and combine harvester at the turn of the last century; large scale irrigation via artesian water and dams; improvements in ground preparation and disease and weed control through the use of advanced chemicals and fertilisers; and the employment of satellite technology to aid in land use decisions and to guide and control spraying and cultivation equipment (ABS 2002a).

The uptake of new or improved production techniques, together with increased mechanisation of many aspects of agriculture production, has made it possible to produce more food with fewer workers, thus freeing up labour for use in other sectors. Australian data confirm that multifactor productivity has risen faster in agriculture than in the service sector (discussed further in chapter 6). Similarly, international evidence indicates that technical innovation associated with agricultural productivity growth is labour saving, permitting a reduction of the share

of labour devoted to production (Johnson 2000). Moreover, international multifactor productivity growth rates tend to be higher in agriculture than other sectors (Martin and Mitra 2001).

Taken together, these factors are seen as being responsible for much of the relative decline of agriculture in Australia (and other OECD countries). However, far from being a sign of systemic weakness, this decline reflects positive factors — principally improved productivity and falling relative prices for food coupled with rising demand for services as incomes rise. These are all features of an efficient, high-income economy.

3 Trends within agriculture

Key points

- Over the twenty year period to 2002-03, there have been considerable structural changes *within* agriculture.
- The number of farms in Australia declined from around 178 000 to 132 000, or by around a quarter.
- The total area of land used for agricultural production declined by around 9 per cent.
- The average size of Australian farms increased:
  - the physical size of farms increased from 2720 to 3340 hectares or by around 23 per cent; and
  - the proportion of farms with a value of operations of less than $100 000 declined by 13 percentage points; while the proportion of farms with a value of operations over $500 000 increased by around 8 percentage points.
- Notwithstanding the trend towards larger farms, Australian agriculture continues to be dominated by small farms. In 2002-03:
  - around 20 per cent of farms were under 50 hectares, 10 per cent were between 50 and 99 hectares and 33 per cent of farms were between 100 and 499 hectares; and
  - 31 per cent of farms (or around 41 000 farms) had a value of operations of less than $50 000 and 17 per cent of farms had a value of operations between $50 000 and $100 000.
- Farm production, however, has become more concentrated on large farms — the top 20 per cent of broadacre farms now account for around 64 per cent of output.
- Other notable trends include a shift to more intensive farming and greater integration of production along the agri-food chain.
- In terms of output growth and changes in farm numbers, there is significant variation across agricultural industries:
  - there are slow or declining growth industries such as pigs, eggs and sheep;
  - average performing industries (recording output growth rates and changes in farm numbers broadly in line with the sector average) — including sugar, beef, grains, vegetables, fruit and nuts; and
  - high growth industries such as poultry, grapes, cotton, nurseries and dairy.

Farming in Australia has been changing. Over the last two decades, Australian farmers have had to respond to a diverse array of adjustment pressures emanating from the globalisation of markets, a continuing decline in their terms of trade, new technologies, changing consumer tastes and attitudes and emerging environmental concerns. Changes in government policies, such as the rationalisation of statutory marketing arrangements, together with reforms in areas such as water and land use, have also influenced the environment in which farmers operate and provided further pressures for adjustment.

Australian farmers have responded to these adjustment pressures by changing the size and output mix of their farms, as well as the management and marketing strategies they employ.

While the previous chapter looked at the changing role of agriculture in the economy as a whole, this chapter explores some of the key trends occurring *within* the sector over the last two decades, including:

- fewer and larger farms;
- increased concentration of farm output on larger farms;
- the adoption of more intensive farming techniques; and
- the closer integration of production and related activities in the agri-food chain.

However, the agriculture sector[1] is highly diverse and there have been significant differences in output growth and changes in farm numbers among the industries making up the sector. For this reason, the chapter also examines how the different industries have responded to adjustment pressures and the implications for the composition of agricultural output and farm types.

3.1 Fewer and larger farms

The last two decades have seen a significant decline in the number of Australian farms. Over the period 1982-83 to 2002-03, the number of farms fell by around one-quarter — from almost 178 000 to 132 000 (figure 3.1).

Due to changes in the definition of agricultural establishments (reflected by breaks in the data series in figure 3.1), it is not possible to quantify the annual average rate at which farm numbers have declined for the entire 20 year period. However, the comparable data suggests that farm numbers have declined at a fairly constant rate over the period. Over the periods 1982-83 to 1985-86 and 1986-87 to 1990-91, farm numbers declined at an average annual rate of around 1 per cent, while between

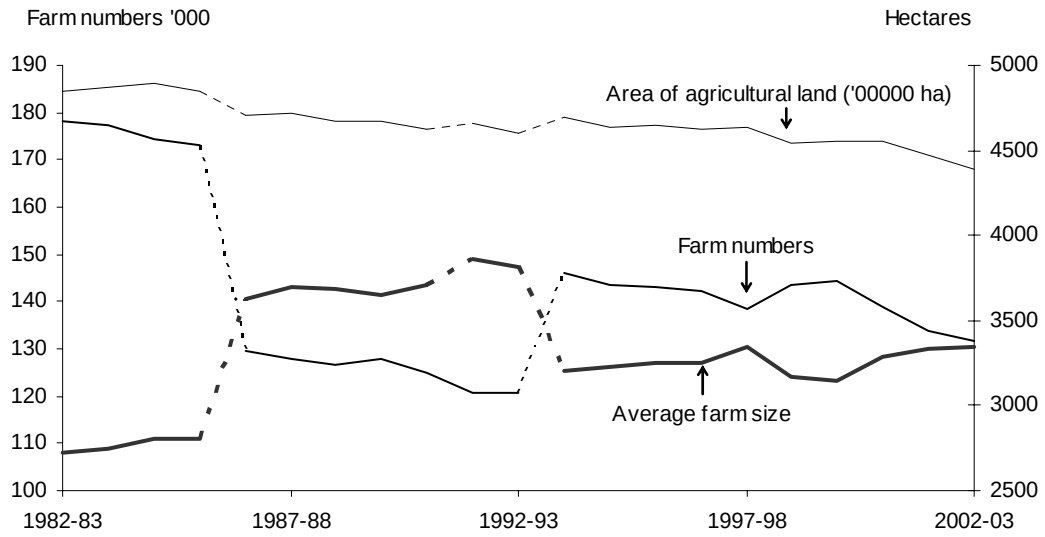
[1] This chapter examines trends within farming or what is traditionally known as ‘agriculture’.

1993-94 and 2002-03 they declined at a marginally faster rate — around 1.2 per cent a year.

Declining farm numbers have also been accompanied by a decline in the area of land in agricultural production — a decline of around 9 per cent over the last twenty years (figure 3.1). While the area of agricultural land remained largely unchanged between 1982-83 and 1985-86, it declined at an average annual rate of 0.4 per cent between 1986-87 and 1990-91 and by 0.7 per cent over the period 1993-94 to 2002-03.

As farm numbers have tended to decline at a faster rate than the area of agricultural land, average farm size has increased. This increase has occurred not only in terms of the input measure of the physical size of land used, but also in terms of the output measure of economic size reflected by the estimated value of farm operations (box 3.1).

Figure 3.1 **Farm numbers, farm size and area of agricultural land[ab], 1982-83 to 2003-04**



a Farm numbers refer to business establishments engaged in productive agricultural activities, typically at one physical location. **b** Breaks in the series reflect periodic revisions to the minimum threshold for inclusion of establishments, based on the estimated value of agricultural operations (EVAO). Until 1985–86, farm numbers included agricultural establishments with an EVAO of $2500 or more. In 1986-87, the EVAO threshold was raised to $20 000, and from 1991–92 it was raised to $22 500. From 1993-94, the EVAO was reduced to include establishments with an EVAO of $5000 or more. Estimates of the number of establishments and average farm size are, therefore, not strictly comparable between periods with differing EVAO thresholds.

Data source: ABS (Cat no. 7121.0).

Box 3.1 **Measuring farm size**

There are two common measures of farm size — physical measures such as hectares operated and financial or economic measures such as value of production. Each measure has advantages and drawbacks depending on its application.

Physical size provides a valuable indicator of the scale of operations. However, it has shortcomings in that it is unable to reflect differences between geographic locations and industries in regard to the productive capabilities of land and differing intensities of land use.

Economic size, on the other hand, provides a measure of size which reflects the aggregate value of output. However, it is sensitive to price and production fluctuations in the short run, and inflation in the long run. It is also unable to reflect differing turnover intensities of different farming systems.

Increasing average physical size

In 2002-03, the average Australian farm was 3340 hectares. This was up from 2720 hectares in 1982-83, an increase of around 23 per cent. Average farm size, however, masks considerable variation in physical farm size (box 3.2).

Over the period 1982-83 to 1985-86, farms increased in physical size at an average annual rate of 1 per cent, while over the periods 1986-87 to 1990-91 and 1993-94 to 2002-03, the rate of average annual growth in farm size halved to around 0.5 per cent (figure 3.1).

The proportion of farms in the three smallest farm size categories (0–49, 50–99 and 100–499 hectares), all declined over the period 1982-83 to 2002-03 — falling by 3.2, 1.7 and 0.8 percentage points, respectively — while the share of medium and, to a lesser extent, large farms increased. The largest increase — 3.2 percentage points — occurred in medium sized farms of between 2500 and 24 999 hectares (figure 3.2).

Notwithstanding the trend towards larger farm size, as illustrated in figure 3.2, small farms continue to dominate the count of farms in Australian agriculture — in 2002-03, 63 per cent of farms were less than 500 hectares. Farms of over 2500 hectares accounted for around 11 per cent of farms.

The median farm size in Australia, however, has remained in the 100–499 hectare range since 1982-83.

Box 3.2 **Facts about the size of Australian farms**

Australian farms range in size from small hobby and horticultural properties to large grazing and cropping farms.

In 2002-03:

- farms under 50 hectares accounted for around 20 per cent of farms (25 400). Most of these farms were engaged in grape growing, beef cattle grazing, fruit growing, vegetable growing and plant nursery operations;
- 33 per cent of farms were sized between 100 and 499 hectares. Farms in this category were mainly engaged in beef cattle farming, dairying, sheep grazing and grain growing;
- farms over 2500 hectares accounted for 11 per cent of all farms and were mainly engaged in grazing or cropping. A significant proportion of these extensive sheep, beef and mixed livestock operations are located in the arid pastoral zone of inland Australia;
- the median estimated value of operations (EVAO) of all Australian farms was $109 000;
- around 17 per cent of farms (21 600) had an EVAO below $22 500, while around 11 per cent (14 100) had an EVAO of more than $500 000;
- the smallest EVAO category (below $22 500) is largely made up of beef cattle and sheep farms. Other industries with a relatively high proportion of farms in this category include fruit and vegetables, grape growing, horse farming, nurseries and cut flowers; and
- farms engaged in cotton growing, poultry raising, egg production and pig farming had a high proportion of farms with an EVAO of more than $500 000.

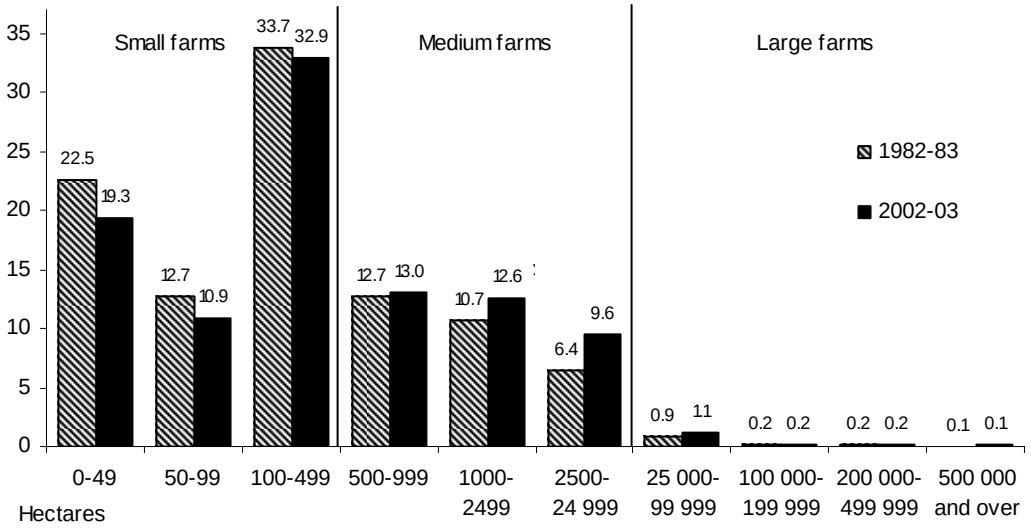
Source: ABS (Cat. no. 7121.0).

Much of the decline in small farms was experienced in the grain, mixed grain and livestock, mixed livestock, pig and cotton industries (accounting for over one-third of the decline). In each of these industries, the decline in small farms translated almost directly to an increase in the proportion of farms in the medium farm category.

The shift towards larger farms has been most evident in cotton, grains, and pig farming. The share of medium and large farms (those with greater than 500 hectares) in these industries increased by 32, 18 and 10 percentage points respectively over the 20 years to 2002-03. In line with the general trend across the sector, the increase in farm size in these industries was most apparent during the 1980s.

Figure 3.2 **Distribution of farms by physical size (hectares), 1982-83 and 2002-03**

Per cent



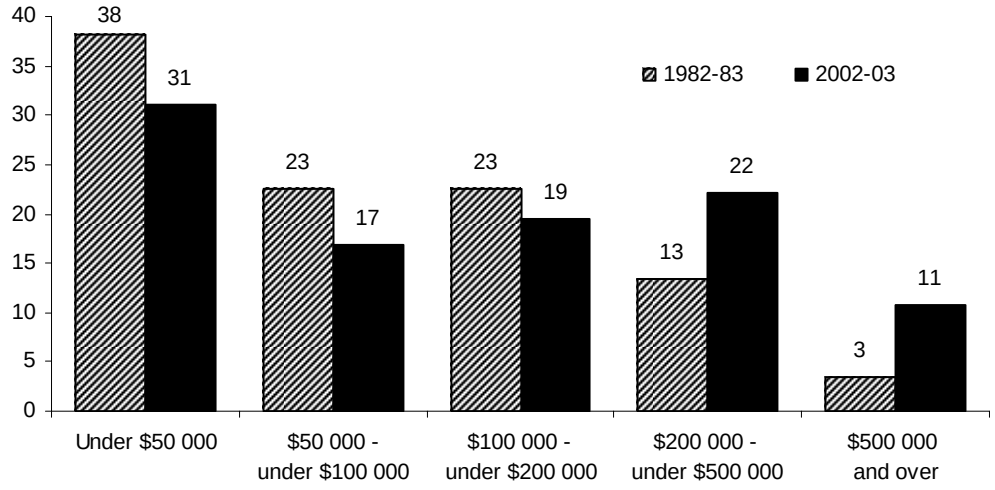
Data source: ABS (Cat no. 7121.0).

Economic measure — value of operations

The trend towards increasing farm size is also evident when an economic measure of farm size is used. An examination of changes in the distribution of farms by value of output over the twenty years to 2002-03 indicates that:

- the greatest decline in farm numbers occurred within the smallest sized farm grouping (farms with a value of operations of less than $50 000). The proportion of farms in this category declined from 38 to 31 per cent;
- farms with a value of operations between $50 000 and $100 000 also declined — by around 6 percentage points;
- the proportion of large farms, those with a value of production over $500 000, increased by around 8 percentage points (figure 3.3).

Figure 3.3 **Distribution of farms by value of output[a], 1982-83 and 2002-03**
Per cent (constant 2004 prices)



a Constant price estimates of the value of output (in 2004 dollars) were produced by deflating EVAO by the GDP implicit price deflator.

Data sources: Unpublished ABS data; Econdata.

Trends not unique to Australia

The trend toward fewer and larger farms is not unique to Australia but is common to most developed countries.

Even in countries where farmers are heavily subsidised, such as the United States and the European Union, farm numbers have declined at a similar rate to that experienced in Australia. The annual decline in farm numbers for OECD countries as a whole averaged around 1.5 per cent over the period 1970–90 (OECD 1998, p. 31).

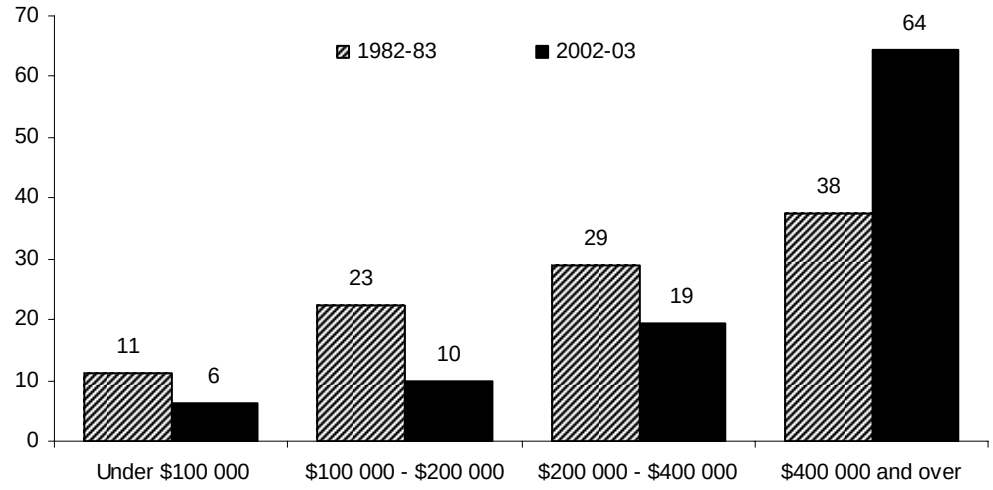
3.2 Increased concentration of output

One of the consequences of the increase in farm size is increased concentration of output on larger farms. It is estimated that 10 per cent of Australian farm businesses account for over 50 per cent of farm output, while the smallest 50 per cent of farms account for 10 per cent of gross farm output (Barr 2003, Corish 2004).

ABARE surveys of broadacre farms — which comprised around 70 per cent of all farms in 2002-03 — also show that while the proportion of farms in the largest economic size category (over $400 000 in value of farm production) increased by 10 percentage points over the last two decades to 20 per cent of farms, their share of the value of production increased from around 38 to 64 per cent — almost three times the increase in the share of farms in this category (figure 3.4). Over the same period, the contribution of farms in the smallest category (under $100 000 in value of farm production or around 40 per cent of farms) declined by almost half to around 6 per cent of the total value of broadacre farm production.

Figure 3.4 **Share of the value of broadacre farm production by value of output[ab], 1982-83 to 2002-03**

Per cent (constant 2002-03 prices)



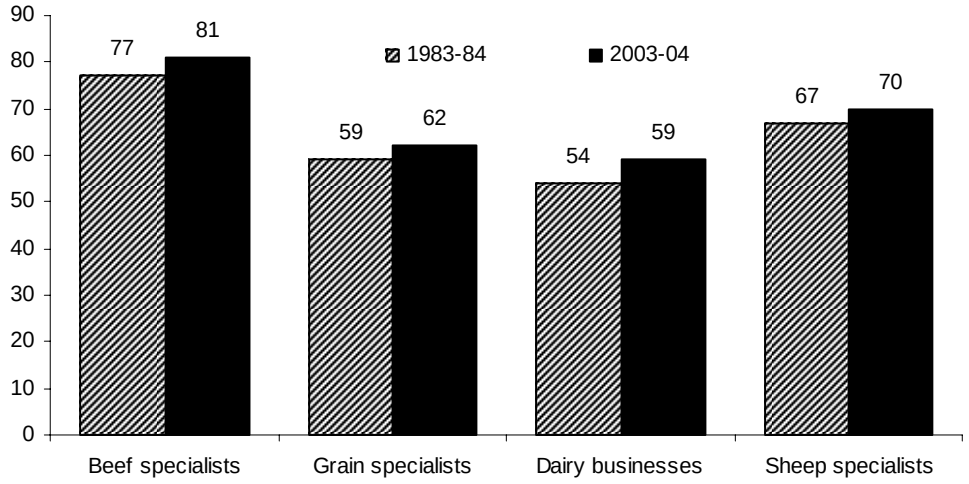
a Data include only broadacre farms grouped by farm size on the basis of value of farm production. Value of farm production as defined by ABARE includes total farm cash receipts plus the build up in trading stock. **B** Broadacre farms include sheep, beef, mixed sheep-beef, grains and mixed livestock and crop industries.

Data source: Unpublished ABARE data from Australia Agricultural and Grazing Industries Survey.

And, while there is evidence of increased concentration of output at the industry level, there is some variation in the level of concentration across different industries (figure 3.5). In the beef industry, for example, in 2003-04 the top 30 per cent of farms (in terms of value of output) produced more than 80 per cent of industry output, while in the dairy industry the top 30 per cent produced around 60 per cent of industry output.

Figure 3.5 **Share of industry output produced by the largest 30 per cent of producers, 1983-84 and 2003-04[ab]**

Per cent



a Ranked by value of output. **b** Sheep specialists includes both sheep meat and wool specialists.

Data source: Department of Agriculture, Fisheries and Forestry (2005).

Concentration has accentuated the dual nature of the sector

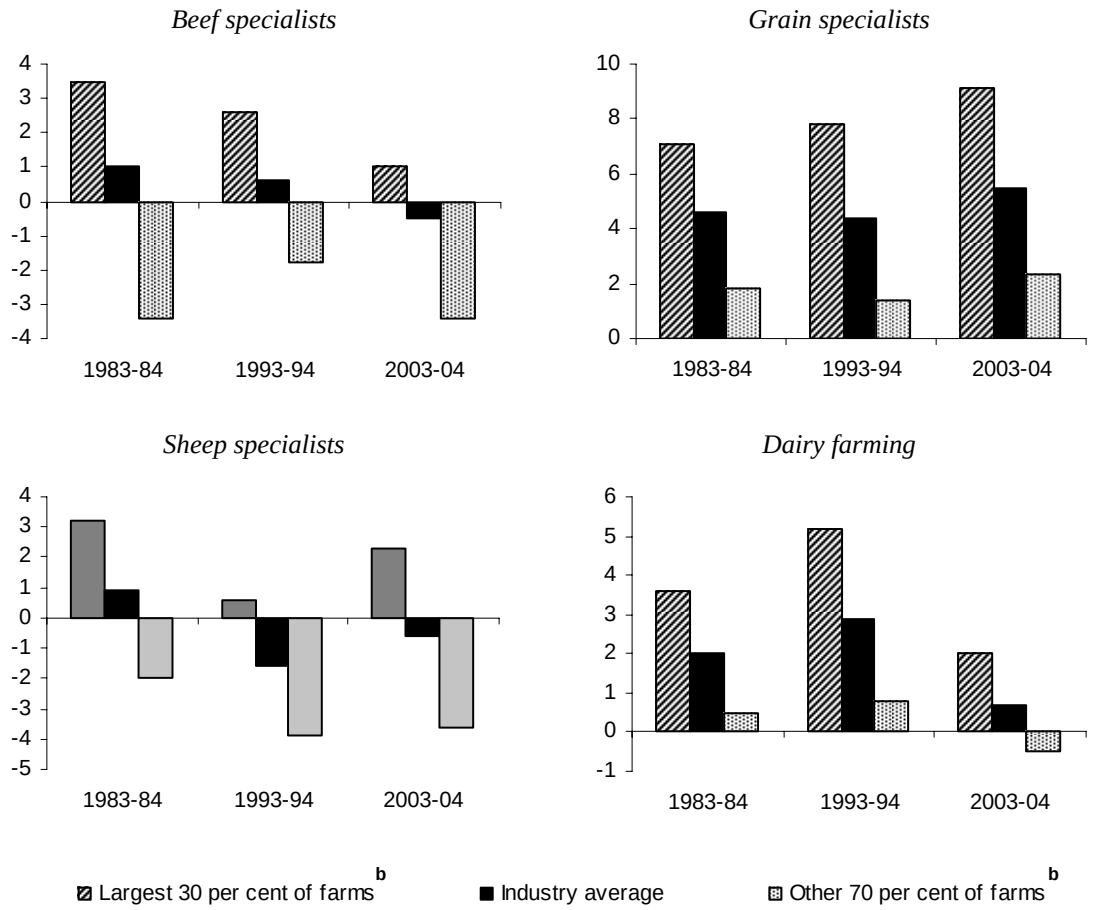
The trend towards increased concentration of output has accentuated the dualistic nature of Australia's agriculture sector — where a small number of large-scale commercial farms produce the majority of agricultural output while small-scale or niche farms (which make up the majority of farms) account for only a small proportion of output. Many of the smaller farms tend to be operated by 'lifestyle farmers', who farm part-time and supplement their income from off-farm sources. These farms are particularly prevalent on the fringes of major metropolitan and regional centres.

ABARE data indicate that smaller broadacre and dairy farms generate considerably lower rates of return than larger farms (figure 3.6). That said, because of the high proportion of small farms in many agricultural industries, average rates of return can appear low. Average returns generated by larger farms (those producing the majority of output), however, are comparable with investment returns elsewhere in the Australian economy. As Martin et al. (2005, p. 19) note:

> Returns on investment in agricultural industries are often low when reported across a whole industry. However, low average returns are partly a consequence of the generally high proportion of small farms in many industries, particularly the beef and sheep industries. The presence of these small farms masks the much higher returns from better performing and larger farms that generate the majority of each industry's output.

The average returns from these better performing and larger farm businesses are frequently comparable with investment returns elsewhere in the Australian economy.

Figure 3.6 **Farm size and rate of return[a], 1983-84, 1993-94 and 2003-04**
Per cent



a Excluding capital appreciation and adjusted to full equity by adding interest paid to farm business profit. **b** Ranked by value of output.

Data sources: ABARE Farm Surveys; Department of Agriculture, Fisheries and Forestry (2005).

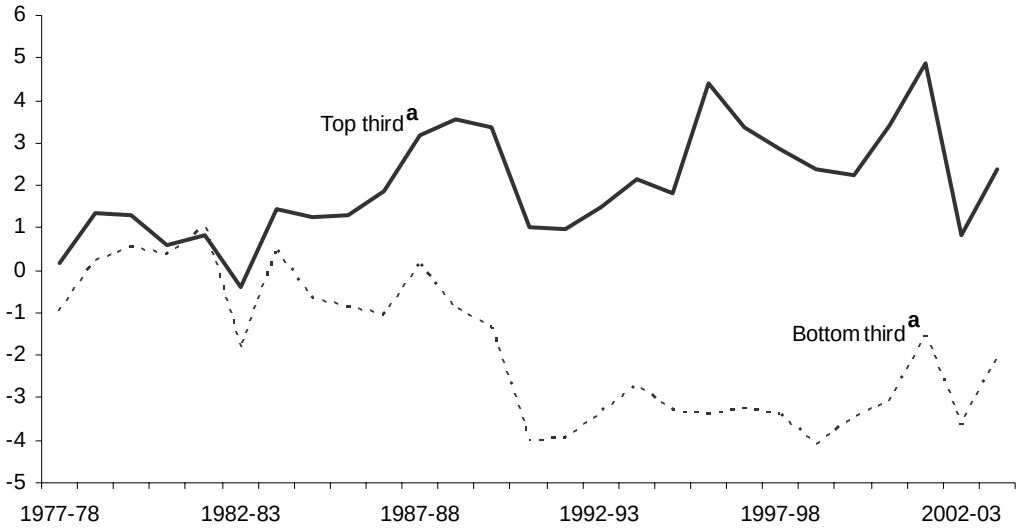
ABARE (Hooper et al. 2002) found that when farms were ranked by size (measured by physical farm area), the farm cash income (total cash receipts less total cash costs) of the largest third of farms was generally two to four times greater than that of the smallest farms over the 25 years to 2000-01. Also, when farm size was measured using sheep equivalents[2], the largest third of farms performed more strongly over the last 25 years than the smaller farms. Notably, there was also

2 The sheep equivalent measure is widely accepted as an indicator of the productive capacity of farms in different industries. It allows comparisons on an equivalent basis of the size of a farm by reflecting the differing feed requirements of various livestock and or the equivalent potential capacity of land used for cropping purposes.

evidence of an upward trend in rates of return for the top third of farms and a downward trend for the bottom third (figure 3.7). As Hooper et al. (2002 p. 496) put it:

> Regardless of the method used to rank farm size, the results for farm financial performance over the past ten years are consistent. And that is, there is both an income and rate of return advantage to being big.

Figure 3.7 **Rate of return for broadacre farms, 1977-78 to 2003-04**
Per cent



a Average rate of return for broadacre farms ranked by sheep equivalents.

Data sources: ABARE Farm Surveys; Hooper et al. (2002).

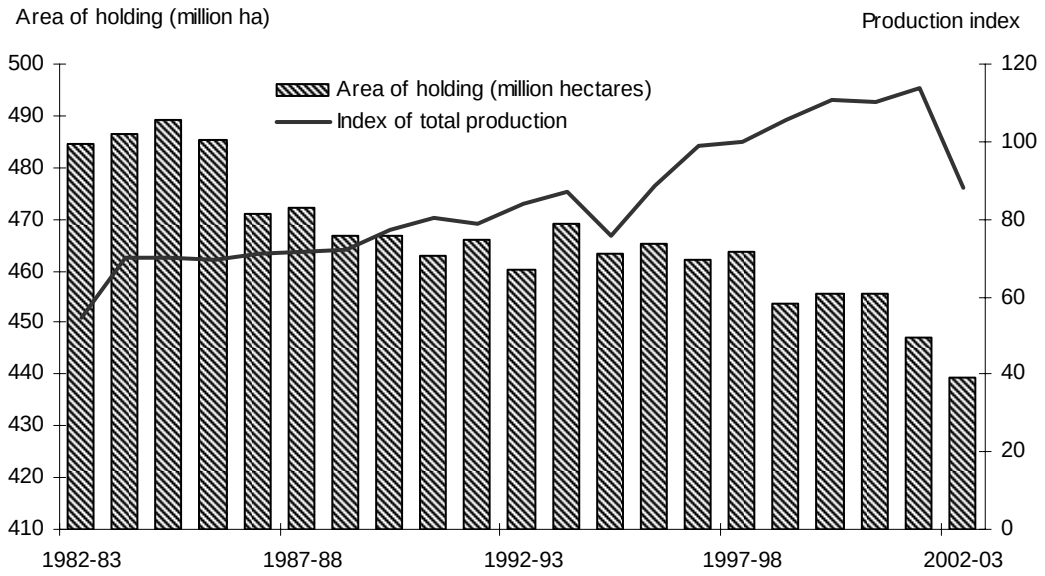
With such financial outcomes, the continued prevalence of small farms can in part be attributed to an increasing reliance by these farms on off-farm income sources to offset negative or low levels of farm-based income (see chapter 5).

For commercial farmers, declining agricultural terms of trade have encouraged the expansion of farming operations in order to capture economies of scale available to larger enterprises. Hooper et al. (2002) suggest that larger farms, particularly those in the cropping, and to a lesser extent, in the broadacre livestock industries have generally been able to capture more of the benefits from new technologies and have therefore achieved much higher growth in productivity over the past two decades (see chapter 6).

3.3 More intensive farming

Intensification of production has been an important adjustment strategy for farmers in many agricultural industries as a means of improving productivity on farms. The trend towards more intensive farming has resulted in higher output despite less land being used for agriculture (figure 3.8).

Figure 3.8 **Trends towards intensification of land use, 1982-83 to 2002-03**



Data sources: Unpublished ABS data; ABARE (2003).

Two factors have contributed to the intensification of agricultural production:

- a structural shift to industries using more intensive production systems — this is known as the 'between' industry effect; and
- more intensive production techniques being used by existing industries — this includes greater use of inputs such as feed, chemicals and irrigation systems to achieve higher production yields. This is known as the 'within' industry effect.

The 'between' industry effect can been seen in both the faster output growth rates and the below average decline in farm numbers occurring in many intensive industries, including, for example, poultry, grapes, cotton and nurseries, over the last 20 years (see figure 3.11).

In terms of the 'within' industry effect, greater intensification in Australian agriculture is taking the form of:

- increased cropping intensity (especially under irrigation);

- greater use of high protein feed concentrates along with irrigated pastures for milk production; and
- a trend toward grain finishing for beef (box 3.3).

Box 3.3 **Intensive production techniques — some examples**

The production of grain-fed beef has more than trebled in the period since 1991-92, with grain fed-beef comprising over 30 per cent of total beef production in 2003-04. The number of cattle being finished in feed lots has been consistently increasing over the decade in response to market demand, from around 200 000 cattle in 1991 to around 700 000 in 2003-04, an average annual increase of around 11 per cent.

In the dairy industry, the past two decades have seen production shift from being largely pasture based toward more intensive production systems. Dairy farmers have enhanced on-farm feed production through irrigation and pasture improvement programs, allowing higher stocking rates. Substantial intensification has also been accomplished through increases in the use of supplementary feeding to boost milk production or to fill seasonal feed shortages. In the decade to 2001-02, the quantity of grain and feed concentrates used in dairy production increased at an average annual rate of around 10 per cent.

Sources: ABARE (2004d); Dairy Australia (2004).

3.4 Closer integration in the agri-food chain

Over the last twenty years, Australian farms have also become more consumer focused. As Keogh (2005, p. 1) observed:

> … in many farm sectors being a farmer is no longer just a matter of growing plants and animals, and delivering them to the auction market that traditionally represents the next step of the market chain that leads to the consumer. Sector-by-sector, farming is progressively being integrated into food and fibre chains, driven by the desire of major food and fibre processors and retailers to reduce chain costs and uncertainty, but also by the desire of farmers to differentiate their produce and increase margins.

This trend has seen an increasing proportion of output supplied to processors or major retailers under comprehensive pre-arranged contracts. For example, over the period 1990-91 to 2003-04, the proportion of beef cattle sold through auction (sale yards) fell from around 65 to 45 per cent. At the same time, the proportion sold over the hook (prearranged specifications for weight, age, fat depth and date of delivery) increased from 22 to 40 percent (Barber and Cutbush 2005).

Contract farming in Australia appears to be most prominent in the fruit and vegetable, wine grapes, poultry and beef industries.

In the citrus industry, for example, many growers have contracts with processors for the supply of juicing oranges. Contracts typically cover terms of three to five years and generally cover a proportion of the grower's crop at an agreed price per tonne (PC 2002).

New technologies which enable producers to exploit economies of scale, have seen the poultry and pig industries become closely controlled, vertically integrated, production-marketing systems. In both these industries, farmers are generally under contract to provide livestock growing-out services to processors who supply all the main inputs — such as, juvenile livestock, feed, medication and technical advice — into the production process. It is estimated that around 85 per cent of poultry meat in Australia is now grown under contract (Tonts and Black 2002, pp. 3–4).

The gradual unwinding of statutory marketing arrangements (SMAs) in many agricultural industries has given farmers more control over how their output is marketed and sold (box 3.4). Previously, under SMAs, marketing controls such as vesting, compulsory acquisition, quotas, price setting, pooling or equalisation gave farmers little incentive or ability to be involved in marketing or processing beyond the farm gate. With the gradual shifting away from highly prescriptive regulation, farmers now have greater choice in the management of their agricultural output, from growing through to processing and packaging.

The closer integration of production and markets has meant that farmers are better able to respond to changing market conditions. For example, the National Competition Council (NCC, 2000, p. 2), commenting on changes to marketing arrangements for the barley industry, including the removal of compulsory marketing arrangements, said:

> Changes in barley marketing are primarily about giving growers a choice as to how, when and to whom, they sell their crops. Growers are increasingly able to take greater control over their businesses and to respond to opportunities as they arise. It also gives purchasers a choice of who they buy barley from and increasingly, choice as to which sort of barley best meets their needs.
>
> In addition, the changing structures of the former statutory marketing authorities are placing them in a stronger, more flexible position to operate effectively in the new business environment and take full advantage of local and international opportunities.

Also, in the dairy industry since the removal of state-based milk marketing regulations, some farmers have explored niche marketing opportunities for high quality and/or organic milk by setting up locally based processing ventures.

Box 3.4 **Changes to some agricultural marketing arrangements**

Historically, compulsory marketing arrangements have been a prominent feature of many of Australia's agriculture industries. Indeed, the bulk of measured assistance to the agriculture sector was once provided through a range of statutory marketing arrangements, regulations and price supports.

Over the last two decades, competition has been gradually introduced into a range of agriculture industries where compulsory statutory marketing arrangements (SMAs) had previously been responsible for all processes between the farm and consumer markets. For example:

- The Queensland Cotton Board was deregulated in 1989. Today all Australian raw cotton is marketed under a competitive system.
- The domestic market for wheat was deregulated in 1989. However, despite a review under National Competition Policy recommending greater liberalisation, single-desk wheat export marking arrangements have been retained.
- In the egg industry, state-based production and pricing controls were progressively withdrawn from the late 1980s, with the remaining state controls in Western Australia due to be withdrawn by the end of 2005. Several major egg marketing groups now compete to supply the domestic market.
- In the early 1990s, the Commonwealth price equalisation levy and statutory equalisation of domestic sales for dried vine fruits was removed, as was the industry's exemption from section 45 of the Trade Practices Act (which effectively reduced the scope for collusive price discrimination.)
- In 1991, the minimum reserve price scheme for wool was abandoned.
- In the tobacco industry, a restructuring program was introduced in 1995 and included the phasing out of local content schemes and import tariffs.
- Competition has gradually been introduced into domestic barley markets in South Australia and Victoria since 1997 with further deregulation of export controls in 2000. Growers can now choose between private traders or pooled marketing services.
- In mid-1997, import tariffs and domestic price supports in the sugar industry were removed. While single desk arrangements for the acquisition and marketing of bulk sugar have been retained from July 2004, exemptions were granted for sugar used in the manufacture of alternative products. Domestic pricing provisions remain in place with producers receiving an average of prices from pooled revenues.
- In the dairy industry, the decision to phase out Commonwealth price supports for manufacturing milk initiated further deregulation, which was accomplished with the removal of state-based milk marketing regulations in mid-2000.
- Despite several National Competition Policy reviews (most recently in late 2004), the NSW rice marketing board retains the legislated power to 'vest, process and market' all rice produced in NSW (around 99 per cent of Australian rice production).

Sources: IC (1998); NCC (2004, http://www.ncc.gov.au); Edwards 2003.

More demand-responsive production is also evident in terms of greater output diversification within the sector, with Australian farmers now producing a wider range of commodities than previously. On broadacre farms, for example, the number of significant enterprises (significant enterprises are defined as any activity contributing more than 10 per cent of farm business receipts) increased from an average of 2.3 per farm in 1990-91 to 2.7 per farm in 1998-99 (Martin et al. 2000).

There is also a trend toward increased diversity for a number of individual commodities, reflecting greater responsiveness to consumer demand for certain features or attributes of agricultural commodities. For example, twenty years ago there was one variety of lettuce grown (iceberg), now the range grown in Australia also includes — cos, coral green, butter, mixed leaves — to name just a few. A not quite so obvious example, is the refinement of grain crops to enhance certain desirable characteristics, such as the development of grains capable of producing omega-3 oils (see CSIRO 2005).

Greater consumer responsiveness is also evident through a range of new and emerging agricultural industries, and the growth of organic farming (box 3.5). Growth in organics has arisen in response to a number of factors including greater consumer health awareness, concerns over the quality and safety of food products and higher incomes.

Box 3.5 **New and emerging industries — some examples**

Wildflowers — Australian exports are estimated to have been around $35 million in 1999-2000. Japan, the United States, the Netherlands, Canada and Germany are Australia's major export markets.

Game meats — including buffalo, camel, crocodile, emu, ostrich, kangaroo — are being farmed and wild harvested for domestic and export markets.

Essential oils — there are around 150 commercial producers in Australia. Tasmania produces commercial quantities of lavender, parsley, peppermint, dill, boronia, blackcurrant bud and fennel. Tea-tree and eucalyptus are the main essential oils produced in New South Wales, while in Victoria it is peppermint. Australia accounts for around 1–2 per cent of world trade in essential oils, with exports valued at US $31.5 million in 1998.

Asian foods — growing domestic consumption arising from greater Asian influence on cuisine has provided recent opportunities for growth. In 2002, the value of Asian vegetable production in Australia was around $136 million, having increased from around $50 million in 1993-94.

(Continued on next page)

Box 3.5 **(continued)**

Native foods — commercially produced native foods include aniseed, myrtle, Davidson's plum, lemon aspen, lemon myrtle, mountain pepper, quandong, wild limes and wattleseed. In 2003-04, the gross value of production for native foods was around $5 million. While average returns across the industry are reputedly low, a recent increase in the take-up of native food products by major supermarkets, both locally and overseas, points to increasing consumer demand.

Organic farming — organics is a multi-output industry involving production without the use of artificial chemicals or genetically modified organisms. In 2003, there were an estimated 1500 certified organic farms in Australia using some 7.9 million hectares (around 1.7 per cent of Australia's agricultural area). A feature of the industry is the high rate of market growth achieved both in Australia and other developed countries over the last decade.

Sources: Department of Agriculture, Fisheries and Forestry (2005); RIRDC (2004); Hallam (2003); Wynen (2003).

3.5 Divergent trends within agriculture

While for the sector as a whole the trend since the mid-1980s has been towards fewer and larger farms, the decline in farm numbers has not uniformly affected all industries in the sector (figure 3.9).

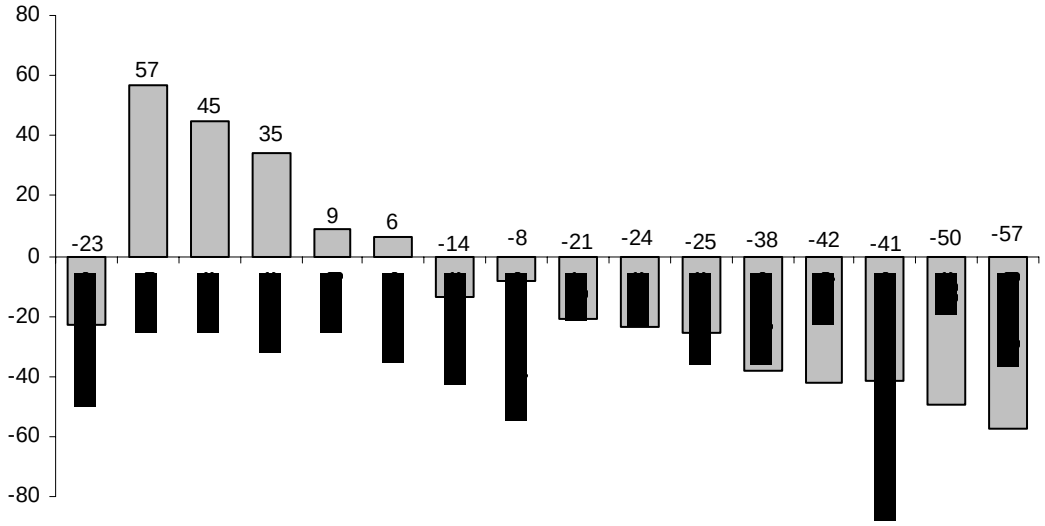
The largest decline in farm numbers was experienced in the pig farming industry — a fall of 57 per cent between 1985-86 and 2002-03. Other industries experiencing significant declines in farm numbers over this period include eggs, sheep (also grain-sheep/grain-beef) and dairy.

Industries going against the sector's trend of declining farm numbers over the period include cotton, grapes, nurseries, poultry and beef cattle.

There has also been considerable variation in rates of output growth across industries over the last two decades (figure 3.10). As expected, the industries recording large increases in farm numbers also recorded trend growth in output above the average for the sector.

Figure 3.9 **Changes in farm numbers, by industry, 1985-86 to 2002-03[a]**

Per cent, average three years ended

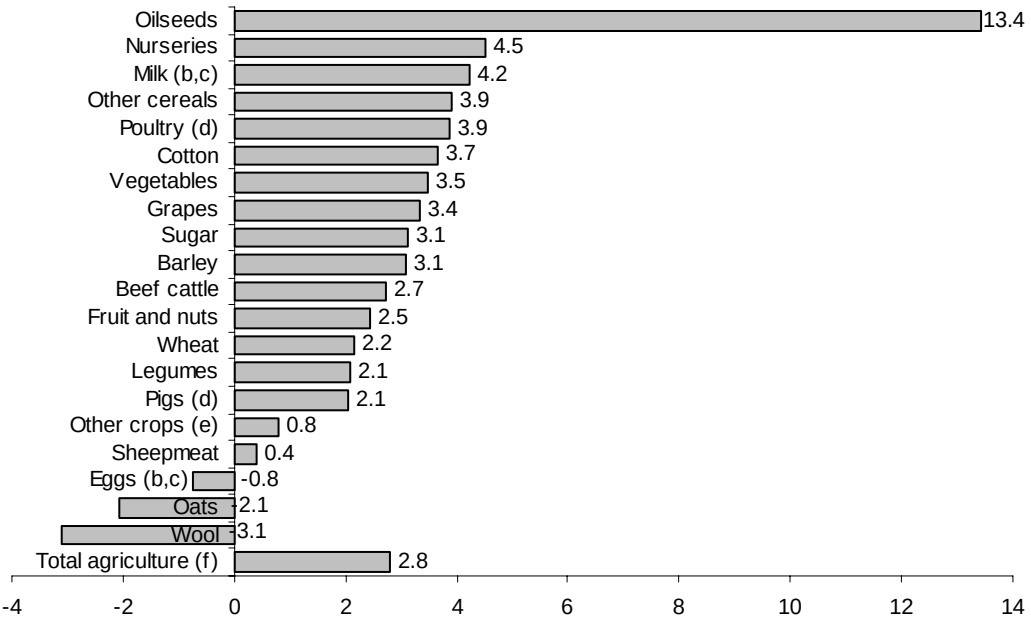


a Data for the change in farm numbers are calculated from the average over the three years ended 1985-86 and 2002-03 (to smooth yearly variations).

Data source: ABS (Cat. no 7121.0).

Figure 3.10 **Trend growth in agricultural output[a], 1985-86 to 2002-03**

Per cent



a Longest available chain volume time series. Each trend growth rate was estimated by regressing the logged values of the chain volume measure of the value of output against a time trend for all the years 1985-86 to 2002-03. **b** Excludes the Northern Territory prior to 1997-98. **c** Excludes the Northern Territory for 2002-03. **d** Excludes pigs and poultry in Tasmania and the Northern Territory prior to 1997-98. **e** Includes pastures and grasses. Excludes crops for green feed or silage. **f** Includes pigs and poultry slaughtering in Tasmania and the Northern Territory, and livestock products in the Northern Territory.

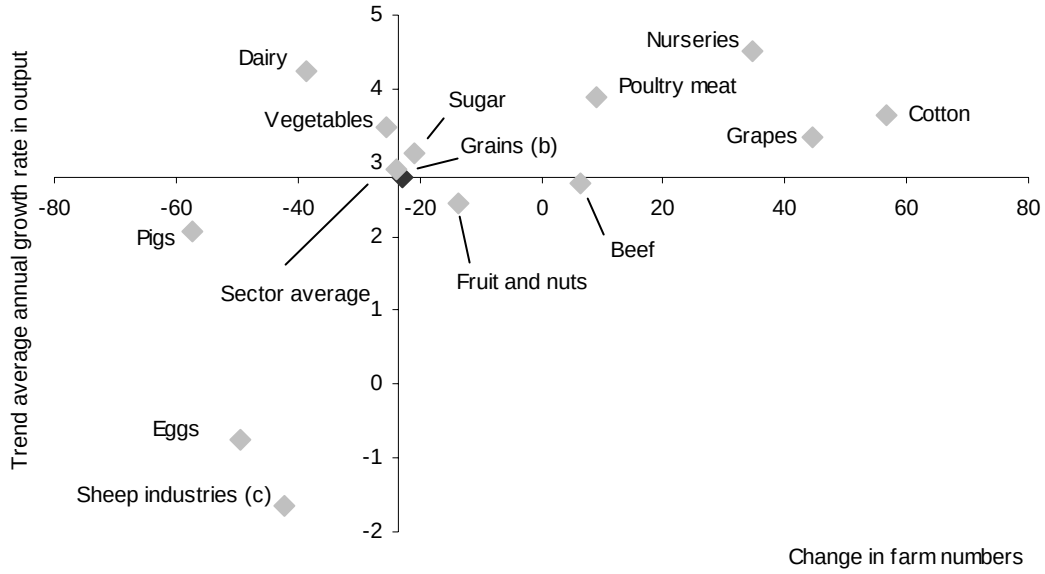
Data source: Unpublished ABS data.

A quadrant analysis, where industries are ranked according to changes in farm numbers and output growth since the mid-1980s, indicates that there are three broad industry groups — average performing industries, slow or declining growth industries and high growth industries (figure 3.11). Some of the factors influencing the trends experienced by these groupings of industries are discussed below.

Average performing industries

Average performing industries — those industries recording output growth rates and changes in farm numbers broadly in line with the sector average since the mid-1980s — include beef, grains, fruit and nuts, vegetables and sugar (figure 3.11). Despite average output growth, the beef, wheat, fruit and nuts and vegetable industries all ranked among the top 5 contributors to overall output growth over the period, reflecting their size and thereby their ability to establish the trends for the sector.

Figure 3.11 **Agricultural industries, growth in the value of output and changes in the farm numbers[a], 1985-86 to 2002-03**
Per cent



a Data for the change in farm numbers are calculated from the average over the three years ended 1985-86 and 2002-03 (to smooth yearly variations). **b** Trend growth for grains was estimated based on an average chain volume index reflecting the relevant commodities (barley, oats, wheat, other cereal grain, legumes and oilseeds) **c** Trend growth for sheep industries was estimated based on an average chain volume index reflecting the relevant commodities (sheep, lambs and wool).

Data sources: Unpublished ABS Data; ABS (Cat no. 7121.0).

While the grains industry ranked as an average performer over the period, within the industry there has been considerable variation in output performance between

crop types. Oilseeds, for example, recorded output growth almost 5 times higher than the sector average over the period (figure 3.10). This largely reflects the rapid growth in output of canola (Australia's main oilseed crop) since the early 1990s. Production of canola increased from around 87 000 tonnes in 1985-86 to 1.8 million tonnes in 2002-03, an average annual trend growth rate of around 27 per cent. On the other hand, wheat, legumes and oats recorded output growth slower than the sector average (figure 3.10).

Slow or declining growth industries

The sheep, pig and egg industries experienced both slower output growth rates and greater declines in farm numbers than the sector's average since the mid-1980s (figure 3.11). Despite similar trends in these industries, differing influences have been driving the changes.

In the sheep industry, the dismantling of statutory marketing arrangements for wool, weak demand for wool and low returns for wool production relative to other farm enterprises throughout the 1990s, saw many farmers move out of wool. Sheep numbers declined from a peak of 173 million in 1989-90 to around 97 million in 2002-03 (Hooper et al. 2003) and the number of sheep farms almost halved over the period 1985-86 to 2002-03.

Economies of scale and productivity gains available to large specialist pigmeat producers encouraged production consolidation towards larger farms and saw the industry transformed from a sideline industry associated with other agricultural production (such as grain and dairy farming) to an intensive grain-fed specialist farming industry (PC 2004a).

In the egg industry, the number of farms has halved since the mid-1980s. This was jointly influenced by a long-term decline in per capita egg consumption (box 3.6) and restructuring associated with the rationalisation of industry regulation. Economies of scale achievable on larger egg farms, together with selective breeding, have seen productivity improvements, such that remaining producers have achieved increases in egg production despite a fall in total bird numbers (PC 1998).

High growth industries

Industries that stand out as having experienced both an increase in farm numbers and output growth above the sector average over the period include poultry meat, grapes, cotton and nurseries. The dairy industry is an exception — achieving output growth above the average for the sector while structural changes within the industry have led to fewer and larger farms (see chapter 6, box 6.1).

Growth in the poultry meat industry has been largely fuelled by shifts in consumers' eating patterns away from red meat to white meat consumption (box 3.6). Chicken meat now rivals beef as Australian consumers' most popular meat (RIRDC 2003).

Exports have largely driven the growth in wine grape production — which has almost trebled since the mid-1980s. In terms of farm numbers, the industry has expanded by around 80 per cent since 1992-93 (see chapter 4, box 4.2).

Box 3.6 **Australians' changing diets**

Over the past two decades, food consumption patterns in Australia have undergone some notable changes. While changes in relative prices and income levels have contributed to these changes, other factors have also been relevant including:

- population ageing and changing household size;
- the influence of convenience considerations;
- concerns regarding health and food safety; and
- ethical considerations regarding the treatment of animals and the environment.

Expenditure shares between the main commodity staples (meat, cereal, fruit and vegetables) have tended to converge in recent years, indicating a broad trend toward achieving a 'balanced diet'. That said, some commodities have experienced sizeable consumption falls, while others have experienced booming demand.

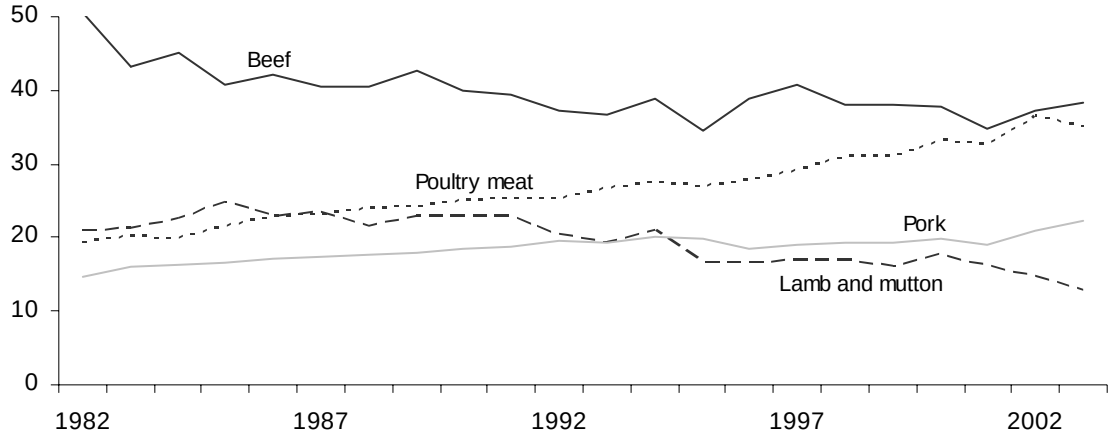
- While overall meat consumption has remained relatively static, since the late 1970's seafood and poultry have both increased their share — seafood consumption doubled to around 10 per cent of meat consumption, while the share of poultry meat increased to almost 30 per cent of meat consumption (figure 3.12).
- Fruit and vegetable consumption increased by almost 40 per cent between 1978-79 and 1998-99, from around 213 to 297 kg per capita.
- Per capita egg consumption declined from 220 in 1978-79 to around 137 in 1998-99, a fall of around 34 per cent.
- Rice consumption more than doubled over the period 1978-79 to 1998-99, from 2.4 to 7.1 kg per capita.

(continued on next page)

Box 3.6 **(continued)**

Figure 3.12 **Meat consumption trends[a], per capita**

Kilograms



a Beef, lamb and mutton and pig meat production are expressed in carcass weight.

Data sources: ABARE (2004b).

In addition, two significant changes in overall diet have emerged.

- Consumption has tended to shift toward more processed and pre-prepared foods, with substantial increases in expenditure on frozen meals (47 per cent) and other prepared meals (68 per cent) between 1993–94 and 1998–99.
- The share of meals consumed away from home has increased to account for 27 per cent of all food expenditure in 1998–99, an increase of around 9 percentage points in the share of total food expenditure since 1984.

Sources: ABS (Cat. nos. 4306.0; 6535.0); Lester (1994); ABARE (2004b).

The cotton industry has recorded an average increase in production of around 3.7 per cent each year since 1985-86. The expansion followed the completion of dams and irrigation infrastructure in a relatively concentrated area around the major river basins of northern New South Wales and southern Queensland. There has been a strong trend towards larger farms in the industry — the proportion of medium and large farms (those with greater than 500 hectares) increased by just over 32 per cent over the last two decades, while the proportion of farms with a value of operations of $500 000 or greater increased by around 15 percentage points.

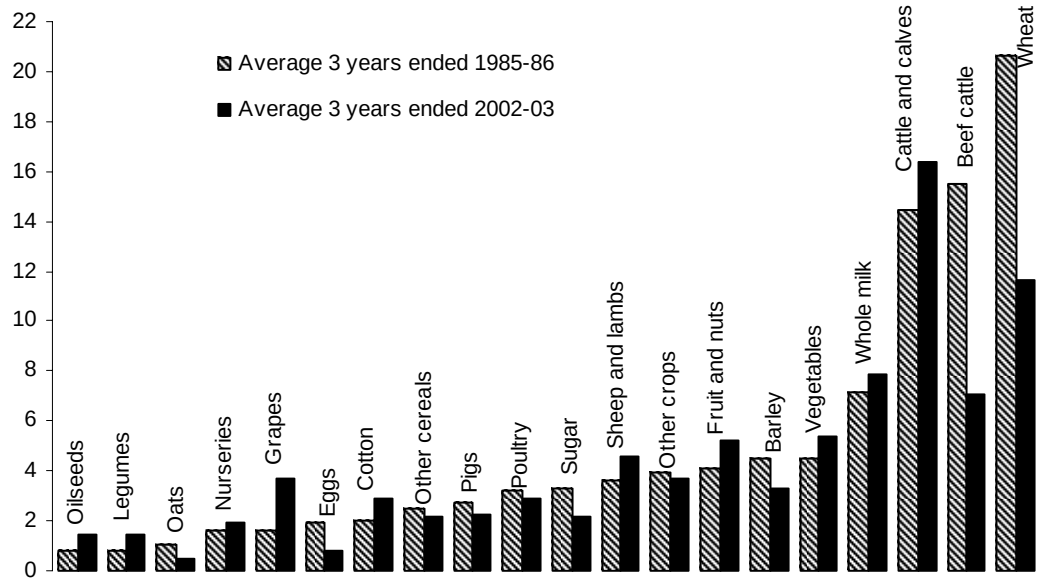
The nursery industry recorded the second highest growth in output over the period — an average annual trend growth rate of 4.5 per cent. This high growth rate, however, was from a small base and, as such, nurseries made only a small contribution to output growth for the sector as a whole.

The changing composition of agriculture

Reflecting the variations in output growth rates and farm number changes across industries, the composition of the agriculture sector has changed since the mid-1980s (figure 3.13). While wheat, beef and wool have dominated Australian agriculture both in terms of output and farm numbers over the period, the combined share of these activities has declined — in terms of output, the share accounted for by the 'big three' declined from around 50 per cent of the gross value of production to around 35 per cent.

Figure 3.13 **Composition of agriculture output, gross value of production 1985-86 and 2002-03[a]**

Per cent, average three years ended



a Data for the composition of output are calculated from the average over the three years ended 1985-86 and 2002-03 (to smooth yearly variations).

Data source: Unpublished ABS data.

As may be expected, 'high growth industries' such as grapes, cotton, nurseries and dairy, increased in relative importance in terms of output over the two decades while the 'slow growth industries' such as wool, pigs and eggs lost output share.

Because Australian agriculture is strongly export oriented, changes in the composition of output are also reflected in the composition of agricultural trade. The next chapter explores key changes in the nature, composition and direction of Australia's agricultural trade.

4 Trade in agriculture

Key points

- Agricultural exports amounted to $28.2 billion in 2003-04 — equivalent to 22 per cent of total goods and services exports. Agricultural products make up 7 of Australia's top 20 exports. Beef, wheat, wine and wool are the largest, with combined earnings of almost $12 billion in 2003-04.
- In 2002, Australia was the 6th largest exporter of agricultural products, accounting for around 3 per cent of global agricultural exports. By comparison, Australia was the 16th largest exporting nation overall, accounting for only 1 per cent of world merchandise exports.
- Australia is an important global player in a number of agricultural commodities. In 2002, Australia accounted for 65 per cent of global wool exports (greasy and scoured); 15 per cent of wheat exports; 15 per cent of bovine meat exports and 9 per cent of wine exports.
- Agricultural exports have experienced steady growth in recent decades. While the sector's reliance on export markets has been increasing, the economy's reliance on these exports has been declining rapidly — down from over two-thirds of total exports in the early 1960s to just over one-fifth in 2003-04. This reflects slower growth in agricultural export volumes and to a lesser extent, declining relative prices for agricultural exports.
- Nevertheless, Australia continues to exhibit a much more rural-based export profile than is the norm for high-income industrialised countries. In 2003, agriculture accounted for less than 10 per cent of OECD exports.
- Australia's agricultural exports have become more diverse in recent decades with less reliance on traditional commodities, such as wool, and more reliance on processed products including wine, cheese, processed foods and seafood. At the same time, the shift in emphasis away from European to Asian markets has continued over the past decade and a half.
- Developing countries are playing an increasingly important role in global agricultural markets, providing both challenges and opportunities for Australian farmers.
- Australia provides the second lowest level of government support to agriculture, after New Zealand, among OECD countries. Despite some reductions in global barriers to trade over the past decade, agriculture remains highly protected in many OECD countries. Although studies have identified substantial potential gains from further liberalisation of agricultural trade, the full benefits are unlikely to be realised for some time. Given the increasing reliance by Australian farmers on overseas markets, productivity improvements remain crucial in maintaining the viability of the sector.

Australian agriculture has a long history of successfully competing on global markets. Recent decades, however, have seen changes in the nature of global agricultural trade, the conditions under which it takes place, as well as the make-up of Australia's agricultural exports.

This chapter explores some of the key changes in the nature, composition and direction of Australia's agricultural trade.

- Section 4.1 looks at how the increasing integration between agriculture and manufacturing has affected agricultural exports and the way they are measured.
- The changing trade orientation of agriculture and its contributions to total Australian and global trade are examined in section 4.2.
- Trends within agricultural exports are examined in section 4.3. Importing trends are briefly canvassed along with changes in the extent of intra-industry trade in agriculture.
- Changes in Australia's export markets for different agricultural commodities since 1990-91 are examined in section 4.4.
- Trends in assistance to Australian agriculture and barriers to international trade in agricultural products are briefly discussed in section 4.5.

Seasonal variations in agricultural production both domestically and globally means that commodity export volumes and prices and the relative importance of different markets are inherently volatile. Because of this, it is difficult to separate longer-term structural shifts from other short and medium term shocks. While it is not possible to completely remove the impact of cyclical factors, where possible, longer-time frames are used as reference points to draw out the more lasting changes and compositional shifts in agricultural exports.

4.1 Measuring agricultural exports

Before examining trends in agricultural trade, it is important to clarify exactly what is meant by the term 'agricultural exports'.

Until recently, measuring the importance of agricultural exports was relatively straightforward as most agricultural production was exported as raw or unprocessed product. Thus, it was possible to compare production quantities or values with export quantities or values for individual commodities.[1] However, an increasing proportion of agricultural output is now being exported in a semi-processed or

[1] After taking into account differences in the valuation basis for production ('farm gate') and exports ('free on board').

manufactured form. This leads to difficulties in determining which industry should be credited with the exports (ABS 2002bc, West 2002, McGovern 1999).

There are two broad classification systems commonly used for defining agricultural exports:

1. *Industry-based classifications* — including the Australian and New Zealand Standard Industrial Classification (ANZSIC); and
2. *Commodity-based classifications* — including the United Nations Standard International Trade Classification (SITC), the Trade Exports Classification (TREC) used by the Department of Foreign Affairs and Trade (DFAT); and the Balance of Payments (BOP) classification used by the Australian Bureau of Statistics.

The ANZSIC provides a framework for classifying businesses to industries according to the predominant activities undertaken by them (it is employed extensively in this report for the discussion of value-added, employment and productivity trends in agriculture). Under ANZSIC, the exporting industry is typically the industry that performs the final activity required to complete the processing or production of the product in question. As such, exports of processed agricultural commodities are classified as manufacturing exports. For example, exports of products like wine, frozen meat, canned food, UHT milk and cheese and woollen products are attributed to the manufacturing sector despite the majority of their value being attributable to the agricultural sector (as discussed in chapter 2).

On the basis of this 'industry-based' framework, the agriculture sector accounted for 8 per cent of total Australian exports in the three years to 2003-04, while the manufacturing sector accounted for almost half of Australia's exports (figure 4.1).

Analysis of input-output data, however, confirm that industry classifications significantly understate agriculture's contribution to total exports. For example, when a narrow definition of beef cattle exports is employed, the sector's export propensity is estimated at 8 per cent. However, 'indirect' beef cattle exports in the form of meat products from abattoirs (part of the manufacturing sector) are more than six times higher than 'direct' exports. When these are included, the estimated export propensity of the industry rises to 58 per cent of production (ABS 2002c).

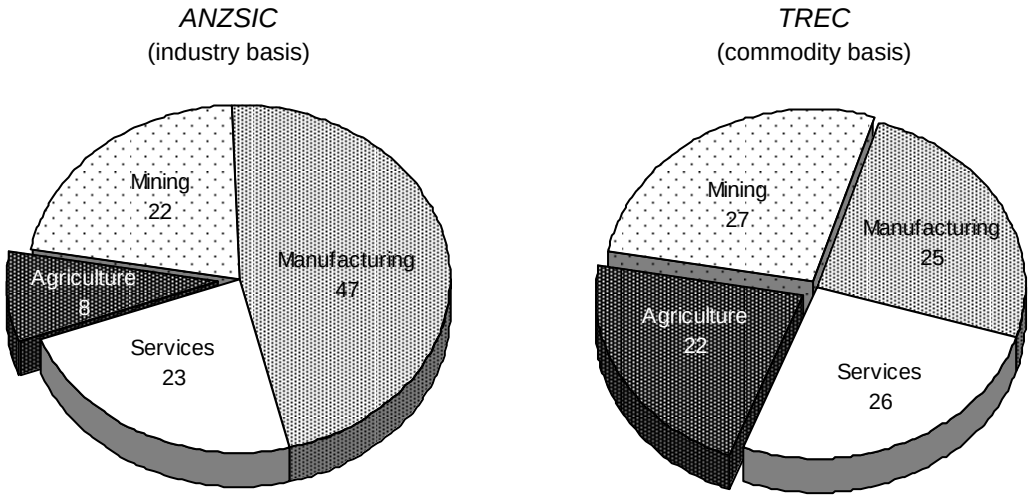
To overcome this problem, commodity-based estimates of trade in agriculture have been constructed. These generally include exports of agricultural goods that have not undergone significant value-adding by manufacturing firms. The United Nations SITC is the most widely used commodity-based classification and forms the basis for the other systems. It aggregates highly detailed customs trade data into comparable groupings to show the nature of the commodities and the materials used

in their production. Under the SITC system, agricultural, or 'rural' exports include most semi-processed agricultural commodities such as sugar, dairy products, frozen and packaged meat and wine.

DFAT uses the TREC system, which regroups SITC data, to allocate trade to various commodity groups based on the degree of value-adding by industries. Using the TREC system, agriculture is estimated to account for around 22 per cent of total exports of goods and services in the three years to 2003-04. This was almost three times its industry-based contribution (figure 4.1).

Figure 4.1 **Two views of the importance of agriculture to Australian exports[a], 2001-02 to 2003-04**

Per cent



a Due to confidentiality, some exports are not attributed to any industries in either the TREC or ANZSIC classifications. These exports were omitted from the totals to allow sector shares to sum to 100.

Data sources: ABS (Cat no. 5368.0), DFAT (STARS Database 2005).

By including agricultural exports with at least some degree of value-adding by the manufacturing sector, the TREC and SITC classifications generally provide a better indication of the role the Australian agriculture sector plays in international trade than does the ANZSIC system. And, although there are differences in the way commodities are grouped, the coverage of agricultural exports by SITC and TREC are almost identical.[2] Hence, despite not being directly comparable to the ANZSIC data on agricultural employment and production presented in other chapters, the TREC and SITC classifications are employed in this chapter according to data

[2] For information on the TREC and SITC treatment of agricultural exports see DFAT (2004c).

availability. In instances where chain-volume data are required and for purposes of international comparability, ABS Balance of Payments data are employed.[3]

It should be noted that independent of which 'commodity' classification is used, the magnitudes and growth rates of agricultural exports are close (see appendix B, figure B.1). Hence, the use of these different measures interchangeably throughout the chapter is unlikely to be misleading.

However, as the ABS (2002c, p. 101) cautions, the variety of methodologies used to estimate exports (and the assumptions required), means that any estimates of the proportion of agriculture output which is exported, or the relative sector contributions to total exports, will only be an approximation.

4.2 Trade orientation and openness

Australia is a major exporter of agricultural products. For much of the last century, agriculture provided the majority of Australia's export revenue. In the first half of the twentieth century, agriculture accounted for between 70 and 80 per cent of total goods and services exports (Butlin 1962). And, as recently as 1963-64, agricultural exports accounted for more than two-thirds of the value of total exports (table 4.1).

Over the past four decades, this share has fallen sharply. It more than halved in the two decades between 1963-64 and 1983-84. Since then it has continued to decline in relative importance, although at a much slower rate.

Agricultural export values (and volumes) are driven largely by trends in agriculture output, with droughts having sharp negative effects (box 4.1). Overall, despite a pick-up in 2003-04, agricultural export volumes[4] have not recovered to the pre-drought peak of $34 billion (constant 2002-03 prices) in 2000-01.

The recovery in agricultural exports in 2003-04, however, was short-lived, with a substantial fall in agricultural output (and exports) in 2004-05 due to ongoing drought conditions in much of eastern Australia. Moreover, forecasts by ABARE indicate a fall in crop production of around 17 per cent in 2005-06 with projected strong growth in Western Australian wheat production counteracted by expected substantial falls in the eastern States and South Australia (ABARE 2005b).

---

3 This measure of agricultural exports includes the BOP category 'rural exports' as well as two 'non-rural' commodities: beverages (predominantly wine) and sugar.

4 Use of the term 'export volumes' throughout the chapter refers to ABS chain volume index (CVI) data unless otherwise stated.

Table 4.1 **Composition of Australian exports by sector[a], 1963-64 to 2003-04**

Per cent

	Average for three years ended				
Sector	*1963-64*	*1973-74*	*1983-84*	*1993-94*	*2003-04*
Agriculture	68.0	46.7	33.0	23.3	21.6
Mining	1.9	19.4	32.5	31.5	30.2
Manufacturing	13.6	19.3	17.0	23.2	24.9
Services	16.5	14.7	17.5	22.0	23.3
Total exports of goods and services	100.0	100.0	100.0	100.0	100.0

a Averages for three years ended 1973-74, 1983-84, 1993-94 and 2003-04 are based on SITC merchandise exports plus services exports (credits). Agricultural exports include beverages (predominantly wine) and sugar. Averages for the three years to 1963-64 are estimates based on a sectoral reallocation of 21 ABS statistical classes published prior to the introduction of SITC (for which data were first introduced for 1969-70). Although not identical, these data are sufficiently close to provide a reasonably accurate picture of the change in agriculture's share of total exports.

Sources: ABS (Cat. no. 5302.0), ABS (Yearbook 1965).

Most of the long-run decline in agriculture's export share has been due to sustained higher growth in other industries. Although agricultural exports have grown in real terms at a trend annual rate of 3.5 per cent since 1974-75, total goods and services exports have grown at almost twice this rate (6.3 per cent a year).[5] And, while price effects also contributed to the decline in share, almost three-quarters of the decline in the agricultural sector's share over the period was due to slower growth in volume terms.

Stronger growth in manufacturing and mining exports have helped transform Australian merchandise exports from a largely agricultural base into a mix of mining, manufacturing and agriculture (table 4.1). This, coupled with strong growth in service exports has resulted in Australia's export profile being split into four roughly equal sized sectoral shares on the broader commodity basis (figure 4.1 above). As a result, changes in a few key commodity prices no longer have the same impact on the Australian economy that they did in previous decades.[6]

5 Longest available constant price SITC time series.

6 For example, in the late-1950s a single commodity, wool, accounted for almost half of Australian export revenue. Wool accounted for 46.1 per cent of total Australian merchandise exports in the three years to 1957-58. However, it fell sharply over the next decade to 26.9 per cent in the three years to 1967-68 (Harris 1990).

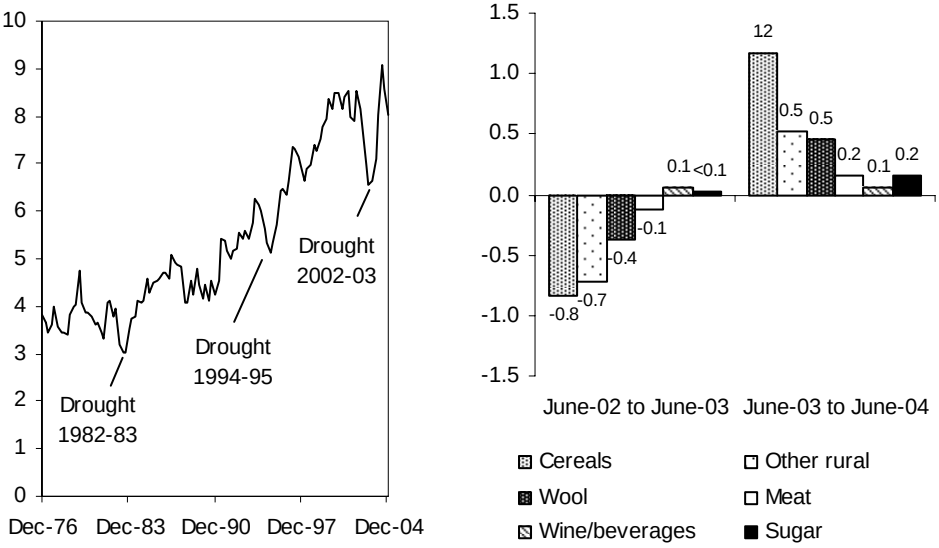
Box 4.1 **Impact of the 2002-03 drought on agricultural exports**

Droughts have traditionally had a substantial impact on Australia's agricultural exports. Quarterly seasonally adjusted data indicate peak to trough falls of 27 and 18 per cent in agricultural export volumes (BOP basis) in the droughts of the early 1980s and mid-1990s (figure 4.2). The 2002-03 drought also had a substantial impact on agricultural exports. Between the June quarter 2002 and the June quarter 2003, export volumes fell by 23 per cent (or $2 billion). The largest contributor to this fall was cereal grains and cereal preparations, with a fall in export volumes of 49 per cent or $844 million over the period. The other contributors were other rural exports, which declined 22 per cent or $725 million, wool and sheepskins (down 35 per cent or $365 million) and meat products (down 8 per cent or $118 million). These declines were only partially offset by slight increases in exports of wine and beverages ($65 million) and sugar ($23 million).

As with earlier droughts, recovery was rapid with increases in export volumes of almost 40 per cent ($2.5 billion) between the trough in the June quarter of 2003 and the June quarter 2004. A more than doubling in cereals exports accounted for almost half ($1.2 billion) of this increase, followed by other rural (up 20 per cent or $522 million), wool (up 67 per cent or $463 million) meat (up 12 per cent or $156 million), sugar (up 45 per cent or $154 million) and wine and beverages (up 8 per cent or $52 million). Consistent with production trends discussed in chapter 2, latest export data indicate that agricultural exports have been declining over the course of 2004-05 — with a 10 per cent fall between the peak in the June quarter 2004 and the December quarter 2004.

Figure 4.2 **Impact of the 2002-03 drought on agricultural exports**

$ billion, constant 2002-03 prices (quarterly, seasonally adjusted)



Source: ABS (Cat. no. 5302.0).

Although agriculture's share of Australian merchandise exports has more than halved over the past four decades, the sector has become even more export oriented. As ABARE (Andrews et al. 2003, p. 250) note:

> Agricultural production has been generally increasing in Australia, primarily as a result of productivity gains. … In contrast, domestic consumption of many agricultural commodities in Australia has either not kept pace with output increases (for example, sugar and wheat) or has shown little if any growth (for example, beef and butter). As a consequence, Australia's agricultural industries have generally become heavily export dependent.

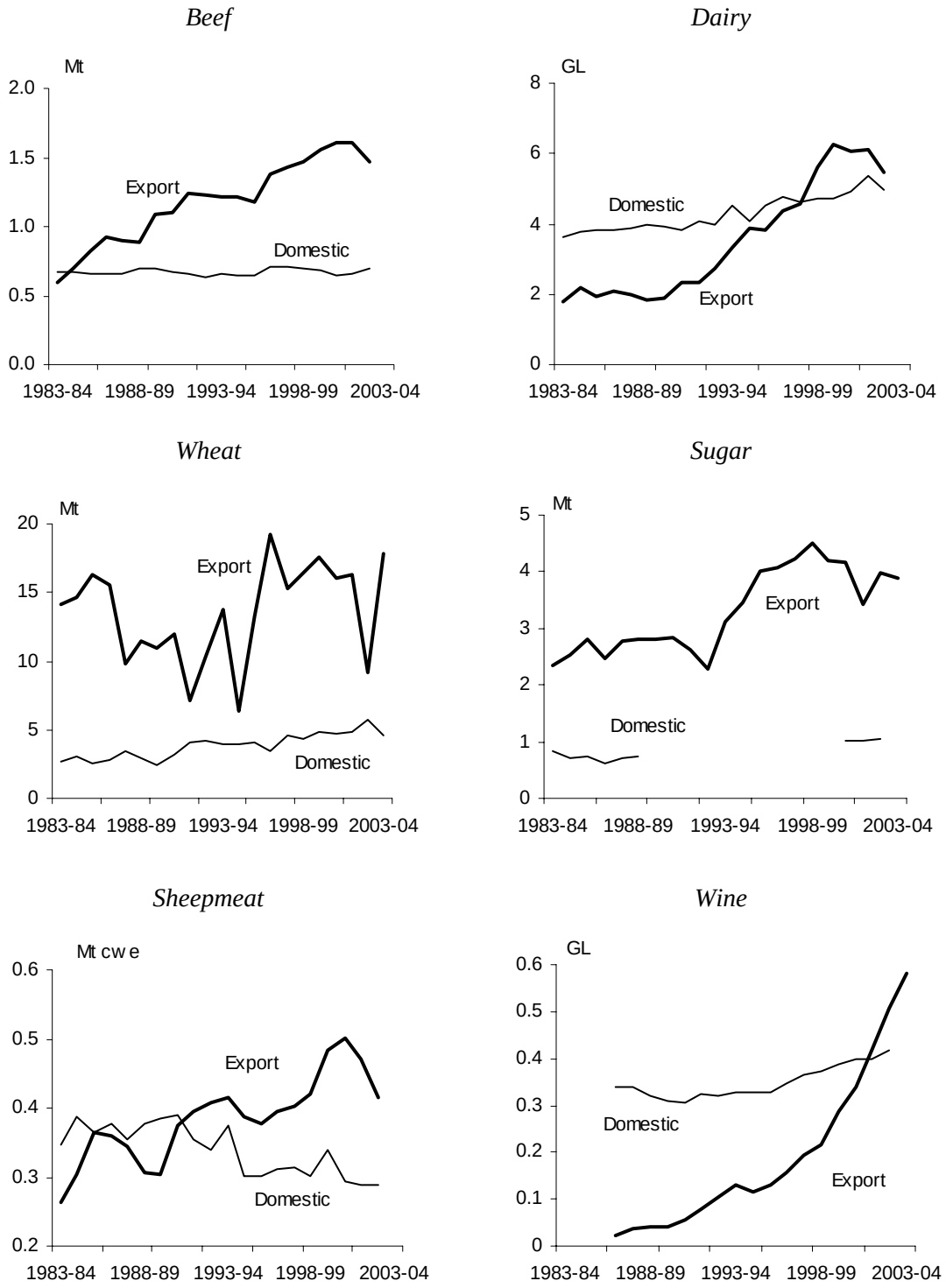
For example, the wool industry currently exports around 95 per cent of its production. The beef, sugar and wheat industries export around 65–75 per cent of production and the sheep meat, wine and dairy industries around 50–60 per cent. With the exception of the wool industry — which has always been highly export oriented — these shares have all risen steadily in recent decades (figure 4.3). Overall, almost two-thirds of agricultural production is now either directly or indirectly exported (DAFF 2005).

Australia, in 2002, was the sixth largest exporter of agricultural products, after the European Union, the United States, Canada, Brazil and China. In the same year, it accounted for 2.9 per cent of world agricultural exports (current prices, $US). Looking at all merchandise exports (excluding service exports), Australia was the 16th largest exporter in the same year, with around 1 per cent of world merchandise exports.[7]

In 2002, Australia accounted for 65 per cent of global wool exports, 25 per cent of mutton and lamb exports, 15 per cent of wheat exports, 9 per cent of wine exports and 3 per cent of sugar exports. Australia is also the world's largest beef exporter, contributing 15 per cent of global beef exports, despite producing only 4 per cent of the world's beef supply (FAOSTAT 2004, DFAT 2003).

[7] Rankings exclude intra-EU trade (WTO 2003).

Figure 4.3 **Australian domestic and export markets for selected commodities, 1983-84 to 2003-04**

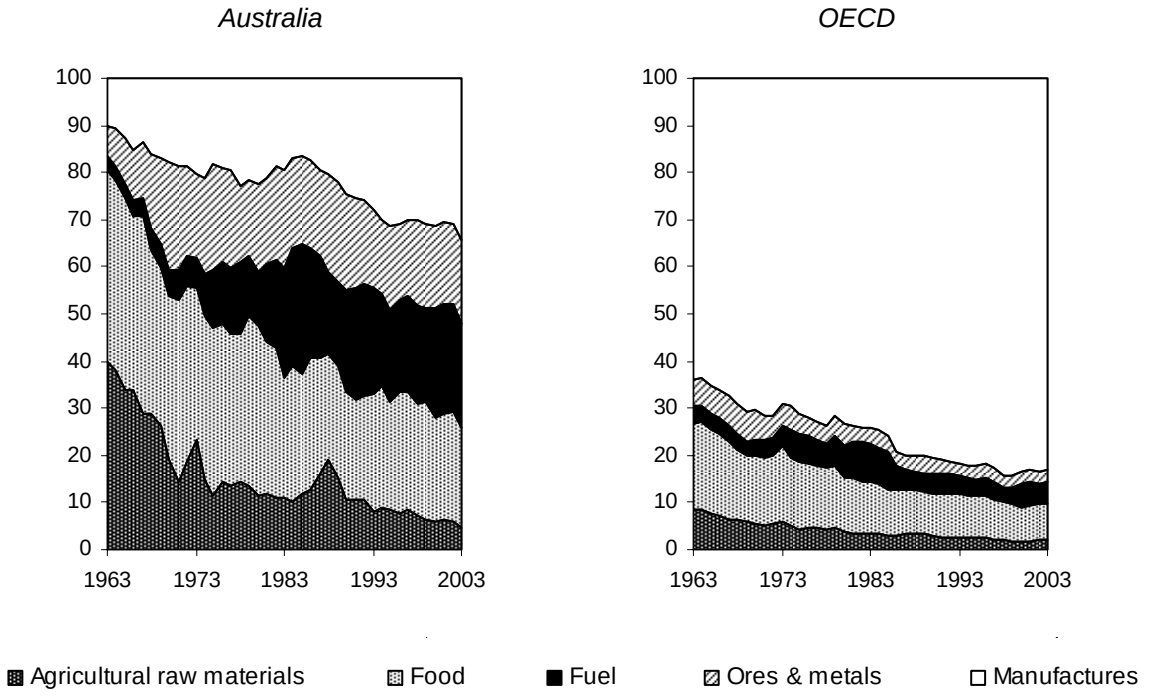


Data sources: Australian Commodities, (vol. 11, no. 1, March quarter 2004, figure E, p. 152) and unpublished ABARE data.

Comparison with other countries

Despite the substantial compositional changes to Australia's trade profile in recent decades, it continues to exhibit a much more resource-based export profile than is the norm for high-income industrialised countries. The 30 per cent share of Australia's merchandise[8] exports contributed by agriculture contrasts with an OECD merchandise export share of less than 10 per cent in 2003 (figure 4.4).

Figure 4.4 **Sectoral shares[a] of total Australian and OECD merchandise exports, 1963 to 2003**
Per cent



a Data are based on World Bank aggregations of SITC commodities. Sectoral shares are broadly commensurate with Australian data presented earlier. OECD countries included in these estimates comprise: Australia, Austria, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Korea, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

Data source: World Bank World Tables from Econdata (2005).

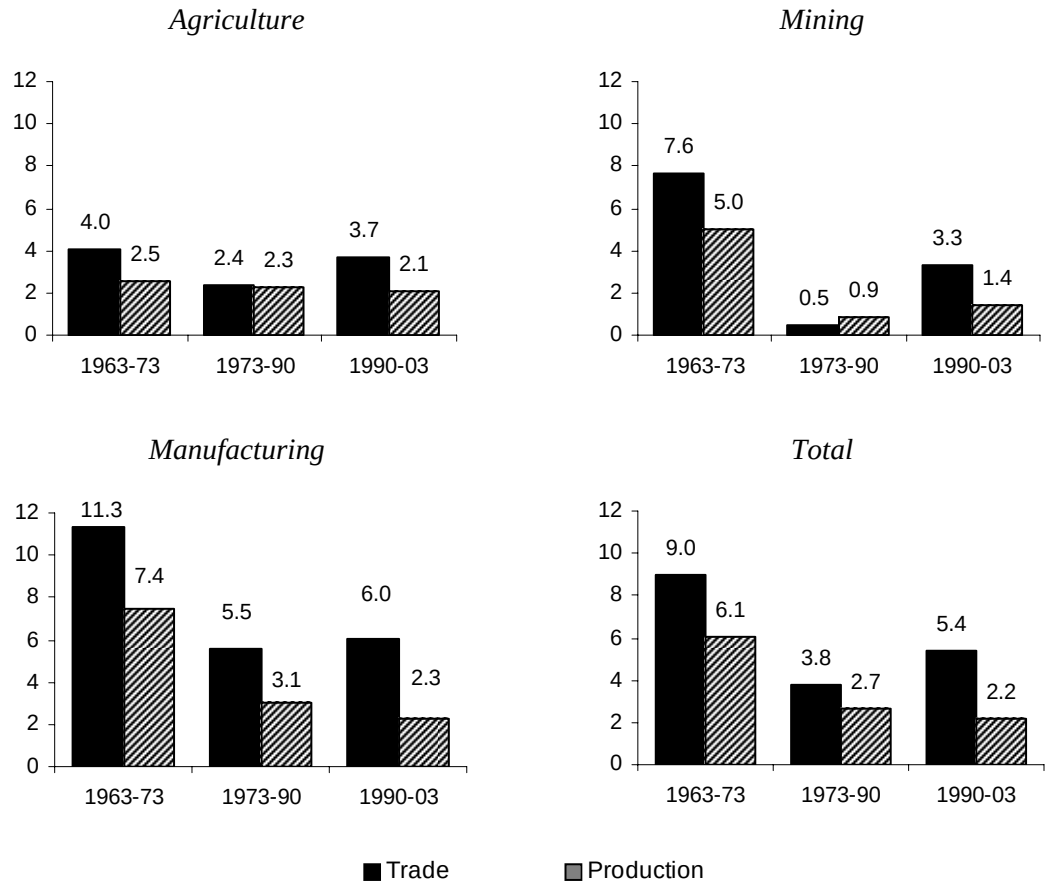
In contrast, Australia's industrial profile is broadly comparable to OECD countries, with agriculture accounting for less than 5 per cent of output and employment. But, the fact remains, that Australia has a much greater reliance on the agriculture and mining sectors to generate export revenue than most high-income countries. However, inter-country differences in industry structure and export profiles reflect a

8 Services credits are excluded due to difficulties in obtaining consistent international data.

myriad of factors, including natural resource endowments, divergent historical experiences, proximity to markets, differing impacts of technological advances and cultural and social factors. It does not necessarily follow therefore that Australia's greater reliance on the agricultural and mining sectors as a source of export revenue points to a structural weakness compared to other developed economies.

Australia's greater reliance on these exports provides it with a different set of threats and opportunities to other OECD countries. For example, global agricultural exports have been rising faster than global agricultural production over the past four decades (figure 4.5).

Figure 4.5 **Growth in global production and trade by sector, 1963 to 2003**
Average annual percentage change in volume terms



Data source: WTO (International Trade Statistics 2004).

Since 1990, the volume of global trade in agricultural commodities has increased by 3.7 per cent a year while global agricultural production volumes have increased by only 2.1 per cent a year. But despite this export growth, the share of global merchandise trade accounted for by agriculture continued to fall due to faster growth in trade in manufactures — 6 per cent a year in volume terms since 1990.

Between 1990 and 2003, agriculture's share of global merchandise trade fell from 13 per cent to less than 10 per cent. This decline reflects a continuation of a longer term trend that has seen agriculture's global export share decline in each of the past four decades.

In conjunction with these trends, the price of global agricultural exports continues to decline with respect to manufactured goods (WTO 2003). Domestically, this has been reflected in ABARE's Australian farmers' terms of trade index (prices received for farm products divided by prices paid for inputs) which has fallen by almost 2 per cent a year over the past four decades (Roberts et al. 2004).

Given that Australian agricultural producers are essentially price takers on world markets, these price trends have placed additional pressures on the sector. In the face of these pressures agricultural producers have sought further improvements in 'on farm' productivity (discussed in chapter 6), as well as restructuring and diversifying output (and exports), and in some cases modifying the degree of processing of agricultural products prior to export (for example, dairy co-operatives). Exporters have also sought to further develop existing and new export markets. These changes are examined further below.

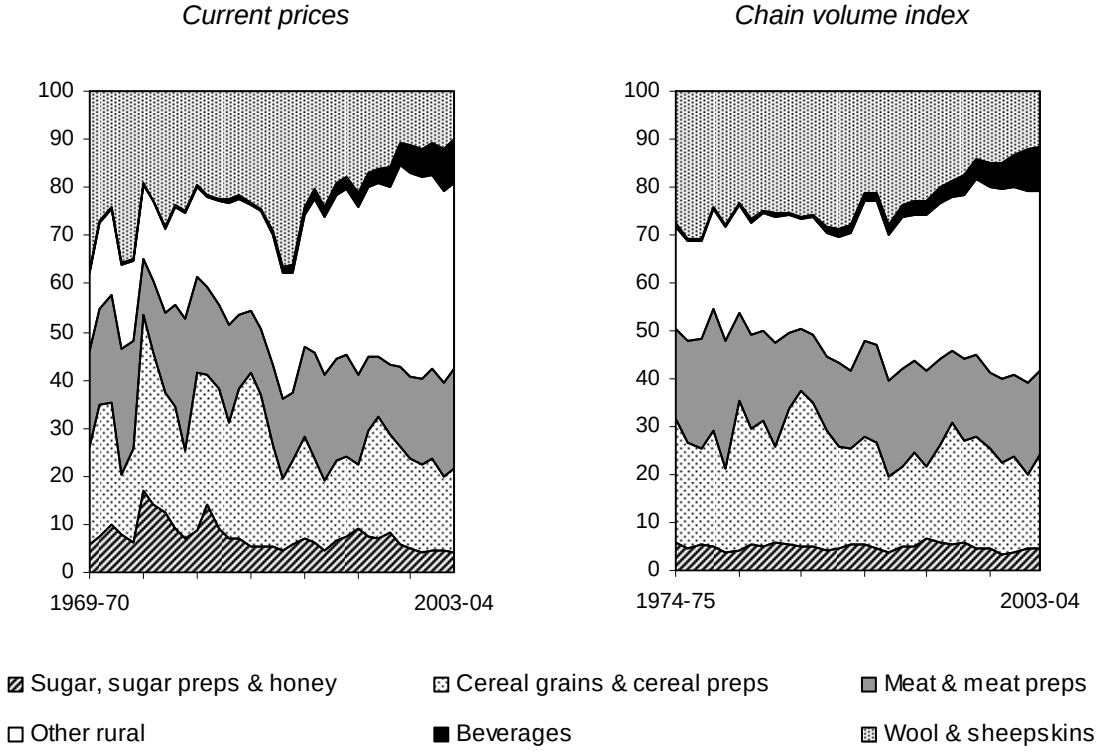
4.3 Key trends within agricultural trade

The changing mix of agricultural exports

The production changes identified in chapter 3, combined with an increase in the processing of agricultural output, have seen the composition of agricultural exports change substantially in recent decades.

Until the late-1960s, a few key commodities dominated agricultural, and indeed Australian exports. In 1969-70, the 'big three' agricultural exports — wool, cereals and meat — accounted for almost four-fifths of agricultural exports in value terms. By 2003-04, their combined share had fallen to just under half (figure 4.6). This reflected the sharp fall in the share of wool and sheepskin exports — from almost 40 per cent of agricultural exports in 1969-70 to 10 per cent in 2003-04. With cereals, meat and sugar retaining roughly similar shares over the period, the 'other rural' category accounted for most of the decline in wool's share. 'Other rural' exports — which include a range of processed foods such as dairy products, tinned and frozen food as well as animal feeds, wood chips and other inedible products — increased from 16 to 39 per cent of agricultural exports over the period. Beverage exports (of which wine comprised 95 per cent of total exports in 2003-04) increased from less than half a per cent in 1969-70 to over 9 per cent in 2003-04.

Figure 4.6 **Agricultural commodity export shares, 1969-70 to 2003-04[ab]**
Per cent



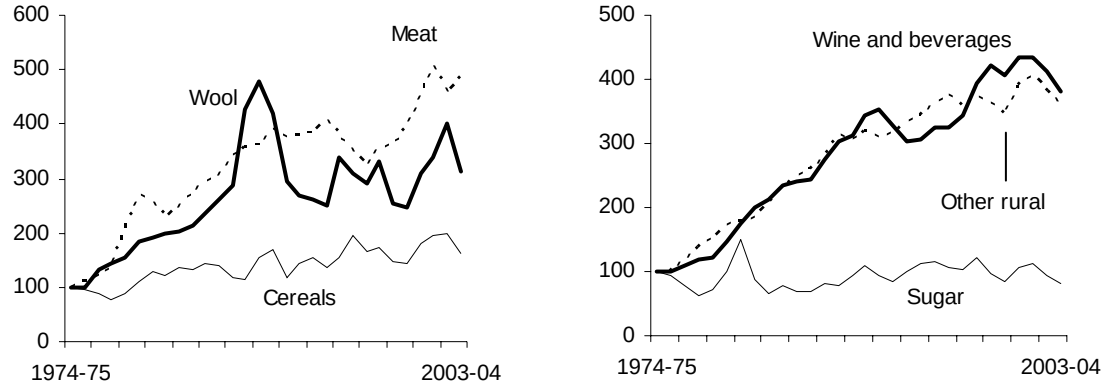
a Data are based on the ABS BOP measure 'Rural exports' plus beverages and sugar. This measure is very close to TREC and SITC measures of agricultural exports — $28.3 billion in 2003-04 on a BOP basis compared to $28.2 billion on a TREC basis in the same year (current prices). **b** Current price data are provided for the period 1969-70 to 2003-04. Constant price data are provided for the period 1974-75 to 2003-04 (longest available series).

Data source: ABS (Cat. no. 5302.0).

Changes in commodity prices have affected the contribution of different commodities to total agricultural export values over the period. Between 1974-75 and 2003-04, meat, wine and beverages and 'other rural' recorded the strongest price rises (5.6, 4.7 and 4.5 per cent a year respectively). Wool and cereal grains recorded slower annual price increases (4.0 and 1.6 per cent a year respectively), while sugar prices fell over the period (down 0.8 per cent a year, figure 4.7). In addition, year to year price volatility resulted in sharp changes in shares for particular commodities in some years. For example, a spike in wool prices in 1988-89 saw wool's share of the value of agricultural exports increase by more than 50 per cent, only to fall again as prices dropped back to their previous levels in the early 1990s.[9]

[9] Similarly, a sharp rise in grains prices in 1974-75, combined with a fall in meat prices in the same year resulted in a substantial (albeit short lived) change in these commodities' relative shares of agricultural exports. Sugar prices were also extremely volatile, with sharp rises in the mid-1970s and early 1980s boosting its share briefly (figure 4.7).

Figure 4.7 **Agricultural commodity export prices, 1974-75 to 2003-04**
Index (1974-75 = 100)



Data source: ABS (Cat. no. 5302.0).

Nevertheless, an examination of changes in export volume shares over the past three decades confirms that the long-term trends in compositional shifts identified above are not simply price effects — with broadly similar trends evident in both current and constant prices (figure 4.6).

In real terms (chain volume index, 2002-03 prices), between 1974-75 and 2003-04:

- wine and beverages recorded the highest growth rate (up $2.8 billion — 16 per cent a year), most of which occurred over the past decade or so (box 4.2);
- 'other rural' exports recorded the largest overall growth (up $9.2 billion — 6 per cent a year), contributing almost half (46 per cent) of the total growth in agricultural exports;
- sugar exports registered the next highest growth rate (up $750 million — just over 3 per cent a year);
- meat and meat preparations increased by 2.8 per cent a year but contributed 16.8 per cent of overall growth due to the large starting size of the industry;
- cereal grains and preparations increased at 2.5 per cent a year, but accounted for just over 16 per cent of total growth, also reflecting the large starting size of the industry; and
- wool exports increased by less than 1 per cent a year and contributed only 3 per cent of the total growth in agricultural export volumes despite being the largest single export category at the start of the period (table 4.2).

Box 4.2 **Australia's wine exports**

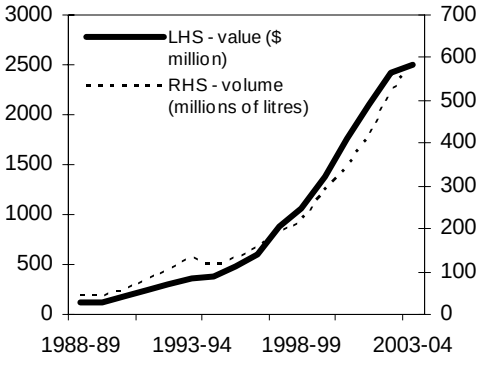
Wine exports are an increasingly important part of our trading profile, with Australia now the fourth largest exporter of wine in the world after France, Italy and Spain. The value of Australian exports has grown from $116 million in 1988-89 to $2.5 billion in 2003-04 — an annual rate of growth of 24 per cent (figure 4.8). This has been underpinned by strong growth in export volumes — up by 20 per cent a year over the past decade and a half, from around 40 million litres in 1988-89 to 581 million litres in 2003-04. Over the same period, exports have increased from less than 5 per cent of total wine sales to more than 50 per cent today. Export values have also benefited from increases in price, with prices per litre up around 3 per cent a year over the past decade and a half. Nevertheless, there has been some volatility. For example, in 2000-01, the average price per litre for exported wine was $5.17, almost twice its value at its lowest point over the past decade and a half (in 1992-93) of $2.85 per litre. A key factor positively affecting the long-term price per litre has been the increasing proportion of Australia's exports made up of bottled wine — with exports increasingly shifting from bulk wine in the 1980s to higher value bottled wine from the early 1990s.

Australia's wine exports are becoming increasingly concentrated among a few key markets. For example, two markets, the United States and the United Kingdom, accounted for almost 70 per cent of all wine exports in 2003-04, up from 40 per cent in 1988-89. Traditionally the United Kingdom has been Australia's largest export market. Although it accounted for more than one-third of total wine exports ($849 million) in 2003-04, the value of exports to the United Kingdom in that year were exceeded for the first time by the United States ($875 million). However, in volume terms, the United Kingdom remains our largest market, accounting for around 20 per cent more exports than the United States.

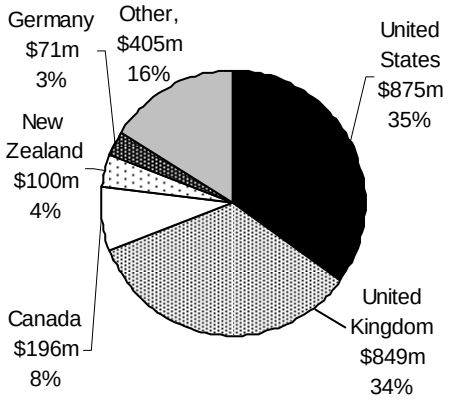
Figure 4.8 **Wine export growth and patterns of trade, 1988-89 to 2003-04**

$ million, millions of litres

Exports in value and volume terms



Top 5 export markets, 2003-04 (by value)



Sources: DFAT (2004a, STARS Database 2005), Gordon (2005).

Table 4.2 **Trends in rural exports, 1974-75 to 2003-04[a]**
Chain volume index (2002-03 prices), BOP basis[b]

	Level in 1974-75	*Level in 2003-04*	*Total change*	*Trend annual average growth*	*Contribution to growth*
		$ billion		Per cent	
Meat & meat preps	2.1	5.4	3.3	2.8	16.8
Cereal grains & cereal preps	2.8	6.1	3.2	2.5	16.3
Wool & sheepskins	3.0	3.6	0.6	0.7	2.9
Other rural	2.3	11.5	9.2	6.0	46.2
Wine and beverages	0.1	2.9	2.8	15.8	14.0
Sugar, sugar preps & honey	0.6	1.4	0.7	3.1	3.7
Total agriculture	**10.9**	**30.8**	**19.9**	**3.5**	**100.0**

a Longest available constant price series. **b** The BOP measure of 'rural exports' has been modified here by the inclusion of 'non-rural' exports of wine and beverages and sugar to provide a more comparable measure to the SITC and TREC measures used elsewhere in this chapter.

Source: ABS (Cat no. 5368.0).

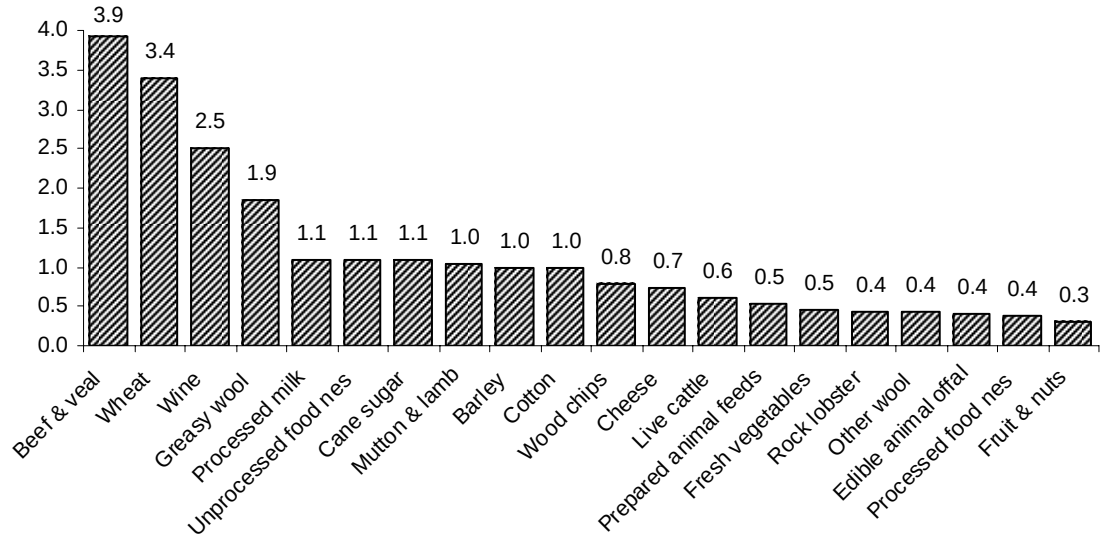
More detailed data available on a TREC basis confirm the increasing diversity of agricultural exports, with a smaller share of total export sales concentrated in a few key commodities. In 2003-04, the top five annual export earners were beef and veal ($3.9 billion), wheat ($3.4 billion), wine ($2.5 billion), wool ($1.9 billion) and processed milk ($1.1 billion), (figure 4.9).[10] Combined, these industries accounted for 45 per cent of total agricultural export sales ($28.2 billion in 2003-04 — current prices). This compares with a figure of 65 per cent for the top five export commodities in 1988-89.

An index of diversification was constructed based on the 99 6-digit TREC agricultural exports commodities.[11] The resulting index provides some evidence of steady, albeit gradual, increases in the diversity of agricultural exports. Between 1988-89 (earliest available year for SITC and TREC data) and 2003-04, the index rose from 0.88 to 0.94 with increases evident in most years.

10 These data are in current prices and hence, differ from data presented for the same year in table 4.2 which are in constant 2002-03 prices and have been adjusted for the 8 per cent fall in agricultural export prices in 2003-04.

11 The resulting index ranges between zero and 1. An index value of 1 indicates exports are completely diversified, with exports spread evenly across all commodities, whereas an index value of zero indicates exports are fully concentrated in a single commodity. The index was calculated as one minus the Herfindahl index (as defined in Bradley and Gans 1998), so that a higher value of the index reflects a higher level of export diversity. The Herfindahl index is calculated as the sum of the square of each commodity's export share.

Figure 4.9 **Top 20 agricultural export commodities, 2003-04**
Annual average exports, $ billion (TREC basis)



Data sources: DFAT (STARS Database 2005) and ABS (Cat. no. 5368.0).

Data on annual average growth rates and commodity contributions to growth since 1990-91 indicate a substantial diversity in the performance of the top 20 agricultural exports (average three years ended 1990-91 compared with average three years ended 2003-04), (figure 4.10). The five largest contributors to overall growth accounted for half of total growth — comprising wine (15 per cent), beef and veal (12 per cent), wheat (10 per cent), processed milk (7 per cent) and unprocessed food (6 per cent).

A number of smaller industries also made strong contributions due to high rates of growth: including mutton and lamb, cheese, live animals (predominantly cattle), see box 4.3), prepared animal feeds, processed food (not elsewhere specified) and fruit and nuts. These industries recorded double digit annual growth rates with small, albeit growing, contributions to overall growth. When combined, they accounted for one-fifth of total growth. The only industries to record substantial falls in export values over the period were greasy wool and other wool products, with annual average falls of around 3 per cent in export values.

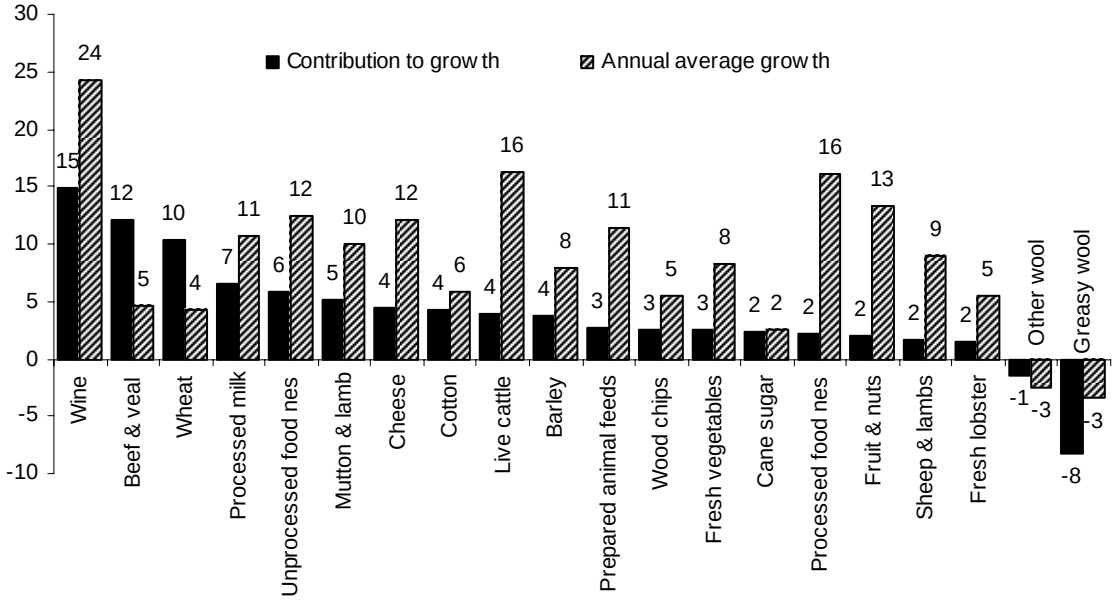
The compositional changes in agricultural exports identified above have been driven by changes in global demand and supply conditions. Growth in developing countries continues to provide challenges and opportunities for Australian farmers. For example, income growth in developing countries, particularly in Asia, is resulting in rapidly rising per capita consumption levels as well as diet diversification with shifts away from grain-based to livestock-based diets. This has increased demand for Australian agricultural products, notably, for commodities

such as meat, seafood and dairy products. At the same time, emerging economies are playing a larger role in supplying world agricultural markets. For example, Argentina and Brazil are major players in the oilseed and beef markets, while Brazil and Mexico are also important suppliers into global sugar markets — all of which means increased competition for Australian farmers on global markets (FAO 2003, OECD 2004a).

For developed countries, factors similar to those driving Australian consumption patterns have been evident (see chapter 3). The OECD projects that demand growth over the next decade in these countries will be driven by shifts in preferences towards products such as poultry, cheese and whole milk powder (appendix B). At the same time, higher projected growth rates in the non-OECD region for all agricultural commodities over the next decade indicate that an increasing share of agricultural produce and feedstuffs will be consumed and produced outside the OECD area (see, for example, OECD 2004a).

Figure 4.10 **Top 20 agricultural export commodities — contribution to growth and growth rate, 1990-91 to 2003-04**

Per cent, current prices (average three years ended)



Data sources: DFAT (STARS Database 2005) and ABS (Cat. no. 5368.0).

Box 4.3 **Australia's exports of live animals**

Australia is a major exporter of live animals, accounting for 33 per cent of global exports of sheep and lambs and 10 per cent of global cattle exports in 2003. The value of Australian live animal exports increased from $296 million in 1988-89 to $865 million in 2003-04 — an annual rate of growth of 7.4 per cent (figure 4.11).

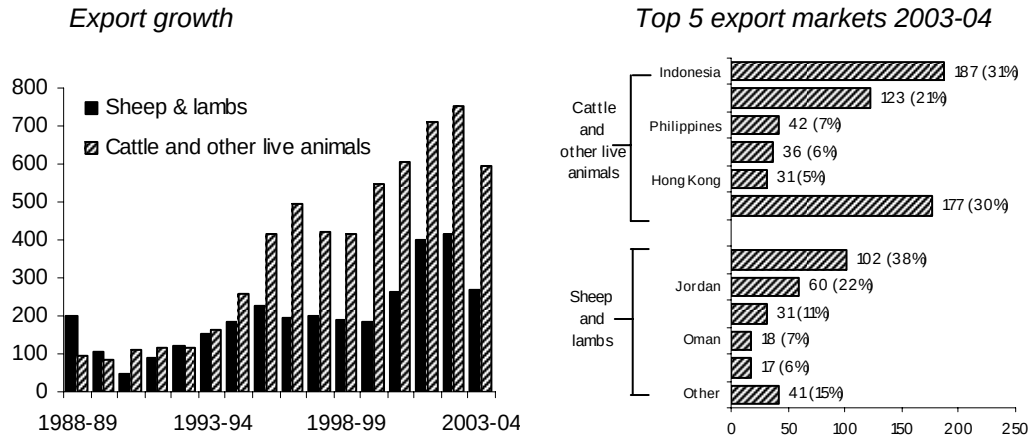
Most of this growth was due to increases in live cattle exports, underpinned by strong growth in cattle export numbers, up 13 per cent a year over the past decade and a half — from 105 000 in 1988-89 to 630 000 in 2003-04. Asia accounts for the majority of live cattle exports. For example, exports of live cattle and other animals (of which cattle comprise around 95 per cent in value terms) to Indonesia (beef cattle predominantly for fattening and slaughtering) and China (diary cattle for breeding) increased by over $300 million — accounting for over 60 per cent of the growth over the period.

Sheep and lamb exports accounted for almost 70 per cent of live animal export values in 1988-89. Despite substantial volatility, overall numbers of sheep exports have declined over the past decade and a half (from 6.4 million in 1988-89 to 3.5 million in 2003-04). Nevertheless, strong price increases have seen export values increase 2 per cent a year (in current prices) over the period.

The Middle East is the predominant market for live sheep and lambs, accounting for 95 per cent of all exports in 2003-04. Strong growth in exports to Kuwait and Jordan in recent years has counteracted the sharp fall in exports due to the recent suspension of trade with Australia's largest market, Saudi Arabia. Most exports are sourced from Western Australia, South Australia and Victoria where a specialised industry has developed to supply the lean male sheep preferred by these markets.

Figure 4.11 **Live cattle and sheep export growth and patterns of trade, 1988-89 to 2003-04**

$million



Sources: DFAT (STARS Database 2005), ABARE (2004d), FAOSTAT (2004), Livecorp (2004).

Imports and intra-industry trade

Imports of agricultural commodities into Australia are relatively small. In 2003-04, they amounted to just under $8 billion, less than one-third of agricultural exports and around 7 per cent of total merchandise imports. Prior to the 1960s, agricultural imports routinely constituted over 10 per cent of Australian merchandise imports. Since then, this share has fallen steadily due largely to the rapid growth in trade in manufactures. Over the same period, the composition of agricultural imports has shifted towards a range of processed foods, including alcoholic beverages, processed and specialty foods such as preserved fruits and vegetables, cereal preparations, seafoods and cheeses.

Some of these agricultural imports constitute two-way trade or intra-industry trade — the export and import of similar products by a country. This form of trade is most commonly associated with manufactured goods. Nevertheless, intra-industry trade in agriculture has risen strongly for developed countries since the 1970s reflecting a range of factors, including:

- increased product differentiation and branding, so that horizontal trade in basically similar products increases (exemplified by the sale of different brands of beers, wines and spirits across borders);
- greater sophistication in the nature of consumer demand;
- a reduction in trade barriers; and
- greater global integration of production (FAO 2003, PC 2003).

The key driver of intra-industry trade in agriculture for any country is the development of a food processing capability. As the Food and Agriculture Organization (FAO) of the United Nations notes (2003, p. 293):

> Growing two-way trade goes hand in hand with the development of an internationally competitive food processing industry.

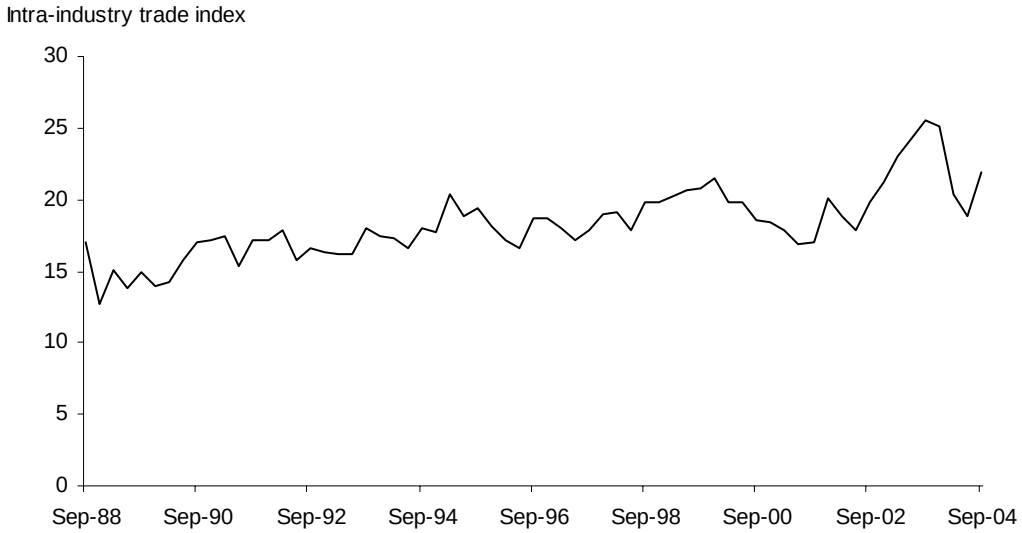
Much of the growth in Australian agricultural exports discussed earlier has been in different types of processed food.[12] Overall, processed food exports increased from 36 per cent of total agricultural exports in 1990-91 to 48 per cent in 2003-04. Over the same period, processed food imports increased from 50 to 62 per cent of total agricultural imports. Consistent with these changes, intra-industry trade in

[12] The category 'Processed foods' is contained within the TREC system and includes edible agricultural products that have been transformed to some degree. Hence, it includes products that have received a low level of processing as well as some involving relatively high levels of processing such as — meat and dairy products, seafood preparations, liquid and dried eggs, refined sugar, fruit and vegetable preparations, prepared animal feeds and alcoholic beverages (DFAT 2004c).

agriculture appears to have been increasing — from a Grubel-Lloyd index[13] estimate of around 15 per cent in 1988-89 to around 20 per cent in 2003-04 (figure 4.12). For an explanation of how the index is constructed see appendix B.

Key contributors to this increase included non-bovine meats, cereal preparations, animal feeds, seafood, fruit and nuts, chocolate, cheese and curd, fruit juices, fresh vegetables and other food products. Combined, these industries accounted for four-fifths of the increase in intra-industry trade over the period.

Figure 4.12 **Intra-industry trade in Australian agriculture[a], 1988 to 2004**
Quarterly data



a Estimates are based on trade within the 64 SITC three-digit agricultural categories plus the two-digit category 'Beverages'. As consistent deflators were not available, the index is based on current price data. Hence, caution should be exercised in interpreting movements in the index as the data reflect both volume and price effects.

Data source: DFAT (STARS Database 2005).

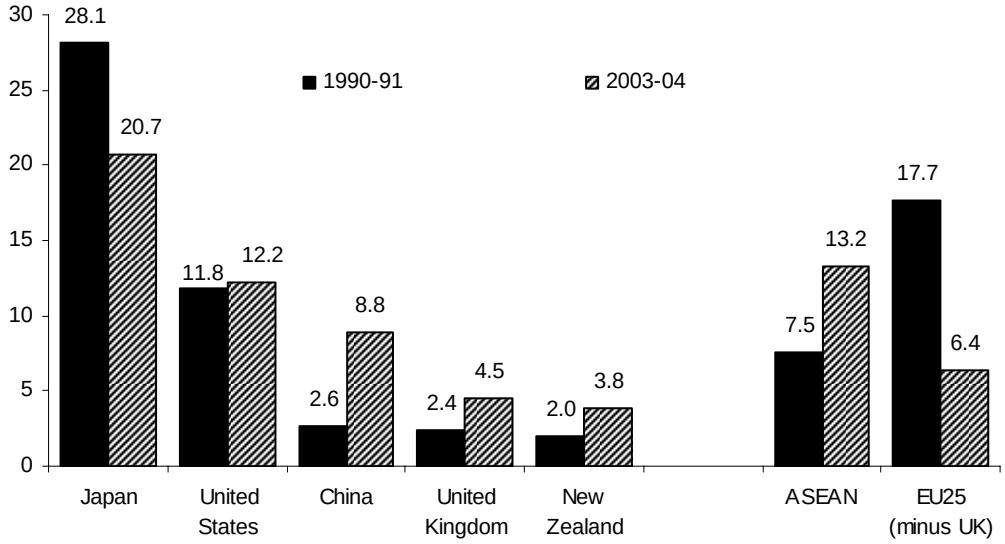
13 There are several criticisms of the Grubel-Lloyd index. In particular, the greater the trade imbalance, the smaller will be the share of intra-industry trade (as evident by the increase in the index when exports fell due to the drought of 2002-03. In addition, the level of aggregation employed affects the index values. Even so, alternative measures have problems and the Grubel-Lloyd index remains the measure most commonly applied (Grubel and Lloyd 1975, Dixon and Menon 1995, PC 2003).

4.4 Changes in export market profile

As Australia's agricultural exports have grown the relative importance of different export markets has changed — with an increase in the relative importance of Asian markets and a commensurate decline in the importance of European markets (figure 4.13).

However, the estimates of growth in agricultural exports by country presented below are not directly comparable with the data discussed earlier as raw sugar, wheat and oats export data are unavailable due to confidentiality constraints (see ABS 2002d). Hence, the relative importance of some Asian countries, and the growth in the share of exports to South Asian and Middle Eastern destinations, is likely to be underestimated.[14]

Figure 4.13 **Australia's top export markets, 1990-91 and 2003-04[a]**
Per cent, current prices (average three years ended)



a *ASEAN* comprises Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam. *EU25* comprises Austria, Belgium/Luxembourg, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

Data source: DFAT (STARS Database 2005).

14 Exports of these commodities accounted for 16 per cent of total agricultural exports in 2003-04 (TREC basis). Malaysia, Korea, Japan and Canada have been key markets for Australian sugar exports in recent years while Indonesia, Egypt, Japan, Korea and Iraq have been major importers of Australian wheat (DAFF 2005)

Australia's trade in agriculture is heavily influenced by sales to three key markets — Japan, the United States and China. Combined, these markets accounted for 42 per cent of Australia's agricultural exports in the three years to 2003-04 (figure 4.13). Beyond these markets, trade in agriculture is broadly dispersed among a wide range of countries across the globe. For example, Australia's next 17 largest markets accounted for only 42 per cent of total agricultural exports.

Japan remains Australia's largest agricultural export market by a substantial margin, accounting for more than one-fifth of total agricultural exports in 2003-04. This was almost double the share of Australia's next largest market, the United States.

Slow growth in the Japanese economy for much of the period 1990-91 to 2003-04, combined with declining wool prices, saw Japanese consumption of Australian agricultural products grow at only 3.2 per cent a year in value terms. This was substantially below the rate achieved for agriculture overall (5.7 per cent) and resulted in a drop in Japan's share of Australia's agricultural exports of more than 7 percentage points. Most of these declines occurred in the early 1990s, reflecting falls in the price of wool exports to Japan together with stagnant demand. Between 1990-91 and 2003-04, exports of wool to Japan fell by more than $0.8 billion in value terms.

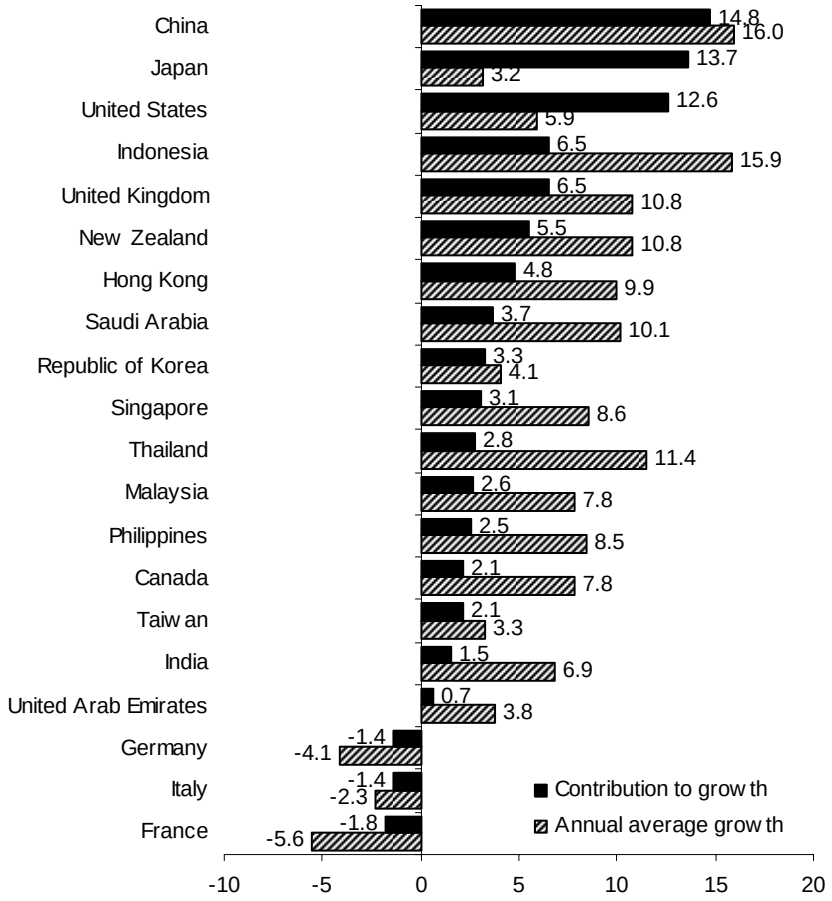
Nevertheless, the sheer size of the Japanese market meant that it still contributed a substantial 14 per cent of the growth in Australian agricultural exports over the period (figure 4.14). This growth was largely driven by increases in exports of beef and veal products, unprocessed foods, wood chips, cheese and prepared animal feeds (table 4.3).

However, the growth rate for beef and veal products to Japan is somewhat misleading as a key contributor to the growth in Australia's beef exports to Japan in 2003-04 was the positive BSE (bovine spongiform encephalopathy — 'mad cow' disease) result in the United States in December 2003 which prevented the United States from exporting to Japan. As a result, Australia's share of the Japanese beef market increased from around 45 per cent to over 90 per cent. As United States beef re-enters Japan, Australian beef exports to Japan are expected to decline — from a forecast 371 000 tonnes in 2004-05 to 315 000 tonnes in 2009-10 (ABARE 2005b).

Annual sales to Australia's next largest market, the United States, increased by almost $1.7 billion between 1990-91 and 2003-04 — accounting for 13 per cent of overall growth. This growth was almost entirely the result of strong growth in wine, beef and veal, and mutton and lamb exports (table 4.3).

Figure 4.14 **Top 20 agricultural export markets — growth rates and contributions to growth, 1990-91 to 2003-04**

Per cent, current prices (average three years ended)



Data source: DFAT (STARS Database 2005).

Despite its small initial starting share (2.6 per cent in the three years to 1990-91), China was the next largest market for Australian agricultural exports in 2003-04. The high growth rates recorded over the period saw it contribute 15 per cent of overall growth — resulting in a more than tripling in its share of total Australian agricultural exports over the period. This strong growth was driven by imports of wool, and, to a lesser extent, sheep and lamb skins, cotton and inedible beef and mutton tallow (table 4.3).

Strong growth in exports to the United Kingdom has seen it become the fourth largest importer of Australian agricultural exports — up from ninth in 1990-91. Nevertheless, it remains a small market (4.5 per cent) relative to the dominant role it played as the major external market for Australian agricultural products during most of the 20th century.

Table 4.3 **Growth in major agricultural exports to Australia's top 5 markets, 1990-01 to 2003-04[a]**

Commodity	*Level ($m, average three years ended)*		*Change*	*Contribution to growth*	*Annual average growth*
(TREC 6-digit)	*1990-01*	*2003-04*	*($m)*	*%*	*%*
Japan					
Beef & veal, chilled or frozen	812.8	1504.2	691.4	41.6	4.8
Wood chips	375.7	688.4	312.7	18.8	4.8
Unprocessed food nes	75.2	472.7	397.5	23.9	15.2
Cheese	60.3	333.7	273.4	16.4	14.1
Prepared animal feed	73.0	250.3	177.3	10.7	9.9
United States					
Beef & veal, chilled or frozen	951.1	1488.0	536.9	32.2	3.5
Wine of fresh grapes	20.8	789.0	768.2	46.1	32.3
Mutton & lamb, chilled or frozen	26.7	305.1	278.5	16.7	20.6
Rock lobster, fresh or chilled	74.5	90.4	16.0	1.0	1.5
Unprocessed food nes	15.7	53.7	38.0	2.3	9.9
China					
Greasy or fleece washed wool	107.5	1067.7	960.2	55.9	19.3
Sheep & lamb skins (wool on)	2.2	118.2	116.0	6.8	36.1
Cotton, not carded or combed	27.4	90.7	63.3	3.7	9.7
Other wool	77.5	88.7	11.3	0.7	1.1
Inedible beef & mutton tallow	8.0	88.0	80.0	4.7	20.3
United Kingdom					
Wine of fresh grapes	41.3	863.2	822.0	96.4	26.4
Mutton & lamb, chilled or frozen	22.9	77.2	54.2	6.4	9.8
Beef & veal, chilled or frozen	41.9	39.7	-2.1	-0.3	-0.4
Cheese	9.1	18.3	9.2	1.1	5.5
Live animals (excl sheep/lambs)	0.1	12.8	12.7	1.5	50.2
New Zealand					
Processed food nes	25.0	129.4	104.4	14.5	13.5
Wine of fresh grapes	16.4	94.9	78.5	10.9	14.4
Sugar & chocolate confect.	27.2	78.2	51.0	7.1	8.5
Prepared animal feed	16.8	61.8	45.0	6.3	10.5
Cereal preparations nes	13.2	58.9	45.7	6.4	12.2

a Contribution figures sum to more than 100 due to declines in other commodities over the period.

Source: DFAT (STARS Database 2005).

From the mid-1950s onwards, Australia increasingly directed its agricultural exports to Pacific rim countries and away from the United Kingdom and Europe. The key factor driving these changes were the formation of the European common market in 1948 and the United Kingdom's accession to the European Economic Community in 1973. The corresponding loss of preferential access by Australian farmers to the United Kingdom market led to a fundamental change in Australian export destinations. For example, in the early 1950s, almost 40 per cent of total Australian merchandise exports were sold to the United Kingdom, around 80 per cent of which were agricultural exports, predominantly wool and beef. By 1990-91, the United Kingdom share had fallen to 3.6 per cent of Australian merchandise exports, of which 21 per cent were agricultural exports.

Despite the growth in the United Kingdom market over the past decade and a half, the overall trend away from selling agricultural products on European markets has continued. Not only did the European Union's (excluding the United Kingdom) share of Australian agricultural exports fall 11 percentage points between 1990-91 and 2003-04 to account for around 6 per cent of Australian agricultural exports, but the value of agricultural sales also fell by almost $0.6 billion in current prices. This was driven, in particular, by falling export sales to France (down $233 million), Italy (down by $178 million) and Germany (down by $177 million) over the period (figure 4.14).

In contrast, exports to ASEAN countries increased strongly. Driven by strong growth in exports to Indonesia, Thailand and the Philippines, ASEAN's share of Australian agricultural exports increased from 7 to 13 per cent of agricultural exports.

Overall, Australian agricultural producers have maintained solid rates of export growth over the past decade and a half through a combination of securing strong growth in a number of new export markets as well as consolidation of existing markets. In addition to cost-reducing productivity improvements (such as developments in aquaculture) and the adoption of other technical innovations[15], an essential element of the success of agricultural exports in recent decades has been continued high levels of responsiveness by Australian producers to consumer demand in export markets. Some examples include: the development of a grain-fed cattle industry to meet Japanese consumers' preferences for 'marbled' beef; the supply of suitable live sheep as well as Halal-certified meat from Australian processing firms to Middle Eastern customers for traditional cooking; providing either whole lobsters (to Asia) or lobster tails (to the United States) depending on market preference; and the use of air freight by Australian suppliers to ensure

15 Such as the use of new varieties of plants and crops including the Pink Lady apple, new grape and wine varieties and insect-resistant cotton (DFAT 2004a).

exports of processed meat, lobster, tuna, vegetables and cut flowers are delivered fresh to market (DFAT 2004a).

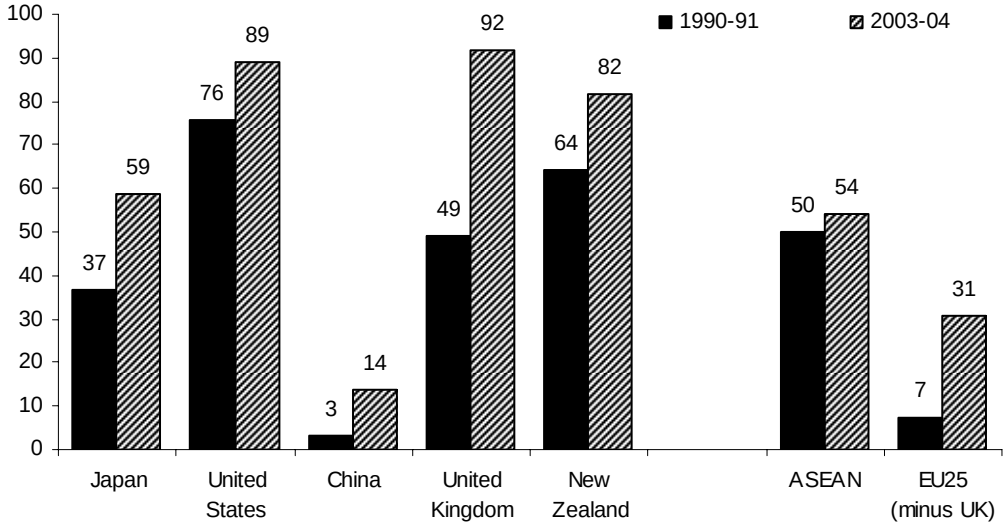
Processed food exports

An important driver of the growth in agricultural exports over the past decade and a half has been processed foods. This growth has been broadly based, with processed foods increasing their share of agricultural exports to most of Australia's key export markets. As noted earlier, caution needs to be exercised in interpreting these data as the 'processed food' category is very broad and contains a number of processed agricultural products that have undergone only a low level of processing (such as chilled and frozen beef) as well as some more highly processed products (such as wine) (DFAT 2004b).

In 1990-91, processed foods accounted for 37, 76 and 3 per cent of agricultural exports to Japan, the United States and China respectively. By 2003-04, these shares had risen sharply — to 59 per cent for Japan, 89 per cent for the United States and 14 per cent for China (figure 4.15).

Figure 4.15 **Share of processed food in agricultural exports to key markets, 1990-91 and 2003-04**

Per cent, current prices (average three years ended)



Data source: DFAT (STARS Database 2005).

The switch away from unprocessed agricultural products has been particularly marked in Japan. The composition of exports has changed markedly, with processed foods almost doubling their share over the period. This was due largely to strong growth in chilled and frozen meat exports (particularly in 2003-04 following the positive United States BSE result discussed earlier) coupled with sharp declines in the value of wool exports over the period.

Between 1990-91 and 2003-04, processed foods increased as a proportion of agricultural exports to most of Australia's major agricultural export markets. Higher income countries generally exhibited higher shares of processed food imports. For example, processed foods made up around 90 per cent of total imports of Australian agricultural products by the United Kingdom and the United States in 2003-04. By contrast, processed food exports to China (14 per cent), India (3 per cent) and Pakistan (18 per cent), although growing, remain relatively small.

4.5 Barriers to growth in Australia's agricultural exports

With only limited scope for domestic consumption growth, the Australian agriculture sector's future growth is highly dependent on world markets. As the President of the National Farmers' Federation recently said (Corish 2004, p. 10):

> With Australia exporting about 70 per cent of what we produce, continued and expanded access to global markets through multilateral and bilateral trade deals is one of the keys to our future.

There are, however, significant institutional impediments to growth in agricultural trade arising from the agricultural support policies of many countries.

Worldwide, agriculture continues to be the most highly protected sector. It has higher tariffs on average than any other sector and has significant non-tariff barriers to trade. It is also the only sector for which WTO rules permit the use of export subsidies.

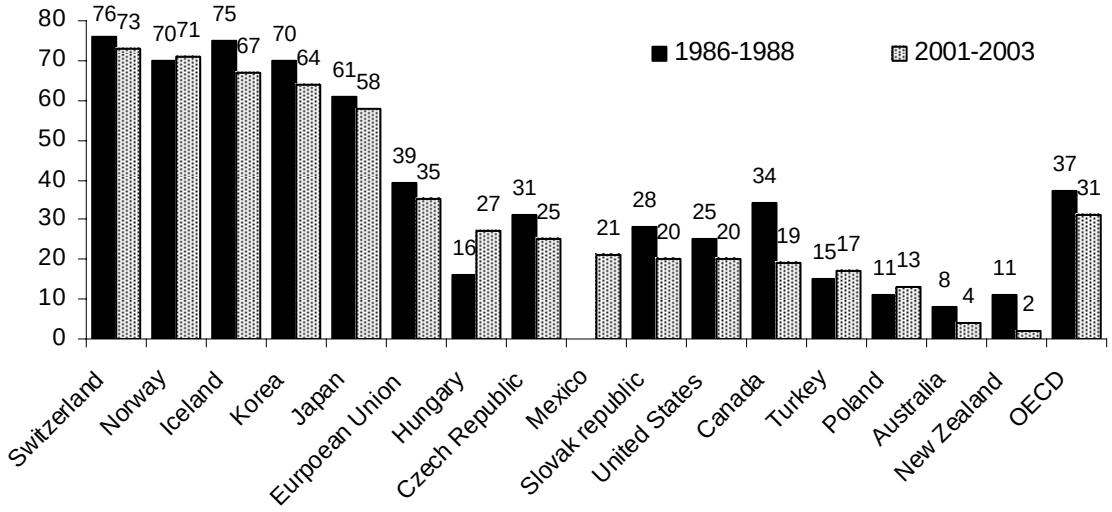
It is estimated that OECD countries transfer around $US 300 billion to agriculture via government support policies each year — equivalent to around 1.3 per cent of GDP or just over 30 per cent of farm receipts (OECD 2003a).

Support measures in these countries include import tariffs, domestic subsidies and export subsidies. A common feature of these measures is that they support farmers' incomes which, in turn, impacts on production decisions and international trade.

Producer support as a share of gross farm receipts among OECD countries is highest in Switzerland, Norway, Iceland, Korea Japan and the European Union (figure 4.16).[16] In contrast, Australia provides the second lowest level of support to agriculture, after New Zealand, among OECD countries. Australia's low result reflects a combination of generally low rates of assistance to agriculture in conjunction with a series of microeconomic reforms since the mid-1980s such as dismantling of statutory marketing arrangements and price support schemes (box 4.4).[17]

Figure 4.16 **OECD agricultural producer support estimates by country, 1986-1988 and 2001-2003**

Percentage of value of gross farm receipts



Data source: OECD , PSE/CSE Database (2004b).

16 The producer support estimate measures the annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, at the farm-gate level, arising from policies that support agriculture, regardless of their nature, objectives or impacts on farm production or income (OECD 2004).

17 The Commission's assistance estimates are discussed in more detail in its Trade and Assistance Review 2003-04 (PC 2004c).

Box 4.4 **Government assistance to agriculture**

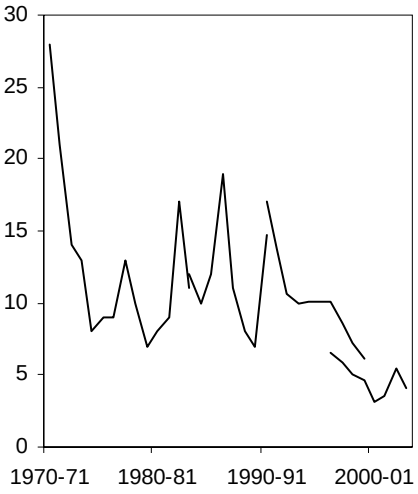
Australian Governments have employed a wide range of measures to provide assistance to the agricultural sector. These include statutory marketing arrangements, tariffs and budgetary measures such as adjustment assistance, R&D support, drought relief and tax concessions. From the mid-1980s, governments began to dismantle statutory marketing and price support schemes which provided the bulk of measured assistance to agriculture as part of a wider program of microeconomic reform. Key industries affected by these changes included dairy, sugar, eggs and tobacco.

The Commission's effective rates of assistance (ERAs) estimates reveal that assistance to agriculture is inherently volatile due largely to fluctuations in world commodity prices. Nevertheless, average ERAs for agriculture declined from around 13 per cent in the 1970s to an average of 5 per cent in the seven years to 2003-04 (figure 4.17) although this figure excludes 'exceptional circumstances' drought payments. Over the same period, assistance to manufacturing declined from around 28 per cent in the 1970s to around 6 per cent in the decade to 2003-04. The latest data series reveals that agriculture's ERA's have declined at 0.3 percentage points a year, on average, since 1997-98 to reach 4.1 per cent in 2003-04. Dairy cattle farming remains the most highly assisted industry with an ERA of 12 per cent in 2003-04, followed by forestry (5.3 per cent) and other crops (4.3 per cent).

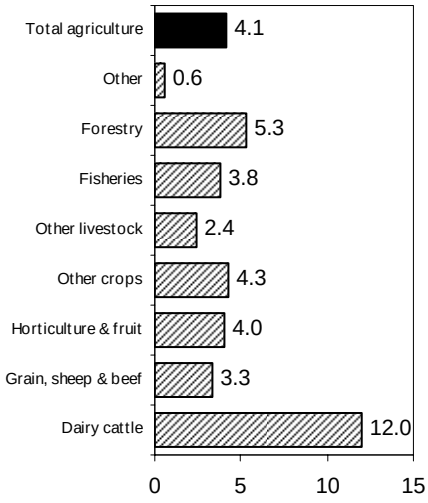
Figure 4.17 **Average effective rates of assistance[a] to agriculture**

Per cent

1970–71 to 2003–04



By industry grouping, 2003–04



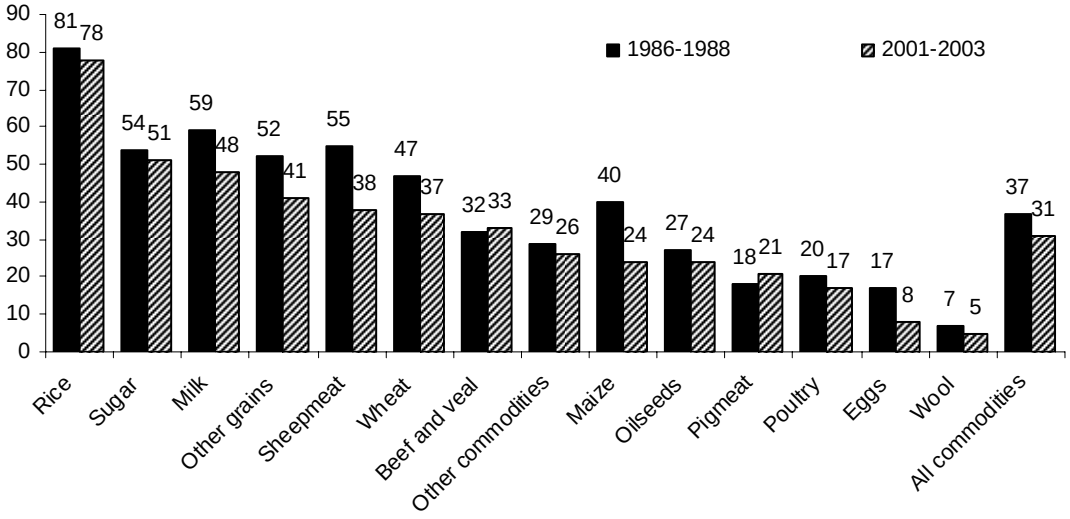
a The effective rates of assistance is the dollar value of measured assistance divided by unassisted value-added. For agriculture, this includes tariff assistance, most budgetary assistance and, the main component, assistance provided by domestic regulatory and pricing arrangements. Breaks in the series reflect the effects of periodic revisions to reference data covering industry inputs and outputs.

Source: PC (2003, 2004c).

There is considerable variation in producer support estimates for commodities across OECD countries, with rice, sugar and milk receiving the highest levels of support while wool, eggs, poultry, pigmeat and oilseeds receive the least support (figure 4.18).

Figure 4.18 **OECD producer support estimates by commodity[a], 1986-1988 and 2001-2003**

Percentage of value of gross farm receipts



a Rates are average most favoured nation applied rates which were used during the Uruguay Round.

Data source: OECD PSE/CSE database (2004b).

And, while there is evidence of some progress in reducing protection to many of the commodities within the sector since the mid to late 1980s — the average producer support estimate for the OECD dropped from 37 per cent in 1986-88 to 31 per cent in 2001-03 — government support for the agriculture sector remains high. As noted by ABARE (Roberts et al. 1999, p. 14):

> Agriculture has been the poor relation when it comes to international efforts to advance economic benefits from more open and less distorted international markets. Government intervention and the associated market distortions for agriculture have been, and remain, very large. This is particularly the case in developed countries.

The high level of agricultural support affects returns to Australian farmers by reducing world prices and limiting access to markets through various quantitative restrictions (such as import quotas and embargoes). As Andrews et al. (2003, pp. 5-6) put it:

> It is in Australian farmers' interest to reduce agricultural support globally. Such action will reduce the competition from subsidised farmers faced by Australian producers on world markets, increase consumption in the large protected markets and lead to higher world market prices. Less distortion in world markets translates into higher and more

stable prices for Australian exporters and producers of agricultural products. Therefore, multilateral trade reform matters for Australian farmers and rural communities.

Various Australian and international studies have identified substantial potential gains from further liberalisation of agricultural trade both for Australia and the rest of the world (box 4.5).

Box 4.5 **Projected gains from liberalisation of agricultural trade**

A number of Australian and international studies suggest that there are substantial gains to be made from further liberalisation of trade in agriculture. For example:

- An Australian study by Dee and Hanslow (2000), estimated that the world as a whole would be better off by more than $US260 billion annually as a result of eliminating all post-Uruguay trade barriers. About $US50 billion of this was projected to come from agricultural trade liberalisation. As expected, liberalisation of trade in agricultural products is projected to encourage resources to shift out of the relatively highly protected sectors in Japan, Korea, the Philippines and the European Community. In contrast, the agricultural sectors of countries such as Australia, New Zealand and the United States were projected to expand in response to more liberal markets for agricultural products.
- A study by the Economic Research Service of the United States Department of Agriculture (2001) found that the full elimination of all agricultural policy distortions would yield long-term global welfare gains of $US56 billion a year.
- ABARE (Freeman et al. 2000) estimated that a 50 per cent cut in agricultural protection between 2005 and 2010 would lead to global welfare gains of $US53 billion a year by 2010.
- Work by ABARE (Andrews et al. 2003) suggests that the Cairns Group proposals before the current WTO trade round would result in a $2.1 billion increase in Australia's gross national product by 2010. This would have favourable flow on effects for Australian farmers with average cash incomes for broadacre and dairy farmers estimated to rise by $10 900 and $15 500 respectively.

Sources: Dee and Hanslow (2000), Economic Research Service of the United States Department of Agriculture (2001), Freeman et al. (2000), Andrews et al. (2003).

However, progress in reforming remaining barriers to trade has been slow, and it seems likely that the potential benefits from global agricultural trade reform will not be realised for some time. As in the past, key challenges facing Australian agricultural producers continue to be how to respond to pressures resulting from the secular decline in their terms of trade and increased competition from existing, as well as newly emerging suppliers. In the face of these pressures, continuing improvement in farm productivity will be crucial in maintaining farm incomes. The productivity performance of the agricultural sector is examined in chapter 6.

5 Agriculture's workforce

Key points

- In 2003-04, agriculture, forestry and fishing employed 375 000 people — 85 per cent were employed in agricultural jobs, 7 per cent in services to agriculture and 7 per cent in forestry, logging, and commercial fishing.
- Agricultural employment, while variable between years, has exhibited only a very slight downward trend over the last four decades — declining on average by less than half of one per cent a year. The 2002-03 drought, however, had a significant impact — a decline of 15 per cent or around 70 000 jobs (12 months to June 2003) — the largest recorded employment shock of any drought since reliable statistics became available.
- Grain, sheep and beef cattle farming combined, are the sectors' biggest employers (44 per cent), followed by horticulture and fruit growing (25 per cent).
- Agriculture is an important employer in rural and regional Australia. In 2001, it directly accounted for almost 14 per cent of non-metropolitan employment and for more than 25 per cent of total employment in 207 of Australia's 425 labour regions.
- Agriculture's share of total Australian employment has more than halved since the 1960s, down from 9 to just under 4 per cent in 2003-04.
- Agriculture's workforce has a number of distinctive features. Compared to other sectors of the economy it has a high proportion of self-employed, family and casual workers. It is also a relatively old workforce with relatively low education levels, long job tenure and low employee wages.
- The last two decades, however, have seen some convergence in the characteristics of the agricultural workforce relative to the workforce in general. There has been an increase in the number of employees in the sector and a fall in employers and contributing family workers. The educational attainments of agricultural workers have improved and this has been at a faster rate than for the general workforce.
- Off-farm employment has become increasingly important to maintaining family farm incomes. Between 1989-90 and 2002-03, the proportion of farm families deriving income from off-farm wages and salary increased from 30 to 45 per cent and average earnings from such sources more than doubled, in real terms, rising from $15 000 to $33 500 per year.

This chapter examines the structure of the agricultural workforce and highlights the features that distinguish agriculture from labour markets elsewhere in the economy. The chapter also looks at how agriculture's workforce has changed over the last twenty years and the factors influencing these changes.

5.1 Agriculture jobs

In 2003-04, agriculture, forestry and fishing employed 375 000 people or around 4 per cent of Australia's workforce (table 5.1). Just over 85 per cent of those employed in the sector are employed in agricultural jobs, around 7 per cent are employed in providing services to agriculture (such as shearing and cotton ginning), and the remaining 7 per cent are employed in forestry, logging and commercial fishing.

Table 5.1 **Agriculture employment, 2003-04[a]**

Industry/sector	*Number employed 2003-04*	*Proportion of agriculture's workforce*
	'000 persons	%
Agriculture, Forestry and Fishing	375	100
Agriculture	320	85.5
Horticulture and fruit growing	95	25.3
Grain, sheep and beef cattle	166	44.0
Dairy cattle	20	5.3
Poultry	10	2.6
Other livestock	10	2.7
Other crops	11	2.9
Services to agriculture	25	6.7
Forestry and logging	12	3.2
Commercial fishing	16	4.2

a Employment data presented in this chapter are based on the average of the four consecutive quarters between August and May in the nominated year, with the exception of 1984-85 where data are averaged over the three quarters November 1984 to May 1985.

Source: ABS (Cat no. 6291.0.55.001).

Agriculture's biggest employers are grains, sheep and beef cattle (combined they account for 44 per cent of the workforce), followed by horticulture and fruit growing (25.3 per cent) and services to agriculture (6.7 per cent) (table 5.1).

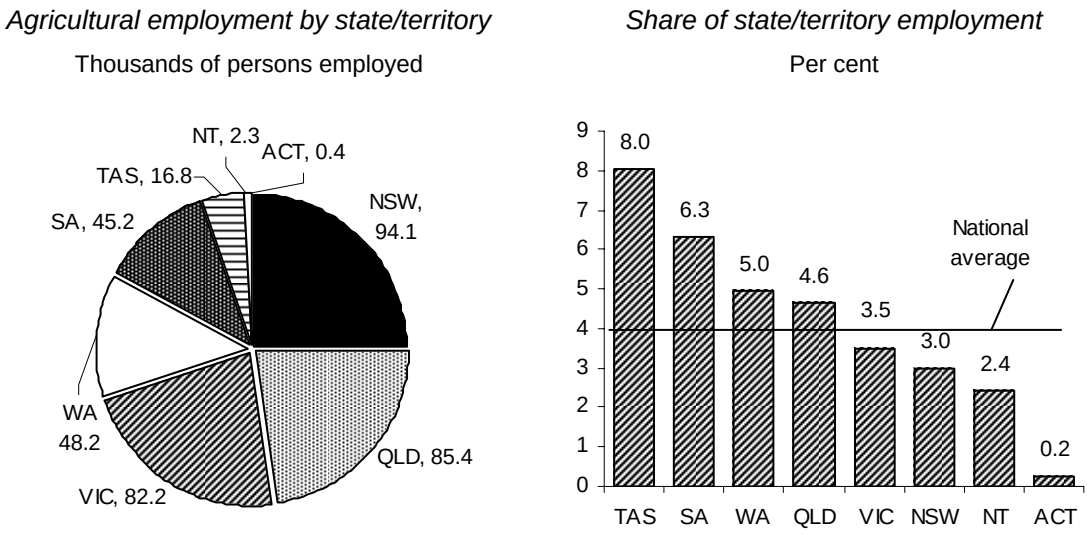
Distribution of agricultural employment

About 25 per cent of the agricultural workforce is employed in New South Wales and just over 20 per cent in each of Queensland and Victoria. The Northern

Territory and the Australian Capital Territory combined employ less than 1 per cent of the agricultural workforce (figure 5.1).

Agriculture's share of state employment, however, is stronger in Tasmania (8 per cent), South Australia (6.3 per cent), Western Australia (5 per cent) and Queensland (4.6 per cent), than the larger states (Victoria and New South Wales) and the territories, which all recorded shares below the national average of around 4 per cent (figure 5.1).

Figure 5.1 **Agricultural employment in the states and territories, 2003-04**



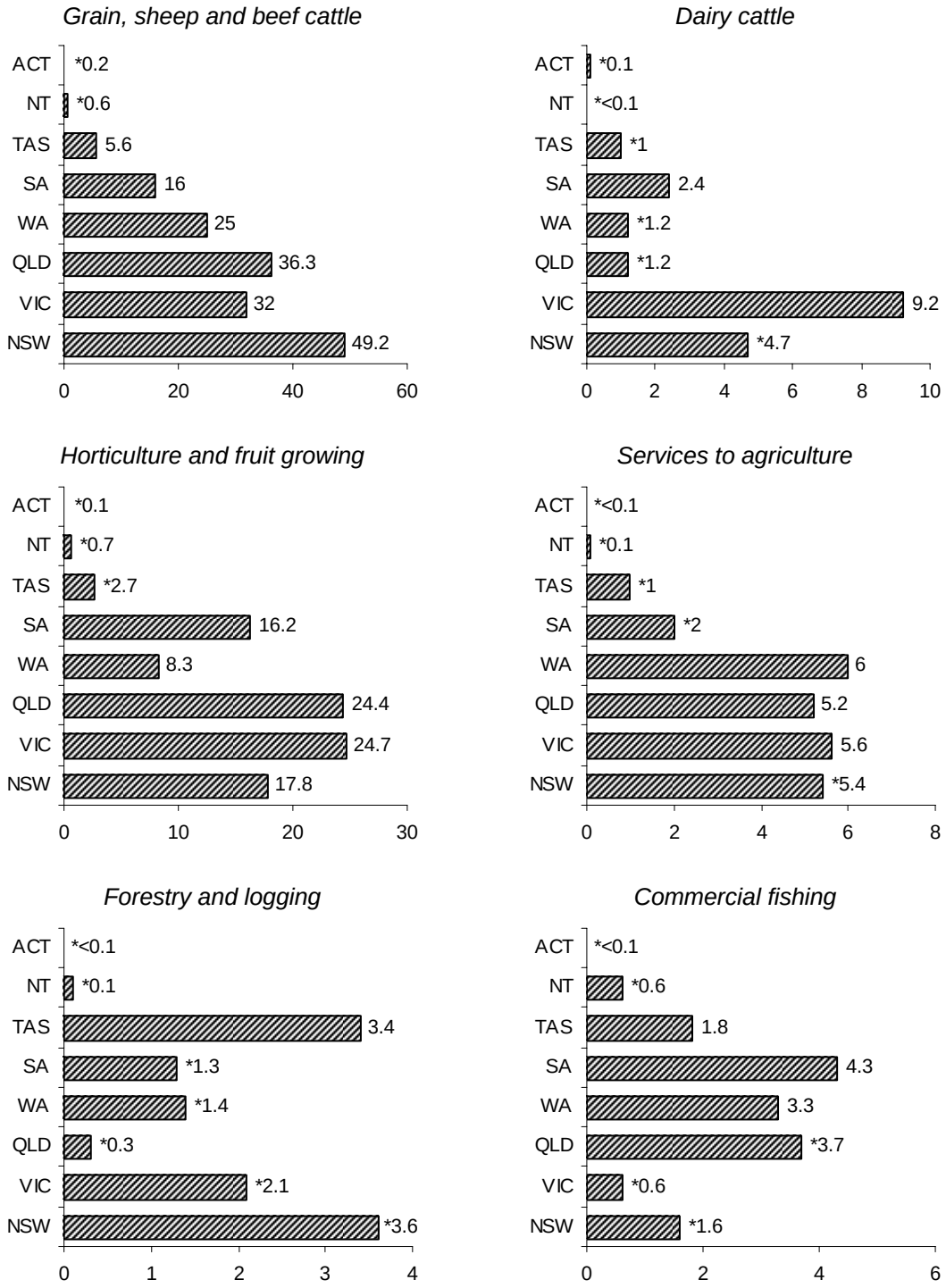
Data source: ABS (Cat. no. 6203.0).

An examination of the distribution of employment by industry also reveals some diversity among the states (figure 5.2, also see appendix C, table C.1). For example:

- grain, sheep and beef cattle industries account for just over 50 per cent of all agriculture, forestry and fishing employment in New South Wales;
- dairy employment is predominately located in Victoria;
- around half of all employment in the horticulture and fruit growing industry is located in Victoria and Queensland;
- New South Wales, Victoria, Queensland and Western Australia dominate employment in services to agriculture, reflecting the distribution of total agricultural employment;
- more than half of all employment in the forestry industry is located in New South Wales and Tasmania; and
- one-quarter of commercial fishing employment is located in South Australia.

Figure 5.2 **Distribution of agricultural employment in selected industries by state and territory, 2003-04[a]**

'000 persons



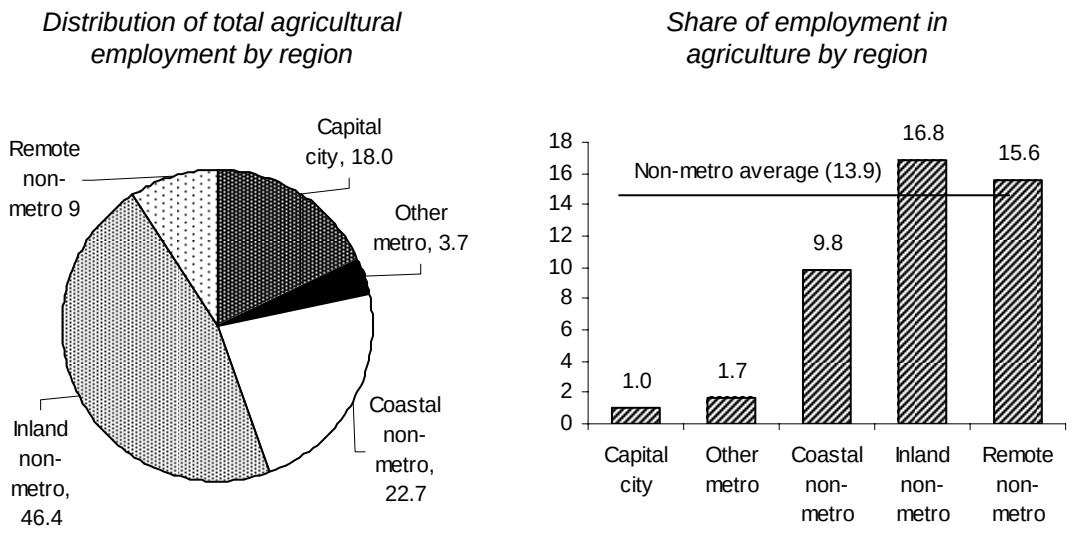
a Data are based on survey information, and so information for Agriculture, Forestry and Fishing subdivisions and groups, or at state and territory level, is less reliable than more aggregate information at division or national level. Estimates with a relative standard error of 25 per cent or greater are preceded by an asterisk (for example, *5.2) to indicate they are subject to high standard errors and should be interpreted with caution.

Data source: ABS (Cat no. 6291.0.55.001).

Agriculture is an important employer in rural and regional Australia. In 2001, almost four-fifths of agricultural employment was located in non-metropolitan regions. (By comparison, just over a quarter for all employment is located in non-metropolitan regions.) Inland regions account for almost half of all agricultural employment, coastal non-metropolitan for around one quarter while remote regions account for almost 10 per cent (figure 5.3).

Agriculture also accounted for around 14 per cent of all non-metropolitan employment and for almost 17 per cent of employment in inland non-metropolitan regions in 2001 (figure 5.3). And for 207 of Australia's 425 labour market regions, agriculture directly accounted for more than 25 per cent of total employment.

Figure 5.3 **Agricultural employment shares by region[a], 2001**
Per cent



a The five regional groupings are based on the BTRE's reworking of the 2001 ABS Remoteness Structure which groups Census Collection Districts into broad classes of remoteness sharing common characteristics in terms of physical distance from services and opportunities for social interaction. This classification divides Australia into 425 regions — 8 capital city regions, 6 other metropolitan regions (comprising Gold Coast/Tweed, Townsville-Thuringowa, Sunshine Coast, Newcastle, Wollongong and Geelong), 89 coastal non-metropolitan regions, 199 inland non-metropolitan regions and 123 remote non-metropolitan regions.

Data source: BTRE (Industry Structure Database 2004).

The regional distribution of agricultural employment, however, varies across industries. For example, over 50 per cent of employment in plant nurseries, cut flower and seed growing and poultry farming was located in metropolitan regions. Other agricultural industries highly represented in metropolitan areas include fruit and vegetable growing, horse farming, services to agriculture, fishing and aquaculture. Most traditional broadacre agricultural industries such as beef, sheep, grains and dairy have non-metropolitan employment shares of between 90 to 95 per cent (see appendix C, table C.2).

Employment linkages with other sectors of the economy

As discussed in chapter 2, agriculture has important linkages with other sectors of the economy and indirectly contributes to employment in industries such as food processing and fibre manufacturing. The employment numbers discussed above, therefore, understate the relative importance of agriculture in terms of employment dependant upon the sector.

Food Processing

The food processing industry — which includes abattoirs, wineries, flour millers and fruit processors — is the second largest manufacturing subdivision. In 2003-04, it employed 170 800 people or 16 per cent of total manufacturing employment (see appendix C, table C.3). It has also been one of the fastest growing manufacturing industries over the last twenty years (PC 2003).

The distribution of food processing employment across the states and territories reflects the location of the agricultural activities that provide intermediate inputs these industries. Meat processing plants, for example, are more highly represented in states with larger reliance on livestock industries such as Queensland and New South Wales. For similar reasons, Victoria and South Australia have disproportionately high shares of dairy and beverage (wine) manufacturing respectively.

As is the case with direct employment in the agriculture sector, a large share of food processing employment is located in non-metropolitan regions (around 40 per cent) — the highest share recorded by a manufacturing subdivision (ANZSIC basis, see appendix C, table C.4).

Other manufacturing industries

In addition to food processing, there are a number of other manufacturing industries that either provide direct inputs to the agricultural sector — such as the production of agricultural machinery, pesticides and fertilisers — or rely heavily on non-food inputs for processing — such as saw mills and wool scouring. Combined, these industries employed another 39 000 people in 2001, the majority of which (54 per cent) were in non-metropolitan regions (see appendix C, table C.5).

Service industries

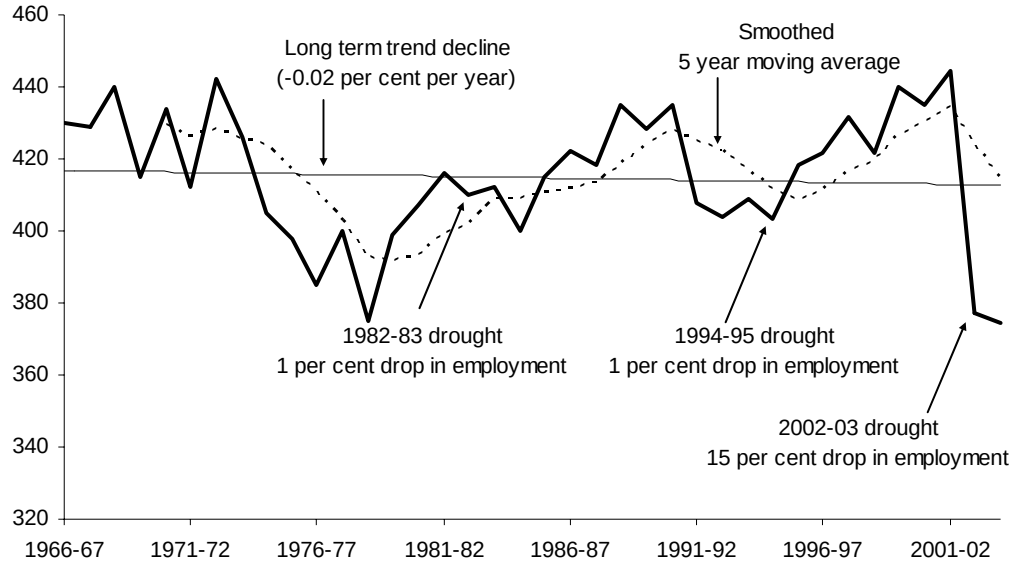
A range of industries providing services to the agriculture sector — such as grain storage, veterinary services, and the wholesaling of wool, meat, timber and farm machinery — employed a further 109 000 people in 2001. Almost half of these (45 per cent) are employed in non-metropolitan regions (see appendix C, table C.6).

5.2 Trends in agricultural employment

Agricultural employment, while exhibiting significant variability between years, has been relatively flat over the last four decades — declining by a trend rate of less than half of one per cent a year over the period 1966-67 to 2003-04 (figures 5.4 and 5.5).

From the mid-1960s through to the late 1970s, agricultural employment declined by around 1 per cent a year. This coincided with a period when capital was being substituted for labour — much of the new technology at that time was embodied in capital (Knopke et al. 1995). The decade of the 1980s saw modest growth, although employment declined by around 1 per cent during the 1982-83 drought.

Figure 5.4 **Employment in agriculture, 1966-67 to 2003-04[a]**
'000 persons



a The trend growth rate was estimated by regressing the logged value of employment against a time trend for the years 1966-67 to 2003-04.

Data sources: ABS (Cat no. 6291.0.55.001); RBA from Econdata.

Figure 5.5 **Trend annual employment growth, agriculture, forestry and fishing, 1966 to 2004,**

Per cent

Data source: ABS (Cat no. 6291.0.55.001).

Agricultural employment declined in the early 1990s, largely driven by job losses on sheep farms — the decline of the sheep flock from 174 million in 1989 to 120 million in 1994-95 coincided with a fall of around 15 000 in the total number of employees in the broadacre sector (Knopke et al. 1995). From a low point during the 1994-95 drought, agricultural employment increased, reaching a peak of around 440 000 in 2001-02.

Triggered by the 2002-03 drought, the 12 months to June 2003 saw the loss of around 70 000 agriculture jobs, or a decline of around 15 per cent (figure 5.4). This decline represents the largest employment shock of any drought since the 1960s (when reliable statistics became available). By comparison, both the 1982-83 and 1994-95 droughts resulted in job losses of around 6000, or a decline of around one per cent. The magnitude of the job loss (one job in six) during the latest drought overshadows the tradition of long term stability of agriculture employment.

Declining share of total employment

While in absolute terms employment in agriculture has remained relatively constant over the last four decades, agriculture's contribution to Australia's total workforce has more than halved since the late 1960s, when it accounted for around 9 per cent of the workforce. Agriculture declined to around 6.5 per cent of the workforce from around the mid 1970s, before falling further to around 5 per cent in the decade to 2001-02. Employment losses associated with the most recent drought saw agriculture's share fall to under 4 per cent in 2003-04.

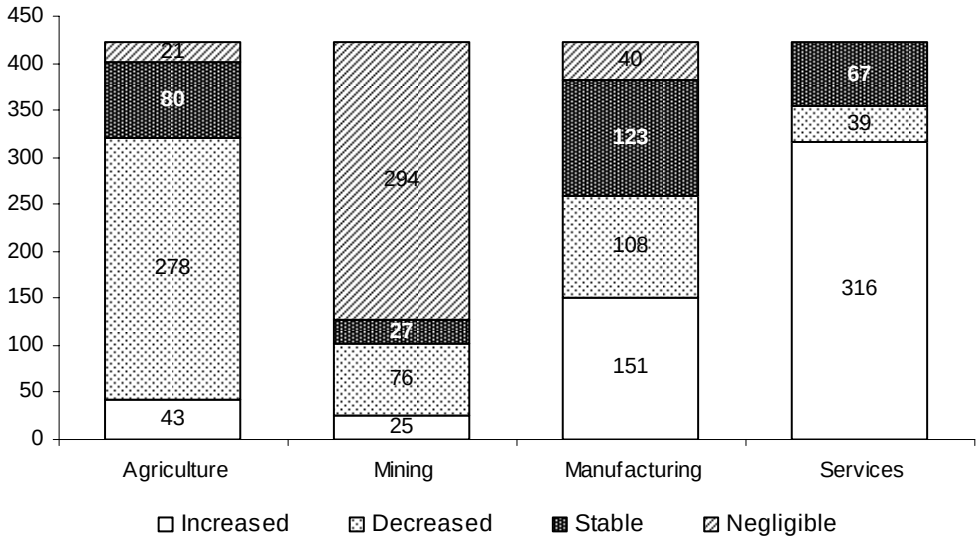
Employment changes in regional Australia

Following the trend in total agricultural employment, the sector's share of regional employment declined over the past decade, while remaining relatively stable in absolute terms.

Census data shows that over the decade to 2001, agricultural employment:

- declined in two-thirds (278) of Australia's 425 regions;
- increased in ten per cent (43) of regions; and
- remained stable in around one-fifth of regions (figure 5.6).

Figure 5.6 **Industry employment share changes across Australia's regions[a], 1991 to 2001**



a Regions with a stable sector share are those in which the employment share changed by less than 1 percentage point. Regions with a negligible sector share comprise those in which the employment share was less than 1 per cent in 1991 and remained so in 2001.

Data source: BTRE (Industry Structure Database 2004).

With total agricultural employment remaining relatively stable over the decade, these declining shares have been driven by faster growth of employment in services. Overall, services increased as a share of employment in three-quarters of all regions and declined as a share in less than 10 per cent (figure 5.6).

Many of the falls in the share of agriculture were quite small, in the order of 1-2 percentage points. The number of regions in which agriculture directly accounted for more than 25 per cent of employment remained relatively stable — down from

221 in 1991 to 207 in 2001. Hence, despite the growth in services employment over the period, agriculture remains a key source of employment in regional Australia.

Changing employment shares within agriculture

The last two decades have also seen changes in the structure of the agricultural workforce. One of the reasons for this has been the differing rates of employment growth among agricultural industries.

Services to agriculture experienced the strongest employment growth over the period 1984-85 to 2001-02 — around 70 per cent or 10 000 additional jobs — to become the third largest employer in the sector. In part, this reflects the use of specialist skills through contractors and changing employment practices (box 5.1). Other agricultural industries recording relatively strong employment growth include commercial fishing, other crops, dairy and horticulture and fruit growing (see appendix C, table C.7)

Agricultural industries recording employment losses over the period 1984-85 to 2001-02 included — other livestock (down 42 per cent), forestry and logging (down 8 per cent) and grain, sheep and beef farming (down 3 per cent).

Box 5.1 **Farmers making greater use of specialised services**

The last few decades have seen changes in the skill set required by farm managers. Technological advancements, larger farms and greater awareness of environmental issues, have all meant that farmers are increasingly required to have a diverse set of skills. As Ferguson and Simpson (1995, p. 95) observe:

> Today's farm manager requires, more than ever, sound financial and risk management skills, rigorous pursuit of technological advances, a level of marketing knowledge and sound land and water management practices. All these skills are in addition to the specialist animal husbandry and/or agronomy skills required for each particular agricultural industry.

One of the outcomes of the increased knowledge and skills requirement of farmers is a significant growth in specialist contractors and consultants servicing the agriculture sector. With the growing complexity of farm management, farmers are hiring or leasing machinery and equipment, buying in services such as marketing and business management services, and seeking advice in areas such as agronomy (crop and soil management).

This trend is reflected in a rapid growth in employment in agricultural services — over the two decades to 2003-04, employment in this industry increased by almost 70 per cent, or by around 10 000 jobs.

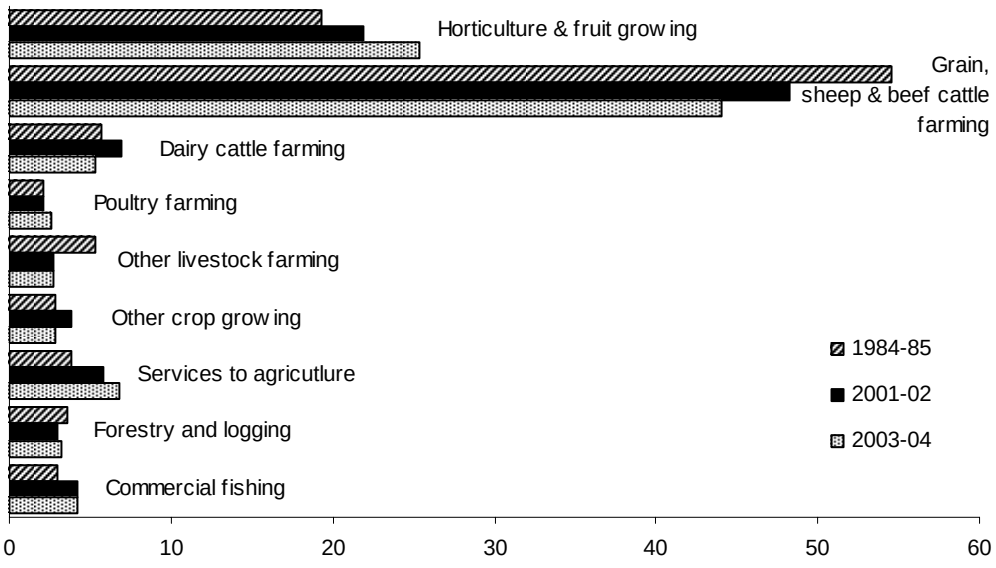
Source: Ferguson and Simpson (1995).

Over period 2001-02 to 2003-04, all agriculture industries (with the exception of poultry) experienced job losses. Losses were minimal in both horticulture and fruit growing (2.5 per cent) and services to agriculture (2 per cent). While the largest job losses occurred in the dairy industry (down 36 per cent or around 11 000 jobs), and other crop growing (down 37 per cent or around 6000 jobs). In the case of the dairy industry, this also coincided with the period of adjustment following further deregulation of the industry.

Higher employment growth rates in some of the more labour intensive industries have meant that some of these industries — horticulture and fruit growing, services to agriculture, poultry farming and commercial fishing — have tended to gain relative employment share over the last two decades. Industries losing employment share include grains, sheep and beef cattle farming, dairy, other livestock farming and forestry and logging (figure 5.7).

Figure 5.7 **Industry share of agricultural employment, 1984-85, 2001-02 and 2003-04**

Per cent



Data source: ABS (Cat no. 6291.0.55.001).

5.3 Some distinctive features

The agricultural workforce has a number of distinctive features. Compared with other sectors of the economy agriculture has:

- a high proportion of self-employed, family and casual workers;
- long job tenure;
- a relatively old workforce;

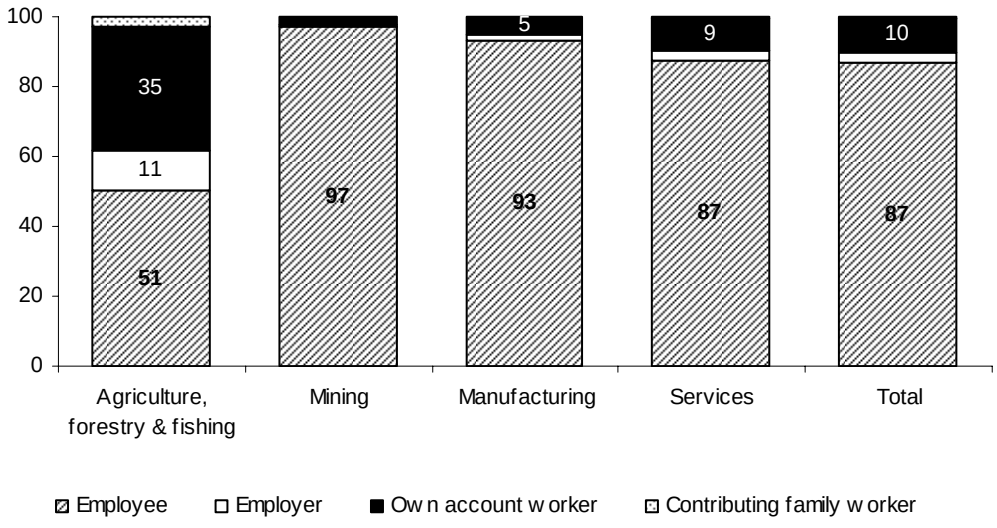
- a low incidence of post-school qualifications; and
- low employee wages.

Many of these features arise from the dominance of family operated businesses in this sector (99 per cent of Australian farms are family owned and operated), which provides flexibility in the use of labour in terms of hours worked and engagement in off-farm work. This section looks at trends in the distinguishing features of agricultural employment over the last 20 years, and provides comparisons with labour markets in other sectors of the economy.

A high proportion of self-employed and family labour

The agriculture workforce has a high proportion of self-employed (employers and owner account workers). In 2003-04, employers accounted for 11 per cent of the workforce and own account workers for 35 per cent. This compares with 3 per cent of employers and 10 per cent of owner account workers for the workforce as a whole. Employees make up around half the agriculture workforce, compared to more than 85 per cent for the workforce generally (figure 5.8).

Figure 5.8 **Status of employment by sector[a], 2003-04**
Per cent



a Employee — a person who works for an employer and receives fiscal remuneration; or a person who operates their own incorporated enterprise with or without hiring employees. Employer — a person who operates their own unincorporated enterprise or engages independently in a profession or trade, and hires one or more employees. Own account worker — a person who operates their own unincorporated enterprise or engages independently in a profession or trade, and hires no employees. Contributing family worker — a person who works without fiscal remuneration in an enterprise operated by a relative.

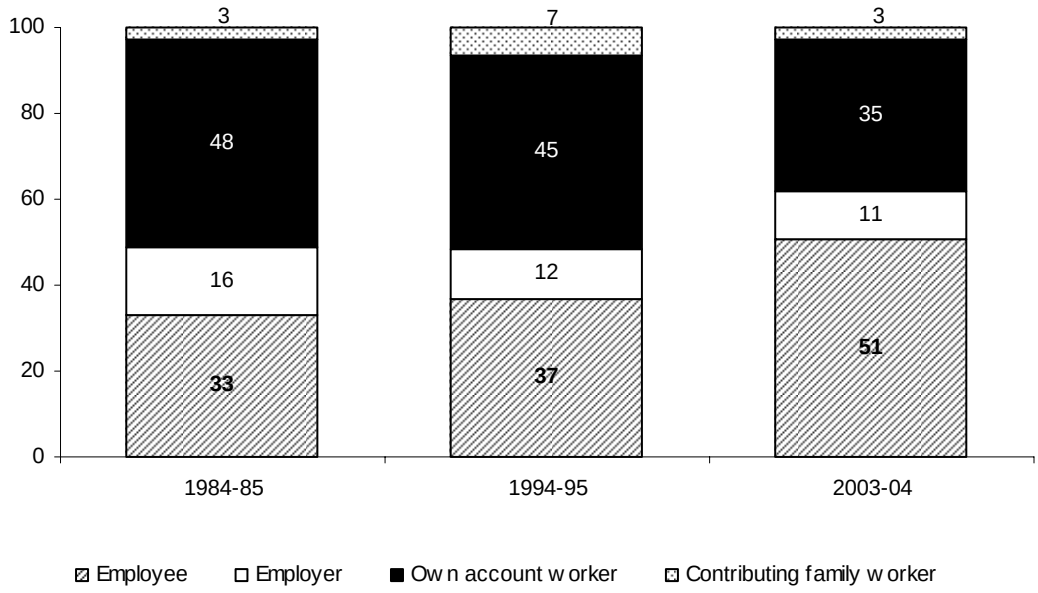
Data sources: ABS (Cat no. 6291.0.55.001), ABS Labour Statistics: Concepts, Sources and Methods (Chapter 4, 2001).

Agriculture is also the sector making greatest use of family labour — almost 3 per cent of the workforce in 2003-04 compared with less than 1 per cent for the workforce as a whole.

Over the last twenty years, the proportion of employers, own account workers and contributing family workers have all declined (figure 5.9). Most notable has been the fall in own account workers, from 48 per cent of the total workforce in 1984-85 to 35 per cent in 2003-04. The proportion of employees, on the other hand, increased from 33 per cent to be just over half of the total workforce in 2003-04.

Figure 5.9 **Status of employment in agriculture, forestry and fishing, 1984-85, 1994-95 and 2003-04**

Per cent



Data source: ABS (Cat no. 6291.0.55.001).

Employment losses resulting from the 2002-03 drought caused a decline in all categories of agricultural workers. With the exception of contributing family workers, the proportional decline was most pronounced amongst employers, amounting to around 20 per cent. Lu and Headley (2004, p. 38) suggest that one of the strategies adopted by farmers to contend with the effects of the drought was to reduce the level of on-farm employment, thus, in some cases, farmers changing their employment status from employer to own account worker.

The increased reliance on paid employees in the agriculture workforce over the last 20 years, in part, can be linked to the trend towards larger farm sizes. Demographic changes such as smaller family sizes (fewer children to help on the farm) and other influences, such as more family members working off-farm, have also reduced the

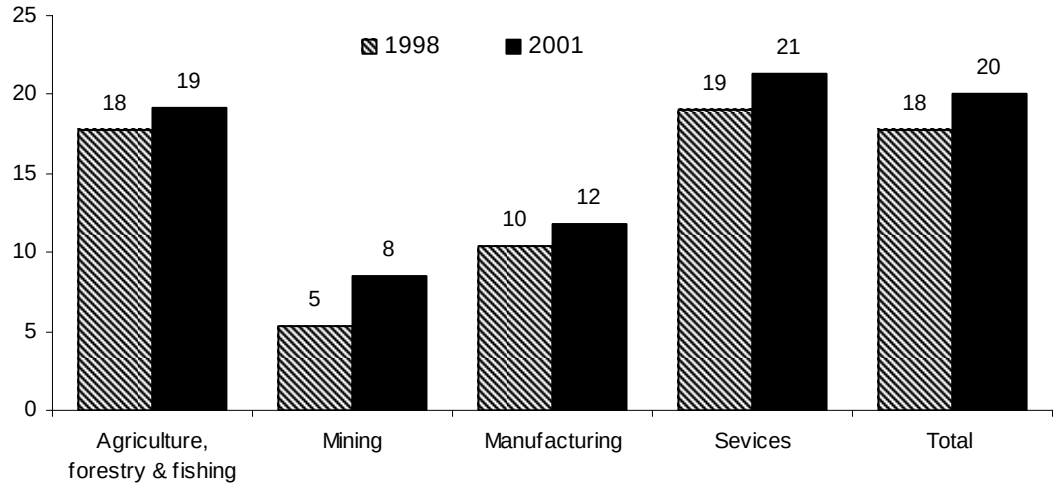
supply of family labour and, hence, increased the share of hired labour. Consistent with this, the number of paid employees per farm increased from around 2.1 in 1984-85 to almost 2.5 in 2002-03.

Casual and part-time labour

Agriculture also stands out as having a relatively high proportion of self-identified casual employees — almost 20 per cent of total employment — similar to that in the service sector, but significantly higher than in either mining or manufacturing (figure 5.10).

Figure 5.10 **Proportion of self-identified casuals in the total workforce, by sector[a], 1998 to 2001**

Per cent



a Self-identified casuals are persons who (a) were not entitled to receive both paid holiday and sick leave, (b) considered their job to be casual, and (c) worked in someone else's business or reported that they worked in their own unincorporated business but paid PAYE tax and did not invoice clients for own payment.

Data source: ABS (Cat no. 6359.0).

Factors contributing to this feature of agricultural employment include:

- the seasonal nature of agricultural work, for example, harvesting and shearing in broadacre industries or pruning and harvesting in horticultural industries, and
- the potential for workers to be employed by a number of employers (across several industries) thus, combining multiple and consecutive casual agricultural jobs in order to obtain continuous work (Rural Industry Working Group 2001).

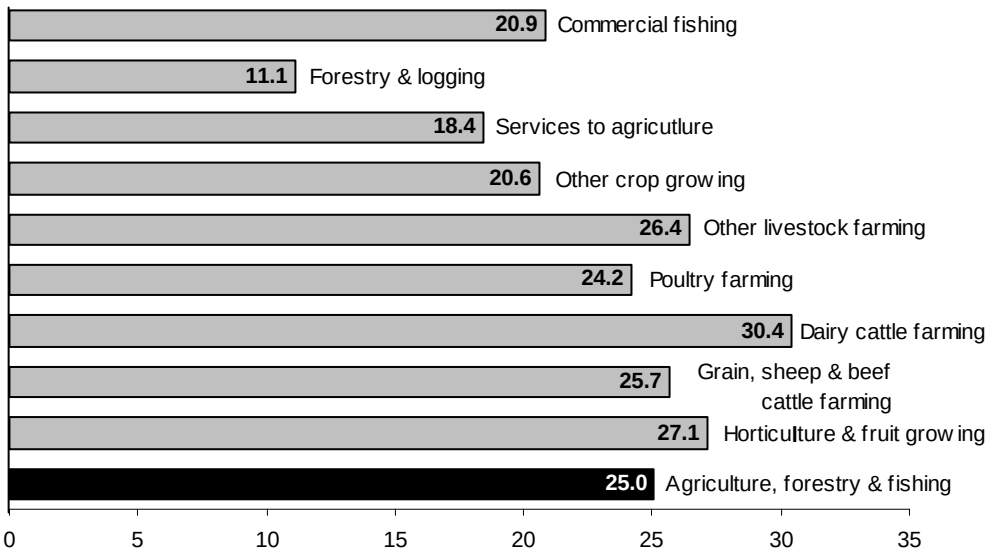
As with other sectors of the economy, there has been an increase in the use of casual labour in the agricultural sector (figure 5.10). This is likely to reflect changing labour supply demographics, demand for workforce flexibility and institutional changes (Murtough and Waite 2000).

Part-time jobs

In 2003-04, around a quarter of all agriculture jobs were part-time. This is considerably higher than the proportion of part-time jobs in both mining (4 per cent) and manufacturing (12 per cent), but lower than services (31 per cent).

Some agricultural industries rely more on part-time employment than others. Agricultural industries with a relatively high proportion of part-time employment include dairy, horticulture and fruit growing and other livestock. Forestry and logging, where the nature of the work tends to be structured more like that of the manufacturing sector, stands out as having a relatively low proportion of part-time employment (figure 5.11).

Figure 5.11 **Part-time employment by industry, 2003-04**
Per cent



Data source: ABS (Cat no. 6291.0.55.001).

In the early 1980s, agriculture recorded a relatively high proportion of part-time jobs. However, over the last 20 years, part-time jobs in the sector increased at a slower rate than part-time jobs in the economy more generally. As such, since 1991-92, the part-time share of employment in agriculture has dropped below that for the economy as a whole (see appendix C, table C.8 and C.9).

In 2003-04, there were around 5000 more females employed in part-time jobs than in full-time jobs in agriculture. This is a long term feature of female employment in agriculture, with part-time employment remaining slightly greater in absolute terms than full-time employment throughout most of the last 20 years (box 5.2). In all other sectors of the economy, the share of females in full-time employment is greater than the share in part-time employment.

Part-time employment in agriculture has also become more prevalent for males. Over the period 1984-85 to 2003-04, the proportion of males employed in part-time jobs increased from 5 to 9 per cent.

Box 5.2 **Women on Australian farms**

Over the last two decades, the proportion of women employed in agriculture increased from 26 to 31 per cent (women employed full-time in agriculture increased from 12 to 15 per cent, while those employed in part-time employment increased from 14 to 16 per cent).

The role of women on Australian farms has also changed in recent decades. As Barr (2002, p. 3), put it:

> Few women living on farms today identify with the once traditional role of 'farmers wife'. They are increasingly likely to identify as a joint farm manager or as having an occupational life separate from the farm business. It has been estimated that women number 40 per cent of farm business partners and 32 per cent of the farm paid workforce. Many women work off the farm to support farm family living standards.

Some of the factors driving the changing role of women in agriculture include changes to the demographic composition and economic situation of family farm households, the growth of part-time employment, as well as changes in the returns to labour, both in farming and in off-farm work.

Work by ABARE (Gooday 1995, p. 8) has shown that the extent and nature of women's contribution on Australian farms varies widely. Some women work alone on the farm and are solely responsible for the decision making and the operation of the farm. Others have numerous responsibilities, such as assisting on the farm during peak times, doing the farm accounts and undertaking financial management and planning for the farm.

(Continued on next page)

Box 5.2 **(continued)**

Women in the dairy industry spend significantly more time working on-farm than women in broadacre industries, while women in the broadacre industries tend to spend more time in off-farm employment.

ABARE has also found that women's involvement in farm activities declines as the size of the farm increases — generally the average number of weeks worked on-farm by women is lower for farms of more than 200 hectares. Similarly, the average number of weeks worked off-farm by women tends to be lower for farms with higher capitalisation. And, as debt levels increases, there is a corresponding increase in the time women spend working both on and off-farm.

There also appears to an inverse relationship between the amount of time worked on-farm and off-farm and the level of income generated by the farm enterprise — the average number of weeks worked off-farm by both women and men tend to be lower for those farms with higher farm income. According to Gibson, Baxter and Kingston (cited in Salce, 1995 p. 331) women's labour both on and off-farm, particularly in poor seasons, has been 'crucial in maintaining the family income, particularly of family farms in recessions'.

Sources: Barr (2002); Salce (1995); Garnaut, Rasheed and Rodriguez (1999); Gooday (1995).

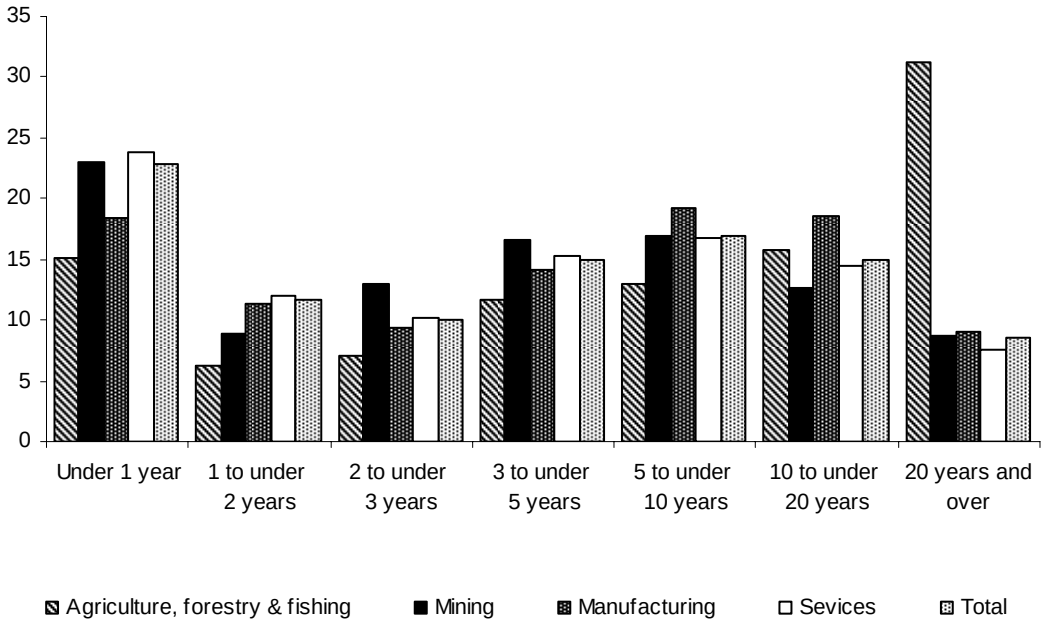
Farmers stay in their jobs longer

The agriculture workforce is characterised by relatively long job tenure. In 2004, around 50 per cent of the agriculture, forestry and fishing workforce had been in their current job for 10 years or more — a share almost double that seen in other sectors of the economy. And, about 30 per cent of the agriculture workforce had spent 20 years or more in their current job, a share more than three times higher than in other sectors of the economy (figure 5.12).

This trend is not new — in 1983 around 40 per cent of agricultural workers had worked in their current job for 10 years or more. It reflects, in part, the high proportion of family owned and operated farms in Australia and the significant financial investment tied to assets on the farm. But as noted by Barr (2004, p. 7) other factors are relevant, including that:

> '[F]or many persons working in agriculture, farming is felt to be not just an occupation but a way of life'.

Figure 5.12 **Years working in current job by sector, 2004**
Per cent



Data source: ABS (Cat no. 6209.0).

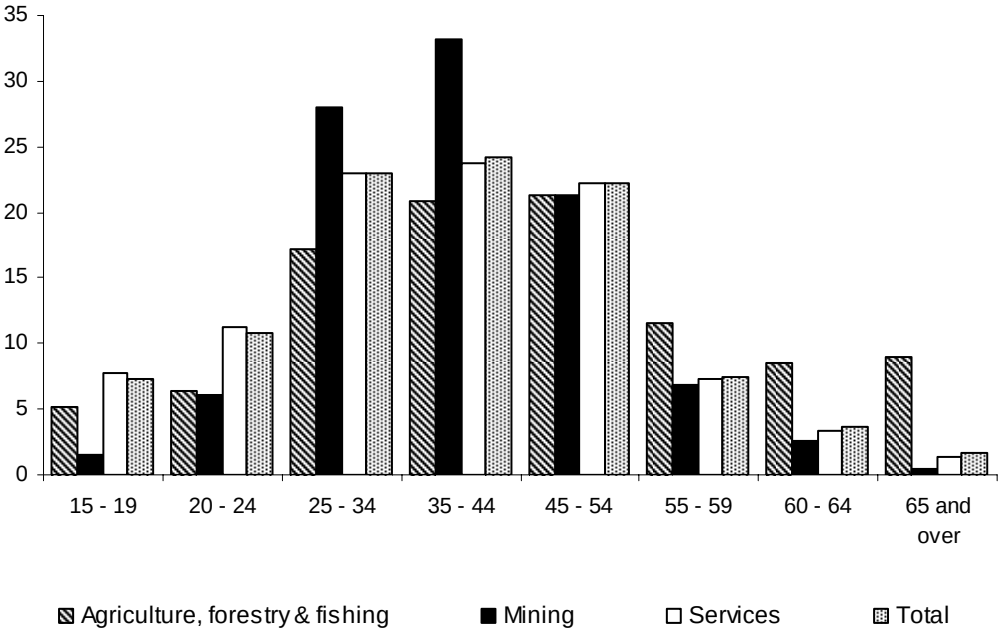
… and this is reflected in the sectors age profile

The agriculture workforce is also older on average than the workforce in general (figure 5.13). In 2003-04, around 71 per cent of the agriculture workforce were aged 35 years or older. This compares with around 59 per cent of workers in all industries (see appendix C, table C.10)

Several factors have contributed to the skewed age profile of workers in the agriculture sector compared to other sectors of the economy, including:

- fewer young people entering farming;
- low exit rates at traditional retirement age, possibly compounded by limited interest of young people in taking over the family farm; and
- delayed exit decisions in response to reduced farm capital during poor seasons or reduced market values during periods of low commodity prices (Barr 2004).

Figure 5.13 **Age profile of agricultural workers, by industry 2004**
Per cent



Data source: ABS (Cat no. 6291.0.55.001).

Reflecting the tendency for those working in the sector, particularly those in farming, to work beyond the traditional retirement age, the share of agriculture's workforce aged 65 or older is significantly higher than in other sectors of the economy. In 2003-04, there were around 9 per cent of agricultural workers aged 65 years or over — this is more than 4 times the percentage of workers in this age category in the workforce generally.

Using census data, Barr (2004) estimates that the median age of agriculture workers has increased from 44 in 1981 to 50 in 2001. The results for each census year between 1976 and 2001 indicate that the median age reached a minimum in 1981, but has been increasing at a uniform rate over the last two decades.

There are, however, differences in the age profile of workers in the different agriculture industries. Both the beef and sheep industries have a more aged worker profile than the more labour intensive industries (see appendix C, figure C.1). In 2001, almost half of the workers in the beef industry were aged 55 years or older. In contrast, the horticulture and dairy industries had younger age profiles, with less than 25 per cent of workers in each of these industries aged 55 years or older. Barr (2004, p.42) suggests that:

> The differing age profiles of agricultural industries suggests that the increasing median age of Australian farmers may be due to differential adjustment patterns within industries.

Qualification and occupational profile

Agriculture workers typically have lower levels of formal tertiary qualifications than workers in other sectors of the economy. The proportion of the agriculture workforce:

- without post-school qualifications is around 20 percentage points higher than for the workforce generally (61 per cent compared to 42 per cent); and
- with university training is more than three times lower than that for the workforce generally (table 5.2).

Table 5.2 **Educational attainment in the Australian workforce, 1984, 1994 and 2004[a]**

Per cent

	University degree			*Other post-school qualifications*			*Without post-school qualifications*		
Sector	*1984*	*1994*	*2004*	*1984*	*1994*	*2004*	*1984*	*1994*	*2004*
Agriculture, forestry & fishing	**2.3**	**4.5**	**6.8**	**23.8**	**23.8**	**31.4**	**73.1**	**70.0**	**61.0**
Mining	8.1	14.4	17.3	44.8	35.8	46.7	47.1	49.8	35.3
Manufacturing	4.5	7.2	13.1	35.0	36.7	40.3	60.2	55.5	45.8
Services	11.7	16.5	24.3	35.5	32.5	34.1	51.1	48.4	40.7
Total	9.6	14.6	22.4	34.5	32.7	34.9	54.5	50.4	41.9

a Other post-school qualifications include vocational training and all other non-university diplomas and certificates. It also includes (the small populations of) people who are still at school.

Sources: ABS (Cat no. 6227.0); Unpublished ABS data.

As is the case for the workforce generally, the educational attainment of agriculture workers has been increasing. While starting from a lower base, agriculture has tended to exhibit stronger growth in educational attainment in its workforce. For example, between 1984 and 2004, the proportion of university graduates in the Australian's workforce more than doubled, while for agriculture the proportion of university graduates almost tripled.

The last decade has also seen a rapid increase in the share of workers with other post-school qualifications. And, despite the increase in the prevalence of university qualifications amongst the agriculture workforce, there remains a greater share of workers with other post-school qualifications — non-university studies, in particular trade and vocational qualifications gained through the vocational, education and training sector.

In assessing the qualifications and skills profile of workers in the agriculture sector, recognition needs to be given to traditional arrangements within the sector for the development of work skills — largely dominated by on-farm learning undertaken as part of employment (Cullen and Cullen 1994, p. 11 and Synapse Consulting 1998, p. 12). However, as Cary et al. (2001, p. 24) suggest:

> It is reasonable to assume, increasingly in the future, that more complex sustainable management practices will be more easily grasped and integrated into farming systems by those with higher levels of formal education.

In comparison to the rest of the economy, the agriculture workforce is dominated by managers and administrators (again reflecting the dominance of owner-operators), with the next most prevalent occupation being labourers and related workers (see appendix C, table C.11).

Earnings

Agriculture has a high proportion of relatively low paid employees compared with other sectors of the economy. In 2003, 68 per cent of all full-time agriculture employees earned less than $700 per week. This compares with 40 per cent of full-time workers across all sectors of the economy. Fourteen per cent of agriculture workers earned in excess of $1000 per week, compared with almost 30 per cent of workers in all sectors of the economy (figure 5.14).

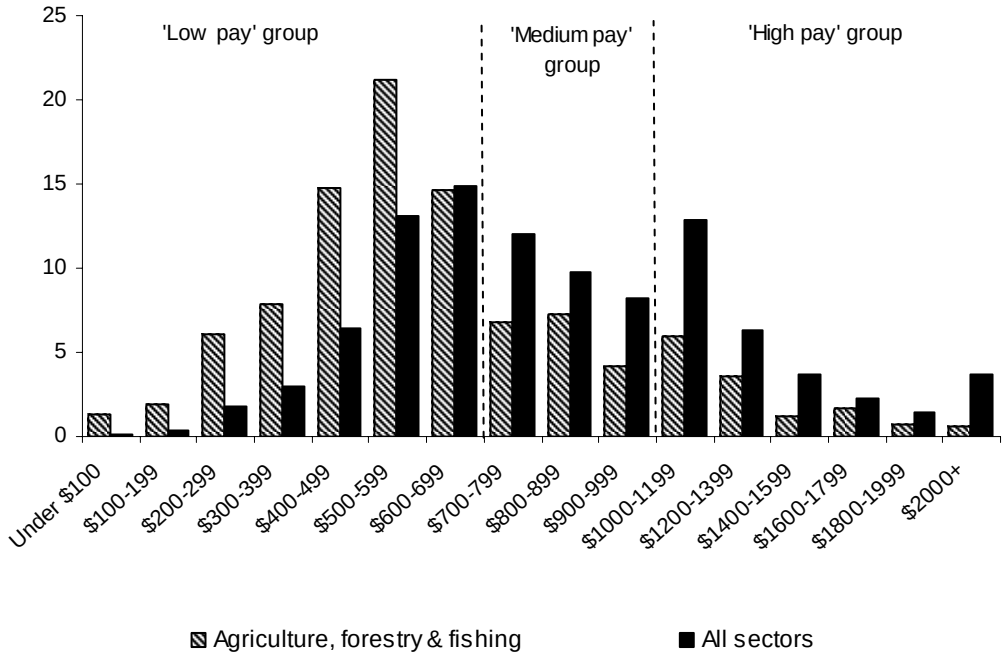
The median weekly earnings for full-time paid employees in agriculture in 2003 was $575. This was around one third lower than the median weekly income for all full-time employees ($769), making agriculture workers the lowest paid workers in the economy. The next lowest paid, on average, were employees in the retail trades ($600) and accommodation, cafes and restaurants ($610).

However, there are often non-wage benefits available to employees in agricultural jobs — such as low cost accommodation and other payments in kind — which may compensate, to some extent, for the sector's relatively low wages.

These data, however, only relate to full-time employees and as such exclude the self-employed (own account workers and employers) and other family labour which account for around half of the agricultural workforce.

Figure 5.14 **Distribution of paid employees by weekly full-time earnings[a], August 2003**

Per cent



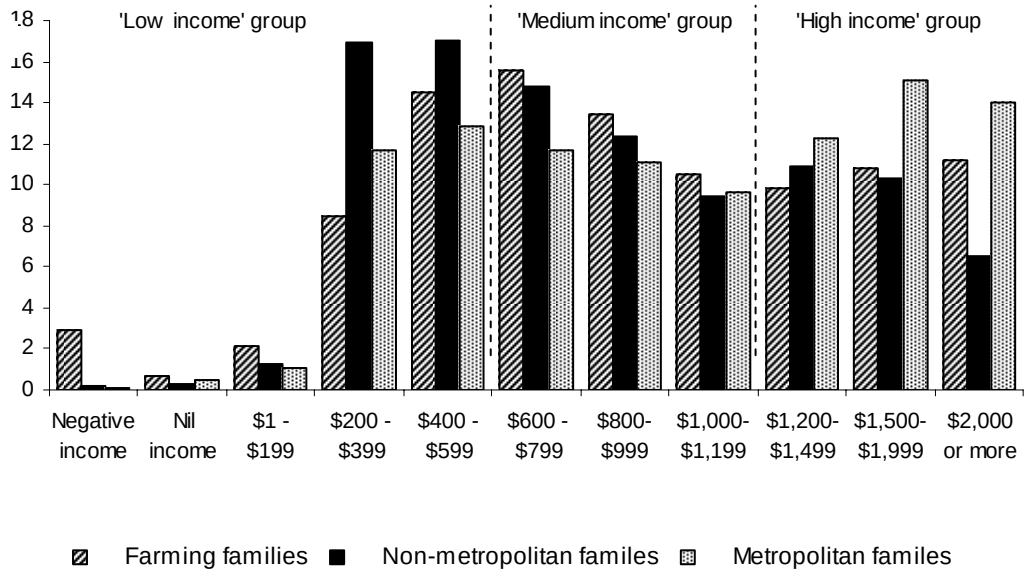
a These data refer to weekly earnings in main job for full-time paid employees and as such exclude the self-employed (own account workers and employers) and other family labour which account for around half of the agricultural workforce. Following McLachlan et al. (2002), the three groups were structured so that each accounted for as close to one third of total employment as possible – low, medium and high accounting for 40, 30 and 30 per cent respectively of Australia's total employment.

Data source: ABS (Cat no. 6310.0).

Compared to the distribution of full-time employees' earnings, the distribution of income for farming families more closely resembles that in the rest of the economy (figure 5.15). In 2001, around 29 per cent of farming families had relatively low incomes (less than $600 per week) — the same proportion of low income families as the rest of the economy. There was, however, a greater proportion of farming families earning negative incomes. That said, a higher proportion of other non-metropolitan families — around 36 per cent — had relatively low incomes (less than $600 per week) in 2001.

Figure 5.15 **Distribution of gross weekly income for farming families, other non-metropolitan families and metropolitan families[abc], 2001**

Per cent



a Gross weekly income is self-reported and includes various government payments or benefits such as, family payments, additional family payments, pensions, unemployment benefits, student allowances, maintenance payments (child support), as well as non-government income from superannuation, wages, salary, overtime, dividends, rents received, interest received, business or farm income (less operating expenses) and workers' compensation. **b** Excludes families where one or more persons did not state their income. **c** Metropolitan is defined as capital city urban centres and any other urban centres (or part urban centres) in the state with a population over 100 000 (Gold Coast/Tweed Heads, Canberra/Queanbeyan, Newcastle, Central Coast, Wollongong, Sunshine Coast, Geelong, Townsville-Thuringowa).

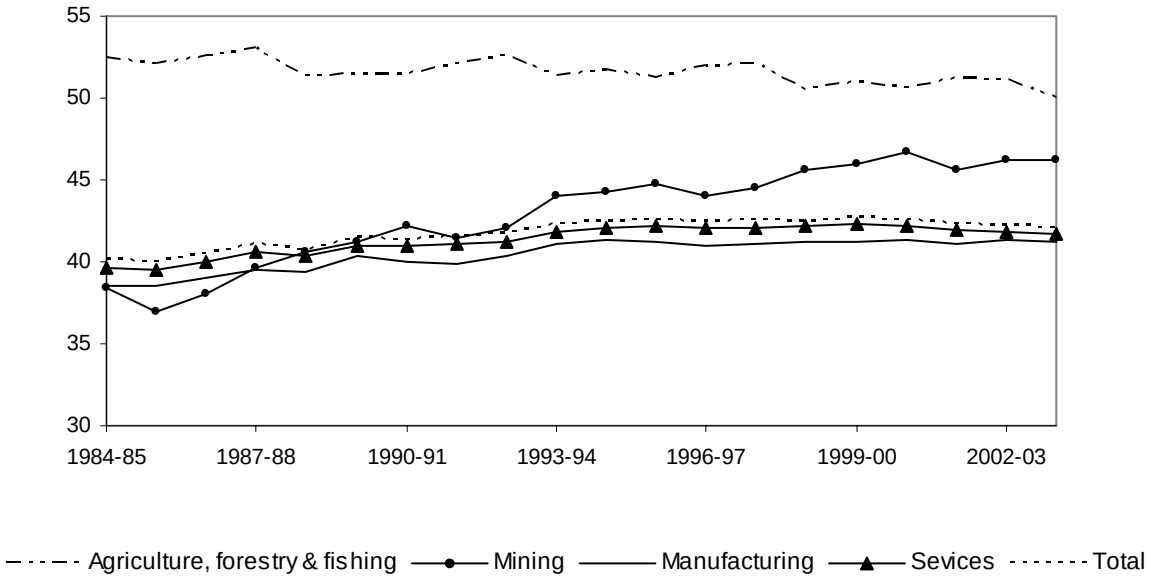
Data source: Unpublished ABS data.

Work intensity

Agriculture workers also work more hours per week than workers in other sectors of the economy. In 2003-04, full-time agriculture workers worked an average of 50 hours per week. This compares with 42 for the total workforce.

Over the last twenty years, however, average hours worked by those employed full-time in agriculture have fallen by 2 hours per week. This trend is the reverse of that exhibited in the other sectors of the economy where average working hours have increased by 2 hours per week (figure 5.16). As the average working week in agriculture dropped from 12 to 8 hours greater than the economy-wide average, this has lead to the convergence of average hours worked by workers in all sectors of the economy over the period 1982-83 to 2003-04.

Figure 5.16 **Average full-time hours per week worked in main job, 1984-85 to 2003-04**



Data source: ABS (Cat no. 6291.0.55.001).

Factors likely to have influenced the rate of decline in hours worked by those working full-time in agriculture include:

- trends within the sector toward labour saving technologies and intensification (chapter 3); and
- an increase in the incidence of off farm work (see following section). This may have reduced the number of hours an individual works in agriculture, although their total average hours worked per week may not have declined.

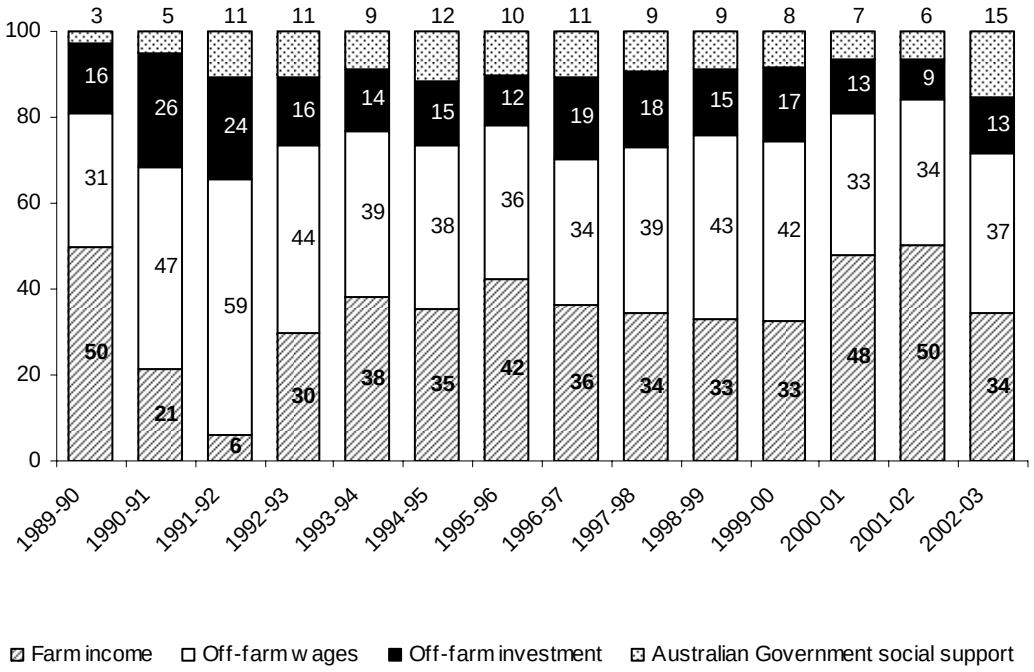
ABARE farm surveys data regarding the source of farm labour for broadacre industries shows that total hours worked by 'other' family members (apart from the farm operator and spouse), paid permanent and casual workers and sharefarmers has remained relatively stable at around 30 hours per week in the years since 1994-95. This suggests that the reduction in average working hours has been concentrated among employers and own account workers — that is, the farm operator and spouse.

Off-farm income

The contribution of off-farm income — that is, off-farm wages and salaries investment dividends, rents and other business income and government social support payments — has averaged around 65 per cent of the total income of broadacre farm families between 1989-90 and 2002-03, not being less than 50 per

cent in any single year (figure 5.17). Variations in the contribution of off-farm income between years largely reflects the volatility of income from farm production (figure 5.17).

Figure 5.17 **Income sources for broadacre farm families[abc]**
Per cent



a Includes only the broadacre industries surveyed by ABARE: wheat and other crops, mixed livestock-crops, sheep, beef and sheep-beef industries. **b** Excludes off-farm income from employment in a business owned or part-owned by the operator or spouse. **c** Includes social security, student assistance and veterans' payments made to the farm operator and spouse only, and excludes payments targeted to businesses, such as fuel rebates, structural adjustment and exceptional circumstances payments or payments received by other family members, such as youth allowance.

Data source: ABARE farm surveys data.

Off-farm employment has become increasingly important to maintaining broadacre family farm incomes. Over the period 1989-90 and 2002-03:

- the proportion of farm families who derive a share of their income from off-farm wages and salaries increased from 30 to 45 per cent; and
- average annual broadacre farm income earned from off-farm wages and salaries more than doubled in real terms — from $15 000 (31 per cent of average farm income of $82 000) to around $33 500 (37 per cent of average farm income of $137 500).

Off-farm work is typically undertaken by spouses (in most cases the female partner (Garnaut et al. 1999)). Since 1989-90, the average number of off-farm hours worked by spouses involved in broadacre industries has more than doubled, from 4 to 9 hours in 2002-03. And, while less common, there has also been a marginal increase in the participation of farm operators in off-farm work, involving an increase of about one hour per week between 1989-90 and 2002-03, to an average of 4 hours per week (box 5.3).

Box 5.3 **Gender differences in off-farm work**

Other than participation rates, notable gender differences also occur in terms of the location of off-farm work and the distribution of off-farm jobs by occupation and industry.

Garnaut et al. (1999) found that around 84 per cent of women with off-farm jobs work in towns, with two thirds working in an urban centre with a population of more than 20 000. Women working off-farm largely work in managerial or professional occupations in the education (34 per cent) and health and community services industries (22 per cent).

In contrast, just over 40 per cent of men with off-farm jobs work in town, while 32 per cent work on other farms. The most common occupations for men working off-farm were labourers (42 per cent) and tradespersons (23 per cent), with almost as many men working in off-farm jobs in the agriculture, forestry and fishing sector (47 per cent) as in all other industries combined.

Source: Garnaut et al. (1999).

As participation in off-farm work involves a trade-off with on-farm activities, several factors have had an influence on farm families' decisions and abilities to participate in off-farm work, including:

- education levels. Off-farm employment tends to be associated with higher education levels for both men and women (Rasheed et al. 1998);
- remoteness or distance to potential off-farm employment opportunities. Average incomes received from off-farm work tend to be lower for people living in remote locations, reflecting the more limited range of off-farm opportunities in these locations (Garnaut and Lim-Applegate 1998);
- labour requirements on the farm. Off-farm employment (both for farm operators and spouses) tends to be lower for those involved in industries with greater on-farm labour requirements, such as dairying. For example, in 1996-97, the share of operators and spouses with off-farm employment in the dairying industry was around 20 and 14 percentage points lower, respectively, than the share for those involved in broadacre industries (Rasheed et al. 1998); and

- the life cycle of the individual farm family. Young families, often those with dependent children, tend to rely more heavily on wages and salaries from off-farm employment as a mechanism to aid capital accumulation. Other off-farm income sources, such as investment dividends or rents, tend to be more important for older farm families who have had a longer period in which to develop investments capable of providing an ongoing income stream (Garnaut and Lim-Applegate 1998).

The greater contribution of off-farm income is not a phenomenon unique to Australian agriculture. The share of household income from off-farm sources has increased in most OECD countries over the last 20 years (OECD 2003b).

6 Agriculture's productivity performance

Key points

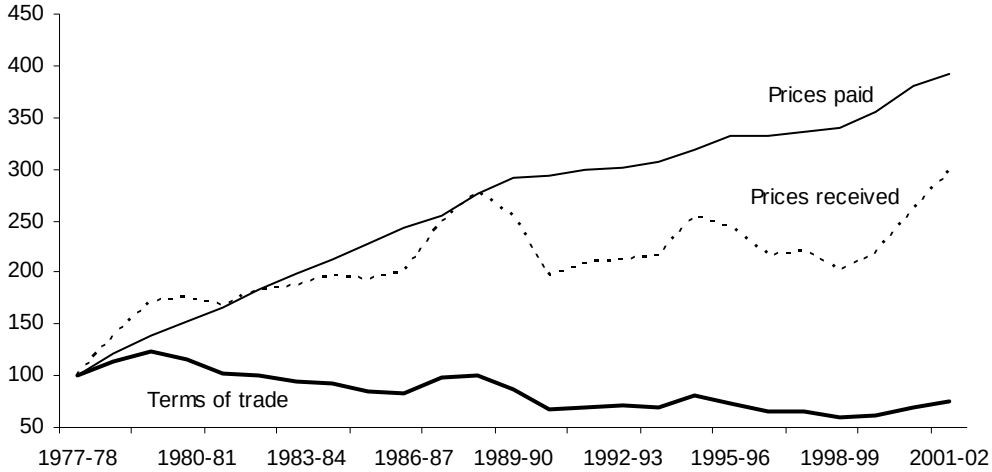
- Agriculture productivity, while quite volatile because of seasonal variations, has exhibited strong growth over the longer-term.
- Multifactor productivity (MFP) growth for the agricultural sector averaged almost 3 per cent a year over the period 1974-75 to 2003-04 (or 2.3 per cent a year in trend terms). This was considerably stronger than that achieved in Australia's market sector where the MFP growth rate averaged 1.1 per cent a year (1 per cent a year in trend terms) over the same period.
- Agriculture is a strong contributor to the economy's overall MFP growth. Over the period 1974-75 to 2003-04, it accounted for 16.5 per cent of market sector MFP growth. This was more than double it's share of market sector value-added.
- Agriculture has exhibited considerably stronger productivity growth from the mid-1990's — in trend terms, MFP increased by around 4 per cent a year between 1993-94 and 2003-04.
- Productivity growth has accounted for the entire increase in output by the agricultural sector over the last thirty years and has produced sizeable benefits — an estimated productivity 'dividend' of just over $170 billion.
- Over the last three decades, the highest productivity gains have been achieved by the cropping industry. Mixed crops-livestock, beef and dairy farms achieved the next highest growth rates. Productivity growth for sheep and sheep-beef farms has been modest and insufficient to offset the deteriorating terms of trade for these farms.
- Key sources of productivity growth include advances in knowledge and technology, better use of available technologies and management practices, and structural changes such as increases in farm size and shifts in enterprise mixes.
- International data suggest that, in 2001, labour productivity levels in Australian agriculture were below that for the United States and Canada, but above the OECD average by around 30 per cent. In terms of MFP growth, Australian agriculture has performed relatively strongly over the last two decades — recording a growth rate similar to the United States, but lower than Canada and Denmark.

This chapter looks at the productivity performance of Australia's agriculture sector over time and across agricultural industries. The chapter also compares Australia's agriculture sector experience with those of other sectors of the economy and other OECD countries. Factors influencing productivity growth in agriculture are also examined.

6.1 Productivity growth — why is it important?

Productivity growth is central to the performance and international competitiveness of Australia's agriculture sector. As discussed in chapter 4, most Australian farmers are highly dependent on world markets where they are largely 'price takers'. The past 25 years have seen world prices for many agricultural commodities decline significantly in real terms. Farmers are also often unable to exert any control over the prices they pay for their off-farm inputs to production. Over the period 1977-78 to 2001-02, prices received by Australian broadacre farmers increased, on average, by 2.3 per cent a year, while input costs over the same period increased by 4.8 per cent a year — the result being a decline in their terms of trade of 2.5 per cent a year (figure 6.1).

Figure 6.1 **Terms of trade, Australian broadacre farms, 1977-78 to 2001-02**
Index 1977-78 = 100



Data source: ABARE Farm Surveys.

Faced with a persistent declining terms of trade, the challenge for Australian farmers has been to find ways to improve productivity to reduce costs in order to remain competitive and maintain or improve farm incomes.

Productivity growth means that resources — such as labour, capital and land — are being used more effectively and efficiently. Increased output and lower costs means that with more income per head of population, Australians can enjoy a higher standard of living. It can also translate into lower food prices for consumers.

Productivity growth in the agricultural sector can also be beneficial for the environment — less land, water and chemicals to produce the same amount of output can mean reduced environmental problems associated with the use of such inputs.

6.2 Measuring productivity

What is productivity?

Productivity is a measure of the efficiency with which inputs are used to produce output.

There are a number of different productivity measures. Productivity *levels* are a measure of the ratio of output to inputs, for example, the number of litres of milk produced per dairy cow or crop yield per hectare.

Productivity *growth* is the amount of output growth in excess of input growth over a specified period, or put another way, the increase in output that cannot be accounted for by an increase in inputs. For example, if output grew by 6 per cent a year over a 10 year period and inputs grew by 4 per cent a year, productivity growth would be 2 per cent a year. Evidence of productivity growth usually means that ways have been found to create more output from given inputs, or alternatively, to produce the same output with fewer inputs.

How is productivity measured?

Productivity can be measured in relation to a single input — such as labour or capital — yielding a partial measure of productivity performance. *Labour productivity* is the most commonly used partial productivity measure. It is a useful measure as it typically relates to the single most important factor of production for many industries. It is also relatively easy to measure. Labour productivity reflects the influence of a host of factors, such as the personal capacities of workers, the intensity of their work effort, the nature and extent of capital equipment used and management practices. Similarly, *capital productivity* can reflect technological changes and changes in other factor inputs (including labour), as well as improvements in the organisation of production processes.

Multifactor productivity (growth in output relative to the combined contribution of key inputs, usually labour and capital) provides a more comprehensive performance measure as it takes account of changes in the main inputs used to produce output. MFP is, however, more difficult to measure.

The choice between the different measures is generally influenced by the purpose of productivity measurement but also, often on practical grounds, by the availability of data.

Measuring productivity for agriculture

Productivity in the agricultural sector is influenced by a range of factors, some of which are outside the control of the farmer. Seasonal variations, for instance, have a significant influence on farm output and input use and hence productivity. For this reason, when measuring productivity improvements 'attempts' should be made to isolate trend rates of growth from the effects of short-term influences.

Point-to-point estimates of productivity growth for agriculture can also be highly sensitive to the choice of start and endpoints. While short-term influences such as variations in rainfall can be expected to even out over extended periods of time, when estimating productivity growth it is important to consider the choice of start and end points to ensure that the years chosen are not 'atypical' (for example, a drought year).

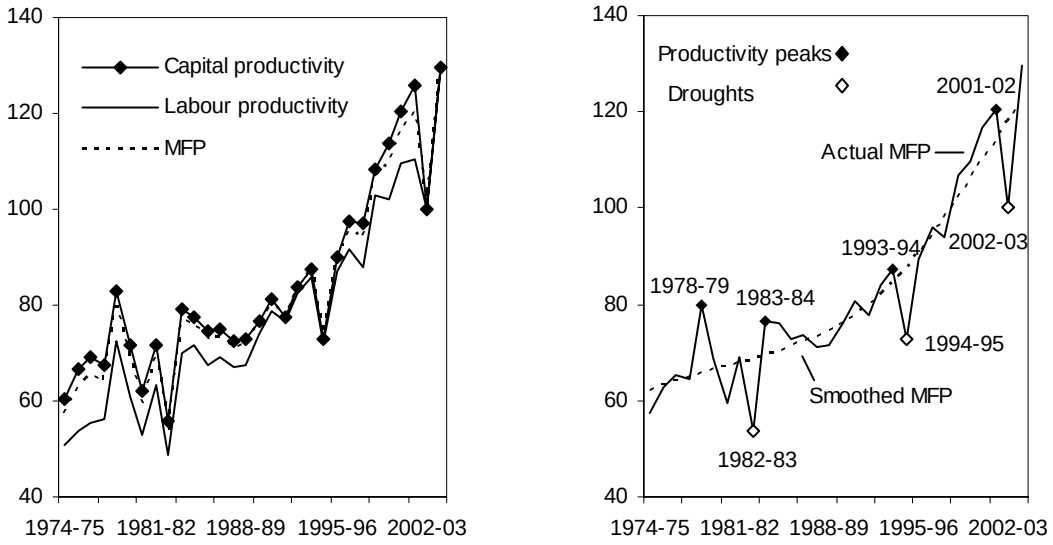
6.3 Trends in agricultural productivity

Agriculture productivity has exhibited strong growth over the longer-term. MFP growth for the agriculture sector — on the basis of start and end points — grew at 2.8 per cent a year from 1974-75 to 2003-04 (figure 6.2). This is considerably stronger than the productivity growth rate achieved for the Australian economy as a whole. The market sector[1] MFP growth rate over the same period was 1.1 per cent a year.

[1] Data limitations make it difficult to analyse productivity growth for the economy as a whole. Analysis is therefore usually limited to the 'market sector' of the economy, or to those industries for which there are reasonably well defined output and input measures and associated prices. The industries excluded from the market sector include: property and business services; government administration and defence; education; health and community services; personal and other services. For these industries, output is not measured independently of inputs and, in most cases, 'value' is measured in terms of the cost of the labour inputs used by them.

Figure 6.2 **Labour, capital and MFP in the agriculture sector, 1974-75 to 2003-04[ab]**

Index 2001-02 = 100



a For a discussion of how peaks were determined see appendix D. **b** Trough to trough estimates are 2.6 per cent a year between 1982-83 and 1994-95 and 4.0 per cent a year over the period 1994-95 to 2002-03. The 'Smoothed MFP' series is calculated by smoothing the original data using a Hodrick-Prescott filter.

Data Source: PC (2004 Productivity Estimates to 2003-04, December, http://www.pc.gov.au/commission/work/productivity/performance/industry.html).

Growth in labour and capital productivity for the agriculture sector largely mirror growth in MFP. Over the period 1974-75 to 2003-04, labour productivity and capital productivity increased by 3.3 and 2.7 per cent a year, respectively (figure 6.2).

As is evident from figure 6.2, there has been considerable variation in agriculture's productivity growth from year to year. This is largely because of seasonal variations — drought effects on agriculture, for example, are evident in 1982-83, 1994-95 and 2002-03.

One way of isolating the long-run trend rates of growth in productivity from the short-term effects of seasonal influences is to use the data from all years and fit simple growth models, such as log-linear trends. Using this approach, over the period 1974-75 to 2003-04, trend growth in the agriculture sector's MFP is estimated to have averaged around 2.3 per cent a year. This compares with trend MFP annual growth for the market sector of 1.0 per cent a year over the period.[2]

2 These estimates are calculated by regressing the log of the data against a constant and a time trend using original (unadjusted) data. This differs from ABS trend data, which are produced by applying a Henderson smoothing algorithm to the original data series (ABS Cat. no. 5216.0).

Peak-to-peak trends are another way of isolating seasonal variations and other random factors in order to make a more meaningful comparison of productivity over time. Peak-to-peak analysis (see appendix D) shows that MFP in Australian agriculture:

- declined at an annual average rate of 0.8 per cent between the 1978-79 and 1983-84 peaks;
- increased by 1.3 per cent a year in the decade between 1983-84 and the pre-drought peak of 1993-94;
- increased by 4.1 per cent a year between 1993-94 and the pre-drought peak of 2001-02; and
- increased by 1.8 per cent a year between 1978-79 and 2001-02 (figure 6.2).

These results confirm the visual observation that MFP in the Australian agricultural sector was relatively subdued between the mid-1970s and the late-1980s, followed by a strong productivity surge during the 1990's. In trend terms, MFP increased at an annual average rate of 1.3 per cent between 1974-75 and 1989-90 and 3.7 per cent per year between 1989-90 and 2003-04.

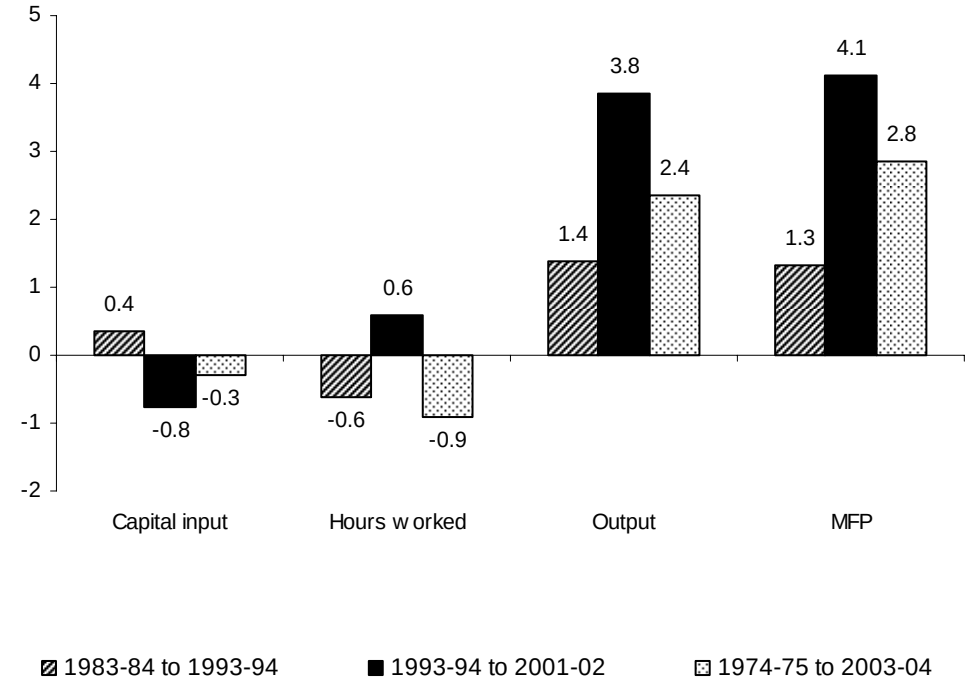
Productivity growth rather than input growth

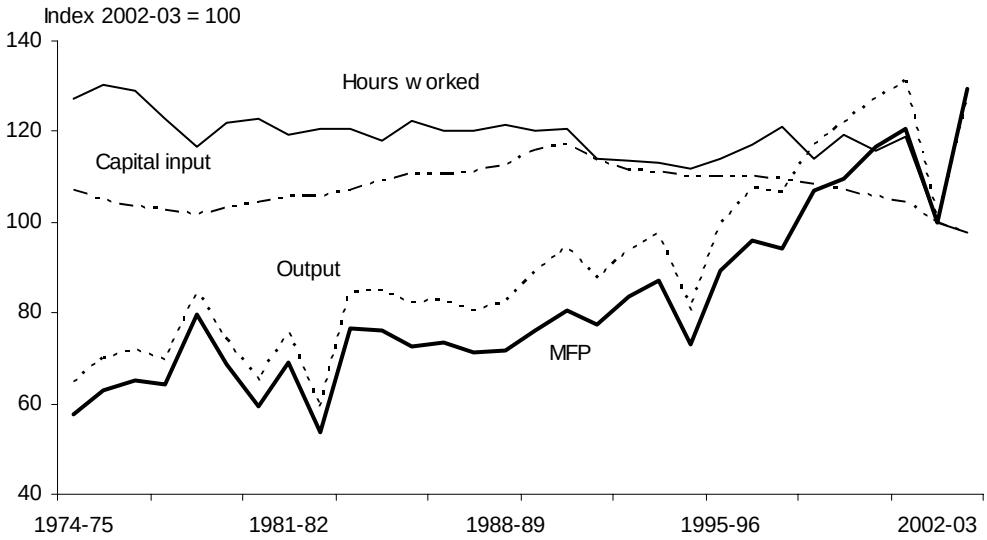
Over the period 1974-75 to 2003-04, the quantities of both labour and capital inputs used in agriculture declined, while total agricultural output increased at a trend annual average rate of around 2.4 per cent. This means that productivity growth has accounted for the entire increase in output of the agricultural sector over the past thirty years (figure 6.3).

By comparing the actual growth in sectoral output over the period with that which would have been observed had there only been changes in inputs (that is, no MFP growth), it is possible to calculate a productivity 'dividend'. Applying the trend MFP growth rate of 2.3 per cent, it is estimated that this productivity 'dividend' amounted to just over $170 billion over the period (box 6.1).

Figure 6.3 **Growth in inputs, outputs and MFP for agriculture, 1974-75 to 2003-04[ab]**

Per cent a year





a Agriculture, forestry, fishing and hunting. **b** Capital stock estimates are based on gross fixed capital formation data on investment in buildings and structures, machinery and equipment and livestock. The acquisition of non-reproducible tangible assets such as land, subsoil assets and natural timber tracts is not included in gross fixed capital formation (and hence in the capital stock estimates). However, capital costs associated with the extension or development of these assets are included, as are outlays on land reclamation and improvement (ABS 2000).

Data source: PC (2004, Productivity Estimates to 2003-04, December; http://www.pc.gov.au/commission/work/productivity/performance/industry.html).

Box 6.1 **Agricultural output and the productivity 'dividend'**

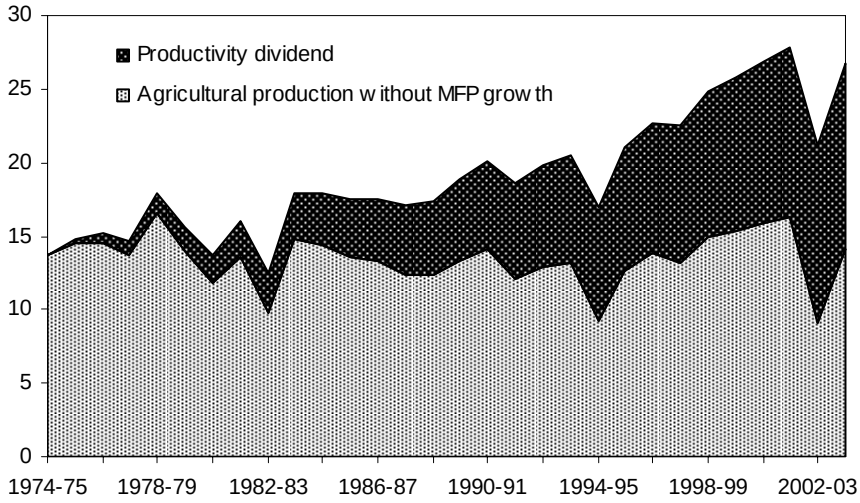
The entire increase in agricultural output over the past three decades can be explained by an increase in MFP. Between 1974-75 and 2003-04, aggregate inputs of capital and labour into agriculture actually declined, while real output increased by 96 per cent. MFP growth accounts for the increase in real agricultural output after accounting for the change in labour and capital inputs (2.8 per cent a year point to point, and 2.3 per cent in trend terms).

Following the methodology of PC (2003), it is possible to estimate the ensuing productivity 'dividend' by comparing the actual growth in agricultural value added achieved between 1974-75 and 2003-04 and that which would have been observed had there been only changes in inputs (that is, no MFP growth).

Applying the trend MFP growth rate of 2.3 per cent, the cumulative annual difference in value added over the period (in constant 2001-02 prices) implies an agricultural productivity 'dividend' of just over $170 billion (figure 6.4).

Figure 6.4 **Impact of MFP growth on agricultural value-added, 1974-75 to 2003-04**

$ billion, constant 2001-02 prices



Data Source: Derived from PC (2004, Productivity Estimates to 2003-04, December, http://www.pc.gov.au /commission/work/productivity/performance/industry.html).

Using the peak to peak periods identified earlier, output growth was stronger in the later period (1993-94 to 2001-02), increasing by around 3.8 per cent per year compared with 1.4 per cent for the decade to 1993-94.

While the number of hours worked in agriculture declined by almost 1 per cent a year over the period 1974-75 to 2003-04, labour inputs declined in the earlier period to 1993-94, but increased slightly in the later period (figure 6.3). Also, as discussed

in the previous chapter, the educational attainment of agricultural workers has increased in recent decades, which suggests an increase in the quality per hour worked.

Also evident from figure 6.3 is the notable decline in capital inputs from around the early 1990s — a decline of around 16 per cent over the period 1990-91 to 2003-04. This decline reflects, in part, some of the structural adjustments that have been taking place in the agriculture sector. For example, as average farm size has increased, the ratio of other capital to land capital has fallen. In line with this trend, growth in capital inputs was slightly positive in the earlier period to 1993-94, but negative in the latter (figure 6.3).

In addition, relatively higher capital prices have induced farmers to adopt capital saving production methods such as the sharing of farm capital equipment (contract harvesting).

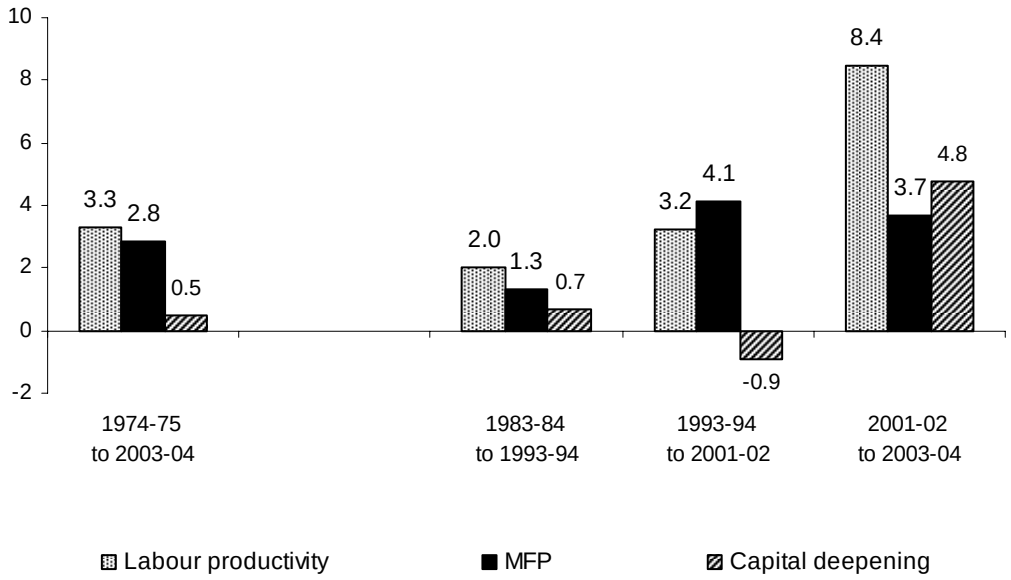
Capital deepening

Labour productivity growth for agriculture was higher than MFP growth over the period 1974-75 to 2003-04, indicating capital deepening (that is, increased quantities of capital per hour worked). Nonetheless, the extent of capital deepening for agriculture over the period was low (0.5 per cent per year) compared with the market sector average (1.1 per cent a year).

As illustrated in figure 6.5, MFP performance was the main influence on labour productivity growth throughout the period. And, over the period 1993-94 to 2001-02, the increase in labour productivity growth was entirely due to increased MFP growth as capital deepening was lower than in the earlier period (and negative, due to declining capital inputs).

Figure 6.5 **Labour productivity, MFP and capital deepening, 1974-75 to 2003-04**

Per cent a year



Data source: PC (2004, Productivity Estimates to 2003-04, December; http://www.pc.gov.au/commission/work/productivity/performance/industry.html).

6.4 Comparisons with other industries

Compared with other sectors of the economy, agricultural MFP growth has been strong. Over the period 1974-75 to 2003-04, MFP growth for agriculture was above all other sectors of the economy. The only industry to record higher MFP growth over the period was communications (table 6.1).

In terms of labour productivity growth, agriculture's performance (3.3 per cent per year over the period) was above the market sector average, but was surpassed by communications and electricity, gas and water. In terms of capital productivity growth, agriculture was the economy's strongest performer — 2.7 per cent per year over the period (table 6.1).

Productivity growth rates, however, provide only part of the story as they do not provide any insight into the relative efficiency with which resources are used. For example, an industry recording a relatively high productivity growth rate may be starting from a relatively low base (that is, have a relatively low level of productivity). Productivity *levels*, therefore, provide an important contextual basis for assessing productivity growth rates.

Table 6.1 **Labour, capital and MFP growth rates by sector and industry for Australia, 1974-75 to 2003-04**

Sector/industry	*Labour productivity*	*Capital productivity*	***Multifactor productivity***
Agriculture	3.3	2.7	2.8
Mining	2.6	-0.8	0.2
Manufacturing	3.2	-1.2	1.6
Services			
Electricity, gas and water	4.1	0.4	1.8
Construction	1.6	-1.6	1.0
Wholesale trade	2.1	-1.0	1.2
Retail trade	1.5	-2.5	0.8
Accommodation, cafes and restaurants	0.0	-2.5	-0.6
Transport and storage	2.8	1.1	2.3
Communications	6.5	1.0	4.2
Finance and insurance	2.2	-3.2	-0.1
Cultural and recreational services	-0.5	-3.1	-1.6
Market sector	2.2	-0.7	1.1

Source: PC (2004, Productivity Estimates to 2003-04, December; http://www.pc.gov.au/commission/work/productivity/performance/industry.html).

Labour and capital productivity levels presented in table 6.2 show that there is considerable variability between industries in output per hour worked and capital employed. Differences in productivity levels between the different industries should not, however, come as any surprise as these levels are really just the inverse of labour and capital intensities. For example, if an industry is labour intensive, its ratio of output to labour is likely to be relatively low. Just as factor intensities vary between industries, so too do partial or single factor productivity levels.

Over the three year period 2001-02 to 2003-04, farmers produced, on average around $29 of output per hour. This was lower than the average for the economy as a whole ($38.50), and for most service industries — the only service industries to record lower levels of output per hour were retail trade, accommodation, cafes and restaurants and personal and other services.

Agriculture's level of capital productivity — $43 of output for every $100 of capital employed — was slightly below that for the market sector as a whole, but higher than electricity, gas and water, transport and storage, mining, communications and accommodation, cafes and restaurants.

Table 6.2 **Levels of labour and capital productivity[a] by sector and industry for Australia**

Average three years ended 2003-04, constant 2002-03 prices

Sector/industry	*Labour productivity* *($ of output per hour worked)*	*Capital productivity* *($ of output per $100 of capital)*
Agriculture	29.2	42.9
Mining	165.4	25.6
Manufacturing	37.7	79.9
Services	36.5	47.9
Electricity, gas and water	119.9	13.2
Construction	30.5	168.3
Wholesale trade	44.7	111.2
Retail trade	18.0	87.7
Accommodation, cafes and restaurants	20.7	39.7
Transport and storage	43.4	22.0
Communications	61.5	29.8
Finance and insurance	88.9	80.8
Personal and other services	27.4	87.5
Market sector	38.5	47.9

a Capital productivity is estimated by dividing output by end-year net capital stock (constant 2002-03 prices) averaged over three years.

Sources: ABS (Cat nos: 5204.0, 6203.0).

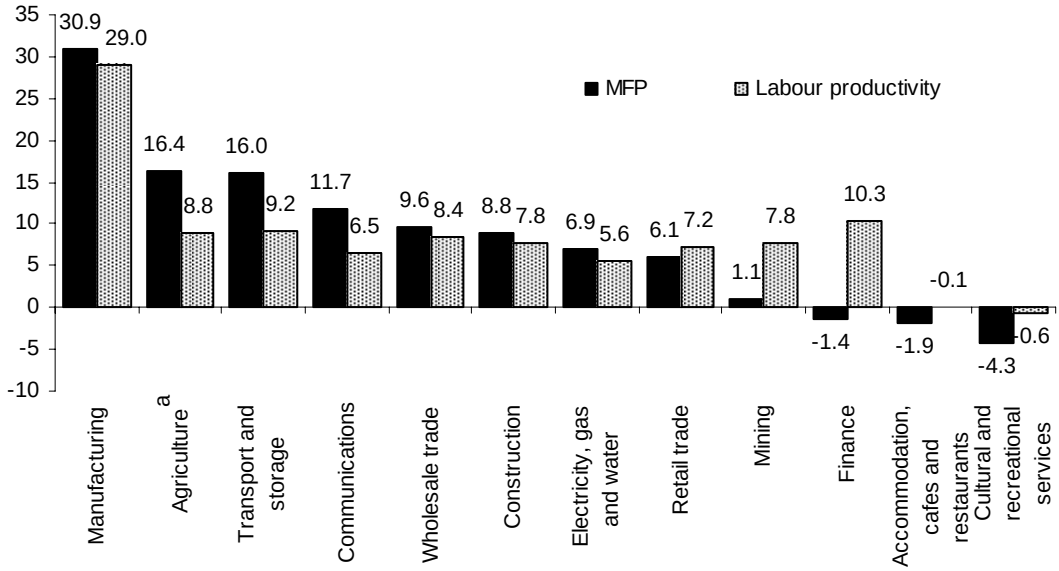
Contribution to productivity growth

The contribution of an industry to market sector productivity growth depends on the industry's growth performance and its share of market sector output. Over the period 1974-75 and 2003-04, agriculture, forestry and fishing contributed 8.8 per cent of market sector labour productivity growth — this was above the sector's value adding share of the market sector (6.7 per cent), and reflects relatively high labour productivity growth in agriculture over the period (figure 6.6).

Agriculture was also a strong contributor to MFP growth over the period 1974-75 to 2003-04, accounting for around 16.4 per cent of market sector MFP growth, or more than double it's value-added share. Indeed, agriculture was the second highest contributor of the twelve market sector industry divisions after manufacturing (31 per cent of MFP growth) over the period.

Figure 6.6 **Industry contributions to productivity growth, 1974-75 to 2003-04**

Per cent



a Agriculture, forestry, fishing and hunting.

Data source: PC (2004, Productivity Estimates to 2003-04, December, http://www.pc.gov.au/commission/work/productivity/performance/industry.html).

With agriculture accounting for around 5-6 per cent of the market sector, changes in agricultural MFP can have a significant effect on aggregate productivity growth. For example, in the 2002-03 drought, agricultural MFP declined by around 17 per cent which in turn, reduced aggregate MFP growth by around one percentage point (around half of market MFP growth) in that year. Similarly, agricultural MFP rebounded in 2003-04 by almost 30 per cent — adding over one percentage point to market sector MFP growth.

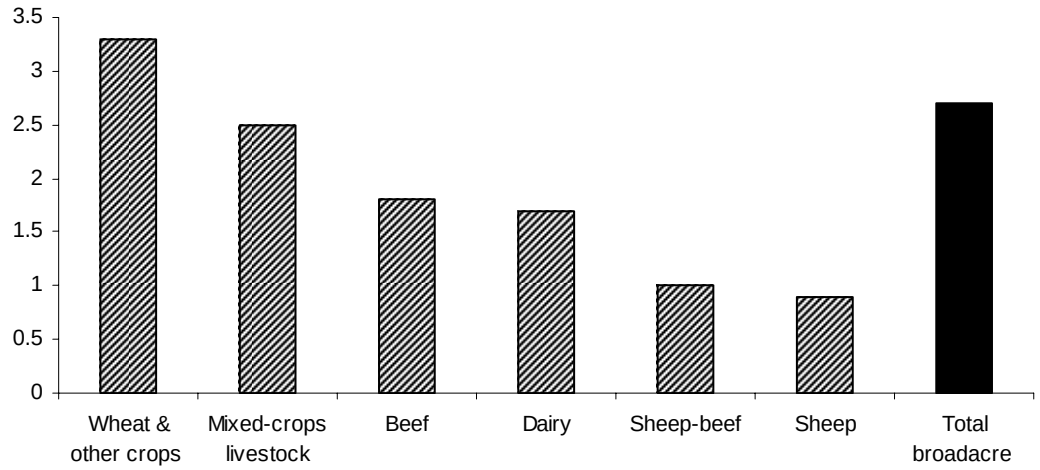
6.5 Productivity trends within agriculture

Productivity growth is far from uniform within the agricultural sector. According to ABARE estimates[3], the cropping industries (wheat, barley, oats, grain sorghum, oilseeds and other crops) have outperformed the livestock industries (sheep, beef and dairy) since the late 1970s.

[3] The data used for ABARE's productivity estimates are from ABARE's annual surveys of broadacre industries. The inputs used by ABARE to calculate MFP growth are capital (including land), livestock purchases, labour, materials, and services. Output consists of four main groups, crops, livestock sales, wool and other farm income.

Over the period 1977-78 to 2001-02, MFP on Australian grain farms increased, on average, by around 3.3 per cent per year. Mixed crops/livestock recorded the next highest growth of 2.5 per cent a year over the same period. Beef and dairy farms achieved productivity growth of 1.8 and 1.7 respectively, whereas productivity growth in the sheep industry was considerably lower at 0.9 per cent a year (figure 6.7).

Figure 6.7 **Broadacre productivity growth, by industry, 1977-78 to 2001-02**
Annual growth, per cent



Data source: ABARE Farm Surveys.

The relatively high productivity growth rate achieved in the cropping industry coincided with a decline of around 40 per cent in the number of grain producers and a doubling in the area sown to grains. The average area operated per farm also increased by 50 per cent and there was increased specialisation in grain production (Hooper et al. 2004).

The development of a wider range of planting options in recent decades, both in terms of crop types and varieties, has given farmers increased flexibility in terms of rotation strategies that has had a positive influence on disease control, soil fertility and labour utilisation. As Alexander and Kokic (2005, pp. 5-6) put it:

> Making use of a range of crops can reduce the risk of total crop failure, provide more options for farmers to respond to changes in relative prices, and have a positive effect on disease control and soil fertility. The rotation of crops can also result in more efficient use of resources, such as labour, by spreading the workload more evenly over the year.

Changes in livestock, pasture and stubble management have also allowed the average grains industry producer to increase sheep and cattle numbers. Pasture

rotations play an important part in the cropping cycle as they can improve soil fertility, texture and yield and also assist in the control of disease, insects and weeds (Alexander and Kokic 2005).

The relatively high productivity growth recorded by the grains industry was achieved in the face of fierce competition on international markets. The terms of trade facing Australian grain farmers declined by 2.6 per cent a year over the period 1977-78 to 2001-02 (a greater rate of decline than that faced by other agricultural industries), although the productivity gains achieved in the industry, on average, more than offset the negative effects of the declining terms of trade (table 6.3).

Table 6.3 **Average annual MFP growth and terms of trade, selected agricultural industries, 1977-78 to 2001-02**

Per cent

	Outputs	*Inputs*	*Productivity*	*Terms of trade*
Sheep specialists	1.2	0.3	0.9	-2.1
Sheep-beef	0.6	-0.4	1.0	-1.6
Sheep-crops	4.2	1.7	2.5	-2.5
Beef specialists	1.8	-0.1	1.8	-1.4
Beef-crops	2.6	0.2	2.4	-2.4
Crop specialists	4.8	1.5	3.3	-2.6
Dairy[a]	4.6	2.9	1.7	-1.1

a The data for dairy cover the period 1978-79 to 2001-02.

Source: ABARE (2004a).

Productivity gains recorded for beef specialists and beef-crop farms also, on average, offset the negative effects of declining terms of trade (table 6.3). And, according to ABARE, productivity growth on beef specialist and beef-crop farms increased in the decade to 2001-02, compared with the decade to 1989-90.

In contrast, the relatively low productivity growth amongst farms raising sheep and sheep-beef over the 25 year period has been insufficient, on average, to offset declines in their terms of trade. This may be partly explained by less significant changes in technology and production methods in these industries relative to cropping. As Knopke, et al. (1995, p. 490) note:

> Although there have been improvements in beef and sheep genetic material and in livestock health products, their impact has been less than that of advances in cropping technology. The handling of livestock (particularly sheep shearing and the handling of the wool clip) remains one of the more labour intensive activities in the broadacre sector.

Sheep producers who have diversified into prime lamb production, however, have recorded average annual growth in MFP of 1.6 per cent over the period 1988-89 to 2001-02. This was more than sufficient to offset the average annual decline of 0.7 per cent in their terms of trade (ABARE 2004a).

Changes in the dairy industry over the last two decades have seen Australia's milk production more than double and annual yields per cow increase by more than 70 per cent. MFP growth for the industry is estimated to have been just under 2 per cent a year over the period 1978-79 to 2001-02, with MFP growth being slower in the decade to 2001-02.

One of the explanations given by ABARE for the slowing of productivity growth in the later decade is that increases in grain feeding have not been matched by increases in milk output. Another is that the more easily exploited productivity improvements resulting from technology changes — such as adoption of larger and more efficient dairies or the introduction of herd recording — may have been largely accomplished and that further productivity improvements may be more difficult to achieve and depend more critically on management skills. Box 6.2 profiles productivity growth in the dairy industry.

Productivity growth estimates for agricultural industries, other than broadacre and dairy, are not readily available. Keogh (2004, p. 7), however, suggests that because of the technology being employed in some of the more intensive agricultural industries, productivity growth may well be higher in some of these industries than that recorded in the grains industry:

> Technology seems destined to produce even faster productivity gains in the more intensive agricultural enterprises, especially poultry meat, pork, dairy and horticulture. Many farmers in these industries already have high levels of investment in technology, which is driving high productivity growth. (Keogh 2004, p. 14)

Productivity growth differences between farms

Farm size appears to have an influence on productivity growth with larger farms typically achieving higher productivity growth than smaller farms. Research by ABARE (Alexander and Kokic 2005), for example, shows that over the period 1977-78 to 1998-99, large farms in the cropping industry achieved MFP growth of around 3.5 per cent per year; this was considerably higher than that achieved on medium (2.7 per cent) and smaller cropping farms (2.4 per cent) .

Box 6.2 **Productivity improvements in the dairy industry**

Over the last two decades, Australian dairy farmers have made many changes to farm management practices and have adopted a range of new technologies. Examples of some of the changes include:

- greater use of supplementary feeding — the feeding of concentrates and grains to boost milk production or fill seasonal feed shortages;
- soil testing and, as a result, changed fertiliser management;
- improved herd management;
- artificial insemination;
- greater use of computers. ABARE survey data indicate that dairy farmers initially used computers for budgeting and financial records but incorporated computerised management of breeding and milk production records as their skills developed; and
- substantial investment to incorporate advances in dairy shed technology, including herringbone swingover and rotary dairies.

The last two decades have also seen:

- the number of dairy farms more than halved, from 22 000 in 1980 to less than 10 000 in 2004; and
- the average herd size increase from 85 cows in 1980, to around 210 in 2003-04.

The outcome of such changes has been significant gains in labour productivity and increases in milk yields per cow and per farm. Over the period 1980 to 2003-04:

- the average annual yield per cow increased from 2 850 to 4 900 litres; and
- the average milk production per farm increased from 247 000 to 1 048 000 litres.

MFP growth over the decade to 2001-02 was around 1.5 per cent a year. This compares with a MFP growth rate of around 2 per cent a year for the period 1977-78 to 1998-99. Only dairy farms in New South Wales and South Australia managed to lift their productivity performance compared with a decade earlier. MFP also increased at a faster average rate in New South Wales, South Australia, Western Australia and Tasmania than that for Australia.

Sources: Hogan et al. (2004); Dairy Australia (www.dairyaustralia.com.au); Garnaut and Rasheed (1998); ABARE 2004c.

Additionally, ABARE found that unit costs of sowing crops declined as farm productivity increased and sowing costs declined as the size of the farm operations increased, indicating that there are economies of size operating in the grains industry (Alexander and Kokic 2005).

Productivity growth has also been closely related to size in the beef and sheep industries. In the beef industry, over the period 1977-78 to 2001-02, the largest third

of farms enjoyed strong productivity growth (2.2 per cent a year), while the smaller two-thirds recorded little or no growth. Similarly, large prime lamb producers recorded MFP growth of 1.4 per cent compared with 0.8 per cent for small prime lamb producers (ABARE 2004a,e).

The lumpy nature of investment in many of the new technologies, such as advanced mechanical harvesters, automated feeding systems and milking robots, means that they are often better suited to larger scale farming. Also, a larger capital base means that larger farms are often better placed to finance new developments in management and farming practices. As Hooper et al. (2002, pp. 498-499) note:

> Larger farms, particularly in the cropping and to a lesser extent in the broadacre livestock industries, have generally been able to capture more benefits from new technologies and have achieved much higher growth in total factor productivity over the past two decades. Higher productivity growth for larger farms has been very important in improving the financial performance of large farms relative to that of smaller farms.

There has also been significant variation in farm productivity growth by states and regions across Australia. This is not surprising given that land quality, climate and enterprise mix vary across the states and regions.

ABARE's mapping of trends in broadacre productivity growth over the twenty year period 1977-78 to 2001-02 found that productivity growth was higher on broadacre farms in Western Australia, South Australia and New South Wales than in Victoria and Queensland. Productivity growth on dairy farms over the period 1978-79 to 2001-02 was higher in Tasmania, Western Australia and New South Wales than in the other states.

The distribution of broadacre industries appears to be a key factor contributing to observed differences in productivity growth across regions. For example, the wheat-sheep zone, where cropping activities are concentrated, recorded the largest productivity improvements while regions where livestock activities dominated recorded lower productivity gains. The areas of lowest productivity growth were concentrated in the high rainfall zones where the combination of livestock focused activities and small farm size are likely to have contributed to the relatively lower productivity gains (Ha and Chapman 2000).

Another factor contributing to variations in productivity across regions is resource quality (for example, the inherent productive capacity of the land or the presence of land degradation). The productive capacity of a particular farm or region is dependent, to some extent, on the quality of the land — which should be reflected in its value. ABARE analysis of farm survey data shows positive relationships

between productivity, land values and rates of return to capital, indicating that measures of productivity are influenced by resource quality issues.

6.6 Drivers of productivity growth in agriculture

Productivity improvements in agriculture reflect a range of mechanisms and underlying influences. As outlined in IC (1997), there are three main 'proximate' mechanisms of productivity growth:

- new knowledge or technology that has brought about new ways of doing things that create more output from a given amount of inputs;
- better organisation of production within farms and between agricultural industries (improving productivity within the bounds of existing knowledge); and
- incidental effects that arise, not through the active pursuit of improved productivity, but as a by-product of other developments.

The following sub-sections briefly discuss these mechanisms and some of the underlying influences.

New knowledge or technology

A key source of productivity growth in agriculture has been the generation of new knowledge or technology. New knowledge introduces new ways of doing things that result in more output per unit of input.

Institutionalised agricultural research and development, as well as farmers own experimentation, have been important factors in the creation of new knowledge and technical advances in agriculture. The OECD (1995, p. 24), for example, observed that 'there is growing agreement that R&D is a crucial determinant of agricultural productivity'.

A Commission inquiry into Research and Development (IC 1995) also found with respect to R&D expenditures, the agriculture sector differs from other sectors of the Australian economy in that there are very low levels of internally generated R&D. That said, the rural R&D corporations and councils which sponsor R&D for the benefit of the agricultural sector tend to be partly funded by industry contributions together with government contributions. Much of the R&D sponsored by these organisations is undertaken by public sector researchers such as CSIRO and state departments of agriculture.

Some examples of technological advances that have contributed to productivity improvements in the agriculture sector include:

- the development of more sophisticated farm machinery and equipment. For example, the development of mechanical harvesting of wine grapes allowed broadacre style harvesting, pruning and spraying of vines yielding significant reductions in the cost of harvesting grapes. Precision agriculture has improved the accuracy of machinery and equipment, and farmers' understanding of their soil. This has enabled farmers to better tailor water, fertiliser, herbicide and pesticide treatments to their production requirements, often reducing the quantities of inputs required and having positive environmental impacts;
- the development of improved herbicides, fertilisers and other chemicals that have enhanced yields (either directly or indirectly through the control of pests and disease); and
- genetic modification involving the manipulation of the genetic structure of living organisms (more directly than through conventional plant and animal breeding) has created opportunities for raising the productive potential of plants and animals by, for example, enhancing their resilience. One example is the commercial release of an insect resistant cotton (Ingard) in Australia in 1996.

Technological advances, such as precision agriculture and biotechnology, (including genetic modification), also hold the potential for further improvements in agricultural productivity (box 6.3).

One of the explanations for the superior productivity performance of cropping industries (see section 6.5) relates to the significant changes that have occurred in cropping technology over the last few decades. Examples include crop varieties with improved resistance to disease, more effective use of as well as improvements to fertilisers and pesticides and the adoption of minimum till practices. And, while there have been improvements in beef and sheep genetic maintenance and livestock health products, their impact has been less than in cropping (Ha and Chapman 2000). Livestock activities have also tended to remain relatively more labour-intensive activities.

Box 6.3 **Biotechnology and agriculture**

Biotechnology covers a range of research tools that allow scientists to understand and manipulate the genetic make-up of plants, animals and other living organisms. In agriculture this includes genomics, marker-assisted selection, genetic engineering and many other tools that complement each other and conventional breeding approaches.

Biotechnology enables researchers to characterise plants and animals at the genomic level, so the specific genes responsible for a desirable trait can be targeted in breeding and conservation programmes. In contrast, conventional breeding relies on the physical appearance of a specimen and this is often an imperfect guide to its value in breeding.

Commercial use of biotechnology to produce genetically modified (GM) crop varieties first emerged in the mid 1990s. The four most widely grown GM crop plants across the world are soybean, maize, cotton and canola. The estimated global value of GM crops in 2003 was over United States $4.5 billion.

There are currently two GM plants grown commercially in Australia – cotton and blue carnations. While GM carnations are grown on a very small scale, GM cotton dominates Australia's cotton crop.

The benefits to farmers from GM crops include higher yields and profits. There are also substantial environmental advantages. For example, there has been a significant drop in pesticide usage in Australia's cotton industry in recent years as the area sown to GM cotton varieties has increased.

As ABARE (Abdalla et al. 2003, p. 111) has stated:

> The application of biotechnology techniques within the agriculture sector can potentially improve food security by raising crop tolerance to adverse weather and soil conditions, by enhancing adaptability of crops to different climates and by improving yields, pest resistance and nutrition, particularly of stable food crops. Over the past decade, the application of biotechnology to the problems in world agriculture has yielded significant productivity gains to producers. With advancements in GM technologies and as market acceptance and availability of GM products increases, these benefits are expected to increase.

Sources: Raney (2004), Higgins and Constable (2004), Abdalla et al. (2003).

Better organisation of production

Productivity growth in agriculture has also come about as a result of the better organisation of production. Key influences in this context have been pressures from competing overseas producers, the enabling effects of new process technologies such as IT and the internet, as well as changes to various institutional and regulatory arrangements (including reforms to statutory marketing arrangements for several industries, see box 3.4).

Australian farmers have responded to these influences by making better use of available technologies and management practices. One example is farmers making use of machinery pooling or the use of contractors rather than tying up capital in plant and equipment which is poorly utilised. Another is dairy farmers making greater use of the feeding of concentrates and grains to boost milk production.

Australian farmers are now better educated than they were two decades ago (chapter 5). Education and training can have an important influence on the ability of farmers to adopt new technology and the way they utilise existing technologies and management practices. In this context, Australian farmers have made greater use of information technology and the internet (box 6.4). An increasing number of farmers, for example, are using the internet and information technology to monitor international market trends, communicate and interact with suppliers throughout the agriculture supply chain, access weather forecasts and use satellite imagery in developing farm plans (Corish 2004). ABARE survey data also shows that while dairy farmers initially used computers for budgeting and financial records, they are increasingly adopting computerised management of breeding and milk production records as their skills develop.

Microeconomic reforms have also resulted in a shift of resources to more productive activities. Water reforms, for example, have seen some shift away from crops which use a lot of water for relatively poor returns towards higher value plantation horticultural enterprises (see, for example, Peterson et al. 2004). As Keogh (2004, pp. 14-15) observed:

> The enhancement of the tradability of water access rights, as is proposed under the National Water Initiative currently being negotiated between Australian governments, should also enhance productivity gains in industries such as horticulture. It is likely that this change will accelerate the movement of irrigation water away from broadacre crop use, to some of the higher-value plantation horticulture enterprises; a trend that is already evident in Victoria and South Australia. The increasing capital value of water access rights will add further impetus to productivity gains in these industries.

The Commission's inquiry into *Native Vegetation and Biodiversity Regulation*, found that regulations in these areas were not as effective as they might be and, in some cases, were imposing significant and unnecessary costs on farmers. Clearing controls, for example, were found to be preventing the expansion of agricultural activities, preventing changes in land use and the adoption of new technologies and inhibiting management of weeds and vermin. Changes to these regulations, as recommended by the Commission, can be expected to improve incentives for farmers to adopt sustainable farm and environmental management practices and thereby enhance the potential for future productivity gains (PC 2004b).

Box 6.4 **Computer technology and farming**

Australian farmers are making greater use of computer technology and the Internet to assist them with their business operations and to gain relevant information.

Over the period March 1998 to June 2002, the proportion of farms with access to a computer and the Internet increased by 22 and 37 percentage points respectively. By June 2002, 62 per cent of Australian farms had access to a computer and around 48 per cent had access to the Internet.

Of the farms with access to a computer in 2002, more than four in five used it as part of their business operations. Nine in 10 farms with access to the Internet used it as part of their business operations.

Email is the most common Internet activity undertaken by farmers (37 per cent of all farms), followed by obtaining weather information (31 per cent). Around 10 per cent of Australian farms purchased or ordered goods or services via the Internet in 2002.

In 2002, the cotton industry reported the highest use of computers — 90 per cent of farms. Other industries with relatively high use of computers included plant nurseries (69 per cent), poultry farming (meat, 63 per cent) and grain growing (67 per cent). Beef cattle farming recorded the lowest use of computers (38 per cent).

The cotton industry also had the highest use of the Internet (87 per cent) and beef cattle farming the lowest (30 per cent).

ABS data for 2002 indicates a strong relationship between farm size (as measured by the estimated value of agricultural output), and the use of a computer and the Internet. For all broad industries, a 50 per cent Internet usage rate was not achieved until the EVAO range of $150 000- $249 999, except for dairy cattle farming where this usage rate was achieved by farms with an EVAO range of $500 000-$999 999.

Source: ABS (Cat no. 8150.0).

Incidental effects

Productivity growth within the agricultural sector has also been affected by structural changes such as increases in farm size, shifts in the enterprise mix of the agricultural sector and the exit of lower performing farmers.

As discussed in chapter 3, farms have increased in size across most agricultural industries as a result of low-performing farmers leaving the sector and farm amalgamations. Larger farms are generally able to capture more of the benefits from new technologies. And, as farm size grows, output can often be increased over a range without requiring extra units of capital, allowing overhead costs to be spread over more units of output. For example, within limits, a dairy herd can be expanded

without the need to expand the milking shed or purchase additional capital equipment.

Also, because productivity varies among agricultural industries, changes in the composition of the sector affects the sector's productivity. Productivity in the wool industry, for example, has been relatively modest and this industry has been declining in importance over the last two decades. The cropping industry, on the other hand, has experienced high productivity growth and has also expanded rapidly in terms of output and farm numbers. These structural changes have acted to bolster the productivity performance of the sector over time.

6.7 International comparisons

International comparisons of productivity are another way of benchmarking the performance of Australian agriculture. The international competitiveness of Australian agriculture is also shaped by its productivity performance.

OECD countries provide a reasonable basis for comparison of Australia's productivity performance given their broadly similar stage of economic development. There are, nevertheless, some important differences among these countries that need to be recognised when making comparisons. More specifically, differences in productivity levels and growth may reflect different resource endowments, different price environments, differences between countries in exploitation of 'catch-up' opportunities, the use of different technologies and differing institutional and regulatory arrangements.

And, while indicative, comparative measures are relatively imprecise since measurement problems (such as issues of data comparability and different industry mixes) are exacerbated in international comparisons. Caution, therefore, needs to be taken in interpreting differences in productivity performance of agricultural industries across countries.

Comparison of growth rates

Bearing the above caveats in mind, it appears that growth in Australian agricultural labour productivity over the last two decades has been relatively low. Using data contained in the OECD's STAN Industrial Database and ABS data for Australia, it appears that over the period 1981-2001, Australia's agricultural labour productivity growth has been lower than that achieved in the United States and many European countries. The only countries to record lower labour productivity growth for agriculture over this period were Sweden, Greece and the United Kingdom (table 6.4).

Table 6.4 **Agricultural labour productivity growth rates for selected countries**

Trend annual growth rates

Country	*1981-91*	*1991-2001*	*1981-2001*
Australia[a]	**1.8**	**4.7**	**2.8**
Austria	2.9	9.1	5.7
Belgium	3.9	4.2	4.7
Canada	3.8	2.2	3.0
France	5.8	6.6	6.7
Finland	4.0	4.8	4.5
EU-15	5.2	4.3	5.1
Denmark	8.2	8.5	8.3
Greece	3.0	1.3	2.4
United States	5.2	5.5	4.8
Ireland	4.5	1.4	3.7
United Kingdom	2.0	2.4	2.6
Portugal	6.6	2.8	6.0
Sweden	5.0	-1.5	1.1
Luxembourg	3.7	8.0	6.6
Spain	7.1	1.3	4.2

a The estimates for Australia are based on ABS data as the OECD's STAN Industrial Database currently does not have data for Australia.

Sources: OECD (2004) STAN Industrial Database; ABS (Cat. no. 6203.0).

In the decade to 1991, Australia recorded the lowest growth in agricultural labour productivity for the group of selected countries. However, in the decade to 2001, Australia's relative position improved, with Australia recording a higher labour productivity growth rate for agriculture than Belgium, Canada, Greece, Ireland, the United Kingdom, Portugal, Sweden and Spain.

In contrast, a recent study by Coelli and Prasada Rao[4] (2003), which compares total factor productivity (TFP) (equivalent to MFP) growth in agriculture across the top 93 agricultural producers in the world (accounting for around 97 per cent of the world's agriculture), suggests that Australia's performance has been relatively strong compared with other OECD countries over the last two decades. The study, which uses data from the Food and Agricultural Organization covering the period 1980 to 2000, shows that Australia's MFP growth was similar to that recorded for the United States. The only other OECD countries to record a higher rate of MFP growth for agriculture over the period were Canada and Denmark.

4 Coelli and Prasada Rao measure TFP using the Malmquist index method. This approach uses data envelopment analysis methods to construct a piece-wise linear production frontier for each year in the sample. The study is based on data from the AGROSTAT system of the Statistics Division of the Food and Agricultural Organization.

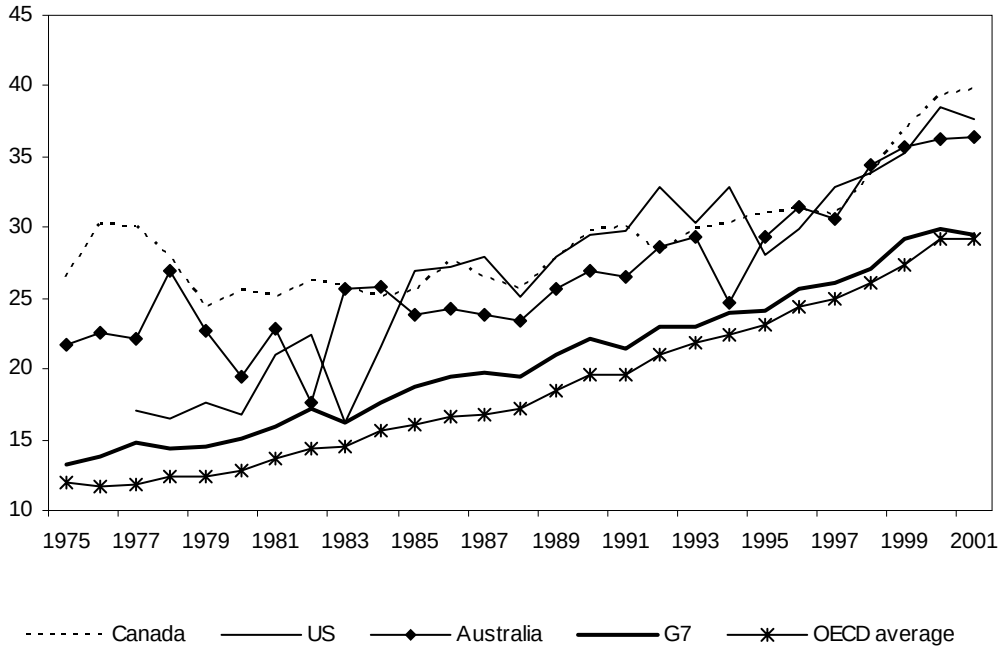
Comparisons of the levels of productivity

Whilst comparisons of growth rates provide a benchmark for the relative performance of Australian agricultural over time, it is also revealing to consider absolute productivity levels between countries. These, together with prices and exchange rates, determine the international competitiveness of Australian agriculture. Comparing productivity levels across countries requires value added to be expressed in a common currency. Exchange rates based on purchasing power parities (PPP) are usually used for this purpose.

Estimates of PPP-based labour productivity levels (output per person employed) between countries indicate that, in 1980, Australian agricultural labour productivity was below the Canadian level, but around 30 per cent above the United States level and around 50 per cent above the OECD average (figure 6.8). While measurement errors may affect comparisons, the data also suggest that, by 2001, Australia had slipped slightly behind the United States but continued to remain well above the OECD average (by around 30 per cent).

Figure 6.8 **Comparative levels of agricultural labour productivity, selected countries, 1975 to 2001**

GDP per person employed (US$'000 PPP)



Data source: PC estimates based on OECD (2004) STAN Industrial Database.

Concluding comment

Compared with other OECD countries, it would appear that Australia has experienced relatively high MFP growth over the last two decades.

That said, as noted, there is considerable variation between high and low productivity performing farms within the Australian agricultural sector. While such variations reflect to some extent differences in climate and soil quality between farms (factors outside the control of farmers), they also reflect differences in the uptake of best practice technologies and farm management techniques. The latter difference points to scope for lifting the productivity performance of the sector as well as the desirability of undertaking research to better understand the drivers of performance differences between farms.

A Input-output links for agricultural industries

Table A.1 **Disposition of output shares by demand category[a], 1998-99**

	Intermediate inputs	*Private consumption*	*Government consumption*	*Investment*	*Exports*
Commercial fishing	37.0	41.7	4.1	0.0	17.2
Forestry & logging	78.8	1.5	11.4	2.2	6.1
Services to agriculture	49.7	1.0	3.4	0.0	45.9
Other agriculture	60.3	30.8	0.0	0.0	8.9
Poultry	75.0	24.7	0.0	0.0	0.2
Pigs	99.1	0.7	0.0	0.0	0.2
Dairy cattle	83.8	0.1	0.0	16.2	0.0
Beef cattle	79.3	0.7	0.0	13.5	6.4
Grains	35.8	0.0	0.0	0.0	64.2
Sheep	50.2	0.8	0.0	3.8	45.3
Agriculture	59.1	12.7	0.9	3.6	23.6
Mining	39.9	0.8	0.0	0.3	59.0
Manufacturing	53.5	21.6	1.1	6.4	17.5
Services	39.7	31.2	13.5	12.1	3.5

a Data are based on input-output industries and exclude changes in inventories.

Source: ABS (Cat. no. 5209.0).

Table A.2 **Direct requirement coefficients for agricultural and selected manufacturing industries, 1998-99**

Per cent

	These industries provide inputs …								
	Sheep	*Grains*	*Beef cattle*	*Dairy cattle*	*Pigs*	*Poultry*	*Other agric*	*Services to agric*	*Forestry & logging*
… to the output of these industries.									
Sheep	0.0	0.5	0.0	0.0	0.0	0.0	3.0	8.9	0.1
Grains	0.0	9.8	0.0	0.0	0.0	0.0	0.0	2.3	0.0
Beef cattle	0.0	0.6	0.1	0.0	0.0	0.0	3.8	3.9	0.5
Dairy cattle	0.0	1.0	0.1	0.1	0.0	0.0	3.1	3.6	0.2
Pigs	0.0	1.7	0.0	0.0	0.0	0.0	3.7	0.8	0.0
Poultry	0.0	1.4	0.0	0.0	0.0	1.7	0.0	1.0	0.0
Other agric	0.0	0.2	0.0	0.0	0.0	0.0	2.3	4.6	0.4
Services to agric	0.1	0.0	0.0	0.0	0.0	0.0	36.3	0.7	0.0
Forestry & logging	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	11.8
Commercial fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Meat/meat products	4.7	0.0	27.4	0.0	4.2	7.0	0.0	0.9	0.0
Dairy products	0.0	0.0	0.0	36.1	0.0	0.0	0.2	0.0	0.0
Fruit/veg. products	0.0	1.1	0.0	0.0	0.0	0.0	13.4	0.0	0.0
Oils & fats	0.0	0.4	0.0	0.0	0.0	0.0	0.7	0.4	0.0
Flour mill products	0.0	19.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bakery products	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Confectionery	0.0	0.3	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Other food products	0.0	4.2	0.0	0.0	0.0	0.0	12.5	0.0	0.0
Soft drinks/cordials	0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.0	0.0
Beer & malt	0.0	9.9	0.0	0.0	0.0	0.0	0.3	0.0	0.0
Wine & spirits	0.0	1.7	0.0	0.0	0.0	0.0	24.6	0.0	0.0
Tobacco products	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0
Textile fibres/fabrics	32.7	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0
Leather products	3.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0
Sawmill products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4
Other wood prods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
Pulp & paper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7

Source: ABS (Cat. no. 5209.0).

B Trade data

Intra-industry trade

The usual measure of intra-industry trade is the Grubel-Lloyd index based on comparing export and import flows within reasonably disaggregated trade classifications.

For the i^{th} trade classification, the value of intra-industry trade (VIIT) is:

$$\mathrm{VIIT_i} = (\mathrm{X_i} + \mathrm{M_i}) - \left|\mathrm{X_i} - \mathrm{M_i}\right|$$

While the Grubel-Lloyd index (IIT) is:

$$IIT_i = \left[\frac{(X_i + M_i) - \left|X_i - M_i\right|}{(X_i + M_i)}\right] \times 100$$

where *X* are exports and *M* are imports of good *i*.

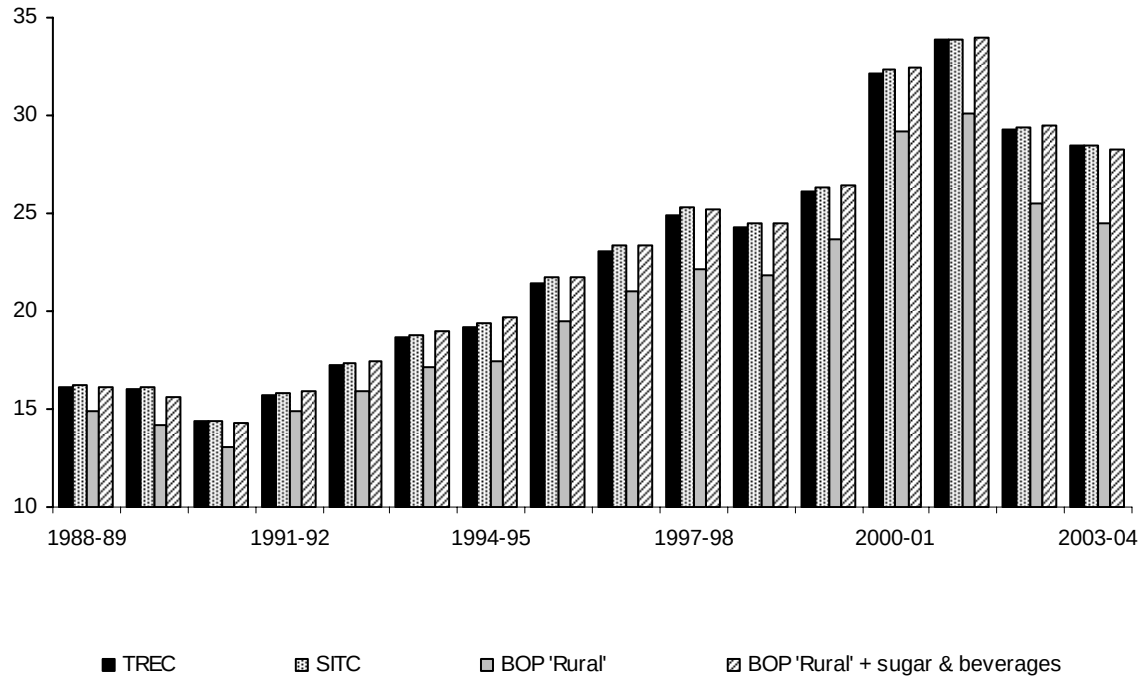
This implies that if exports or imports are zero, IIT will be zero. If exports and imports are exactly matched, then the measure will be equal to 100. So, the measure is bounded by 0 and 100. The overall intra-industry trade index for agriculture in Australia is calculated as a weighted average of the individual intra-industry trade measures:

$$IIT = \sum_{i=1}^{n}\left\{\frac{(X_i + M_i)}{\sum_{i=1}^{n}(X_i + M_i)}\frac{(X_i + M_i) - \left|X_i - M_i\right|}{(X_i + M_i)}\right\} \times 100 = \left\{\frac{\sum_{i=1}^{n}\left((X_i + M_i) - \left|X_i - M_i\right|\right)}{\sum_{i=1}^{n}(X_i + M_i)}\right\} \times 100$$

The resulting index represents the share of total agricultural trade accounted for by intra-industry trade (Grubel and Lloyd 1975).

Figure B.1 **Agricultural exports according to TREC, SITC and BOP[a] classification systems, 1988-89 to 2003-04**

$ billion, current prices



a BOP 'Rural' exports include most agricultural commodities included in the SITC classification with the exception of the 'Non-rural' BOP commodities: 'Beverages' (predominantly wine) and 'Sugar, sugar preparations and honey' (predominantly raw sugar). For this report, beverages and sugar are added to rural exports. Although based on SITC data, BOP estimates are adjusted where necessary for timing, coverage, classification and valuation in order to meet the change of ownership conventions and classification requirements required by BOP international statistical standards. For example, wool exported to stockpile abroad before being sold is excluded from the BOP when shipped, but included when sold.

Data sources: ABS (Cat. nos. 5302.0, 5331.0); DFAT (STARS Database 2005).

Table B.1 **OECD projections of agricultural consumption and production growth rates for OECD and non-OECD countries, 2004 to 2013**

Annual average growth (per cent, volume terms)

	Consumption			*Production*		
	OECD	*Non-OECD*	***Total***	*OECD*	*Non-OECD*	***Total***
Wheat	0.8	1.4	**1.2**	1.5	2.0	**1.8**
Rice	0.8	0.8	**0.8**	1.1	1.3	**1.3**
Coarse grains	0.8	1.8	**1.3**	1.4	1.8	**1.6**
Coarse grains used for feed	1.0	2.1	**1.5**	na	na	**na**
Oilseeds	na	na	**na**	2.5	2.8	**2.7**
Oilseed meal	1.6	3.8	**2.6**	2.2	2.9	**2.6**
Beef	0.4	3.0	**1.5**	0.6	2.8	**1.6**
Pig meat	0.8	2.0	**1.5**	0.8	2.0	**1.5**
Poultry meat	1.7	2.5	**2.0**	1.7	2.1	**1.9**
Butter	0.4	3.3	**2.3**	0.0	3.8	**2.2**
Cheese	1.7	2.8	**2.0**	1.6	3.4	**2.0**
Skim milk powder	0.0	2.3	**1.0**	-0.7	5.6	**0.7**
Whole milk powder	1.7	2.8	**2.6**	1.9	3.4	**2.6**
Vegetable oils	1.7	3.8	**2.9**	2.0	2.9	**3.0**
Sugar	0.5	2.2	**1.8**	0.5	2.2	**1.7**

Source: OECD (2004a).

C Supplementary employment data

This appendix provides additional employment data to support the analysis presented in chapter 5. It includes the following:

- the distribution of agricultural employment and employment in associated manufacturing and services industries by State/Territory and metropolitan/non-metropolitan region; and
- the changing composition of the agriculture workforce, in terms of industry shares, gender, working hours, age and occupation.

Table C.1 **Agricultural employment by state/territory[a], 2003-04**
'000 employed persons

Industry/sector	*NSW*	*VIC*	*QLD*	*WA*	*SA*	*TAS*	*NT*	*ACT*
Agriculture, forestry and fishing	94.1	82.2	85.4	48.2	45.2	16.8	2.3	*0.4
Agriculture	83.2	74.1	76.0	37.5	37.5	10.6	1.4	*0.4
Horticulture and fruit growing	17.8	24.7	24.4	8.3	16.2	2.7	*0.7	*0.1
Grain, sheep and beef cattle	49.2	32.0	36.3	25.0	16.0	5.6	*0.6	*0.2
Dairy cattle	*4.7	9.2	*1.2	*1.2	2.4	*1.0	…	*0.1
Poultry	*3.3	*2.4	*2.4	*0.8	*0.5	*0.4	…	…
Other livestock	*2.5	*3.0	*2.4	*0.8	*1.2	*0.2	…	…
Other crops	*1.2	*0.9	8.0	*0.3	*0.1	*0.2	*0.1	…
Agriculture nec	*4.6	*1.8	*1.5	*1.1	*1.2	*0.6	…	*0.1
Services to agriculture	*5.4	5.6	5.2	6.0	*2.0	*1.0	*0.1	…
Forestry and logging	*3.6	*2.1	*0.3	*1.4	*1.3	3.4	*0.1	…
Commercial fishing	*1.6	*0.6	*3.7	3.3	4.3	1.8	*0.6	…
Agriculture, forestry and fishing nec	*0.6	…	*0.2	…	*0.2	*0.1	*0.2	…

… Indicates industries where employment is either nil or negligible. **a** Data are based on survey information, and so information for Agriculture, Forestry and Fishing subdivisions and groups, or at state and territory level, is less reliable than more aggregate information at division or national level. Estimates with a relative standard error of 25 per cent or greater are preceded by an asterisk (for example, *5.2) to indicate they are subject to high standard errors and should be interpreted with caution.

Source: ABS (Cat no. 6291.0.55.001).

Table C.2 **Agricultural employment in metropolitan[a] and non-metropolitan regions[b], 2001**

	Metropolitan		*Non-Metropolitan*		*Total*
ANZSIC class	*No. employed*	*%*	*No. employed*	*%*	*No. employed*
Shearing services	89	3.1	2823	96.9	2912
Grain-sheep and grain-beef cattle farming	1380	3.5	38 439	96.5	39 819
Grain, sheep and beef cattle farming, undefined	71	3.5	1965	96.5	2036
Sugar cane growing	353	3.6	9501	96.4	9854
Cotton growing	181	5.1	3390	94.9	3571
Sheep-beef cattle farming	935	5.2	17 180	94.8	18 115
Grain growing	997	5.5	17 034	94.5	18 031
Sheep farming	1800	7.5	22 098	92.5	23 898
Dairy cattle farming	2194	7.7	26 311	92.3	28 505
Cotton ginning	27	7.9	314	92.1	341
Pig farming	283	8.1	3213	91.9	3496
Aerial agricultural services	49	8.8	506	91.2	555
Beef cattle farming	4368	9.3	42 787	90.7	47 155
Other livestock farming, undefined	3	10.3	26	89.7	29
Forestry and logging, undefined	55	13.0	367	87.0	422
Deer farming	21	15.0	119	85.0	140
Logging	528	15.9	2801	84.1	3329
Fruit growing, nec	2427	16.7	12 078	83.3	14 505
Services to agriculture; hunting and trapping	15	16.9	74	83.1	89
Hunting and trapping	90	17.6	422	82.4	512
Grape growing	2859	18.3	12 775	81.7	15 634
Other crop growing, undefined	9	19.6	37	80.4	46
Agriculture, undefined	1478	20.4	5777	79.6	7255
Line fishing	19	20.4	74	79.6	93
Forestry	848	20.6	3271	79.4	4119
Apple and pear growing	607	21.7	2193	78.3	2800
Stone fruit growing	346	22.5	1194	77.5	1540
Livestock farming, nec	505	23.6	1631	76.4	2136
Horticulture and fruit growing, undefined	1196	24.7	3643	75.3	4839
Finfish trawling	71	24.9	214	75.1	285
Squid jigging	3	25.0	9	75.0	12
Aquaculture	1140	27.1	3070	72.9	4210
Services to agriculture, undefined	139	27.4	369	72.6	508
Rock lobster fishing	402	27.5	1062	72.5	1464
Marine fishing, nec	293	28.5	736	71.5	1029
Marine fishing, undefined	174	30.1	404	69.9	578
Services to agriculture, nec	3991	30.3	9172	69.7	13 163
Prawn fishing	322	30.9	721	69.1	1043
Commercial fishing, undefined	982	31.2	2161	68.8	3143
Horse farming	905	32.3	1898	67.7	2803

(Continued next page)

Table C.2 **(continued)**

ANZSIC class	Metropolitan No. employed	Metropolitan %	Non-Metropolitan No. employed	Non-Metropolitan %	Total No. employed
Kiwi fruit growing	19	32.8	39	67.2	58
Vegetable growing	5147	32.9	10476	67.1	15 623
Agriculture, forestry and fishing, undefined	836	37.5	1392	62.5	2228
Crop and plant growing, nec	1650	38.5	2638	61.5	4288
Services to forestry	1329	42.2	1821	57.8	3150
Poultry farming (eggs)	1482	45.2	1795	54.8	3277
Cut flower and flower seed growing	1872	56.7	1427	43.3	3299
Poultry farming, undefined	1300	59.2	895	40.8	2195
Plant nurseries	7030	62.0	4306	38.0	11 336
Poultry farming (meat)	810	64.2	452	35.8	1262
Agriculture total	**53 630**	**16.2**	**277 100**	**83.8**	**330730**

a Metropolitan regions are the 8 capital cities plus the Townsville-Thuringowa, Gold Coast-Tweed, Sunshine Coast, Newcastle, Wollongong and Geelong Statistical Subdivisions. Estimates of metropolitan shares for total agricultural employment are 6 percentage points lower than the BTRE estimates presented in chapter 5 as the BTRE database is based on a lower level of regional classification (Statistical Local Areas). This allows the inclusion in the metropolitan category of some additional regions on the fringes of the capitals and other metropolitan areas. **b** These data are not directly comparable with the ABS Labour Force Survey (LFS) data presented in chapter 5 due to differences in scope, coverage, timing, measurement of underlying concepts and collection methodology. LFS employment estimates are 11-14 per cent higher than census employment estimates for the economy overall and around 30 per cent higher for agriculture. Census under-enumeration and residents temporarily overseas are the main contributors to the difference. Although LFS data provide a better estimate of total employment, they cannot provide reliable estimates of regional industry employment due to sampling methodology (BTRE 2004). Moreover, detailed employment data for the 50 4-digit ANZSIC agricultural industry classes is not available for the LFS.

Source: Unpublished ABS data (2001 Census of Population and Housing data).

Table C.3 **Employment in food, beverage and tobacco manufacturing[a], 2003-04**

'000 persons, 3 digit ANZSIC

	NSW	VIC	QLD	WA	SA	TAS	NT	ACT	AUST
Meat and meat products	12.7	9.7	15.1	4.5	3.0	1.0	…	…	**45.9**
Other foods	*5.7	8.2	7.0	*2.3	2.8	1.3	…	*0.1	**27.3**
Bakery products	10.7	5.9	*2.8	*1.6	2.6	*0.4	*0.3	*0.4	**24.8**
Beverage and malt products	*5.2	5.4	*2.2	*1.8	8.7	*0.7	…	*0.1	**24.1**
Dairy products	*3.4	8.1	*2.1	*1.9	*0.7	*0.3	…	…	**16.5**
Food, beverages & tobacco nec	*4.9	5.1	*0.9	*0.3	*0.6	…	…	…	**11.8**
Fruit & vegetable processing	*2.9	*3.6	*2.0	*0.3	*1.4	1.3	…	…	**11.5**
Flour mill and cereal foods	*2.7	*2.9	*0.7	*0.4	*0.1	…	…	…	**6.8**
Tobacco products	*1.1	*0.5	…	…	…	…	…	…	***1.5**
Oil and fat processing	*0.1	*0.4	*0.3	*0.1	…	…	…	…	***0.8**

… Indicates industries where employment is either nil or negligible. **a** See table C.1 for other relevant notes.

Source: ABS (Cat no. 6203.0).

Table C.4 **Food, beverage and tobacco manufacturing employment in metropolitan and non-metropolitan regions[a], 2001**

	Metropolitan		*Non-Metropolitan*		*Total*
ANZSIC class	*No. employed*	*%*	*No. employed*	*%*	*No. employed*
Sugar manufacturing	641	10.4	5536	89.6	6177
Dairy product manufacturing, nec	1391	24.9	4197	75.1	5588
Meat processing	5342	30.0	12 444	70.0	17 786
Meat and meat product manufacturing, undefined	141	31.1	313	68.9	454
Prepared animal and bird feed manufacturing	1946	35.4	3553	64.6	5499
Wine manufacturing	5277	36.4	9204	63.6	14 481
Seafood processing	928	42.1	1274	57.9	2202
Fruit and vegetable processing	4265	43.6	5511	56.4	9776
Milk and cream processing	2750	51.0	2642	49.0	5392
Flour mill product manufacturing	507	52.8	454	47.2	961
Flour mill and cereal food manufacturing nec	663	55.9	523	44.1	1186
Dairy product manufacturing, undefined	1016	56.9	769	43.1	1785
Spirit manufacturing	86	58.5	61	41.5	147
Bacon, ham and smallgoods manufacturing	3424	68.2	1597	31.8	5021
Cereal food and baking mix manufacturing	2951	72.2	1138	27.8	4089
Ice cream manufacturing	1605	73.6	577	26.4	2182
Bread manufacturing	9552	74.4	3281	25.6	12 833
Food manufacturing, nec	6467	74.5	2214	25.5	8681
Oil and fat manufacturing	1217	78.7	329	21.3	1546
Confectionery manufacturing	5773	79.5	1490	20.5	7263
Poultry processing	7093	80.5	1713	19.5	8806
Fbt manufacturing, undefined	10 916	82.6	2295	17.4	13 211
Cake and pastry manufacturing	5198	83.5	1030	16.5	6228
Bakery product manufacturing, undefined	209	85.3	36	14.7	245
Beverage and malt manufacturing, undefined	207	86.6	32	13.4	239
Soft drink, cordial and syrup manufacturing	4168	88.1	565	11.9	4733
Beer and malt manufacturing	3509	89.6	406	10.4	3915
Other food manufacturing, undefined	39	90.7	4	9.3	43
Tobacco product manufacturing	1776	91.3	169	8.7	1945
Biscuit manufacturing	4562	94.1	288	5.9	4850
Total food, beverage and tobacco manufacturing	**93 619**	**59.5**	**63 645**	**40.5**	**157 264**

a See table C.2 for source and other relevant notes.

Table C.5 **Selected agriculture-related manufacturing employment in metropolitan and non-metropolitan regions[a], 2001**

	Metropolitan		*Non-Metropolitan*		*Total*
ANZSIC class	*No. employed*	*%*	*No. employed*	*%*	*No. employed*
Log sawmilling	793	16.7	3943	83.3	4736
Wool textile manufacturing	152	22.3	531	77.7	683
Wood chipping	138	23.0	462	77.0	600
Timber resawing and dressing	736	27.4	1948	72.6	2684
Log sawmilling and timber dressing	1379	30.0	3220	70.0	4599
Agricultural machinery manufacturing	1792	35.1	3318	64.9	5110
Fabricated wood manufacturing	943	44.7	1166	55.3	2109
Cotton textile manufacturing	553	46.9	626	53.1	1179
Plywood and veneer manufacturing	530	49.2	547	50.8	1077
Wood and paper product manufacturing	428	50.2	425	49.8	853
Wool scouring	512	55.4	412	44.6	924
Other wood product manufacturing	880	55.6	704	44.4	1584
Leather tanning and fur dressing	1184	62.5	711	37.5	1895
Textile fibre, yarn and woven fabric	274	68.2	128	31.8	402
Pulp, paper and paperboard manufacturing	3299	69.1	1472	30.9	4771
Fertiliser manufacturing	2048	70.5	856	29.5	2904
Pesticide manufacturing	1105	79.3	288	20.7	1393
Food processing machinery manufacturing	1165	87.1	173	12.9	1338
Total selected agriculture-related manufacturing	**17 911**	**46.1**	**20 930**	**53.9**	**38 841**

a See table C.2 for source and other relevant notes.

Table C.6 Selected agricultural-related services employment in metropolitan and non-metropolitan regions[a], 2001

	Metropolitan		*Non-metropolitan*		*Total*
ANZSIC class	*No. employed*	*%*	*No. employed*	*%*	*No. employed*
Grain storage	334	26.7	916	73.3	1250
Farm produce wholesaling, undefined	124	37.3	208	62.7	332
Farm and construction machinery wholesaling	6001	41.7	8376	58.3	14 377
Meat wholesaling	6573	43.4	8577	56.6	15 150
Farm produce and supplies wholesaling, nec	9709	47.2	10 843	52.8	20 552
Cereal grain wholesaling	901	47.3	1005	52.7	1906
Wool wholesaling	1172	58.8	822	41.2	1994
Dairy produce wholesaling	2939	60.4	1926	39.6	4865
Fruit and vegetable wholesaling	9864	61.1	6275	38.9	16 139
Fish wholesaling	3565	64.3	1983	35.7	5548
Veterinary services	8292	64.9	4485	35.1	12 777
Timber wholesaling	5618	67.1	2757	32.9	8375
Poultry and smallgoods wholesaling	3610	75.9	1146	24.1	4756
Food, drink and tobacco wholesaling, undefined	716	79.4	186	20.6	902
Total selected agriculture-related services	**59 418**	**54.6**	**49 505**	**45.4**	**108 923**

a See table C.2 for source and other relevant notes.

Table C.7 Change in agricultural employment, by industry, 1984-85 to 2003-04

Sector/industry	*Number employed 2003-04*	*Change from 1984-85 to 2001-02*	*Change from 2001-02 to 2003-04*
	'000 persons	%	%
Agriculture, forestry and fishing	375	6.7	-15.7
Agriculture	320	6.2	-17.1
Horticulture and fruit growing	95	24.8	-2.5
Grain, sheep and beef cattle	166	-3.0	-23.0
Dairy cattle	20	34.7	-36.2
Poultry	10	11.9	4.3
Other livestock	10	-42.2	-18.7
Other crops	11	47.2	-37.3
Services to agriculture	25	68.1	-1.9
Forestry and logging	12	-8.1	-8.0
Commercial fishing	16	53.8	-14.9

Source: ABS (Cat no. 6291.0.55.001).

Table C.8 **Changing composition of the agriculture workforce, 1984-85, 1994-95 and 2003-04**

	Agriculture		Mining		Manufacturing		Services		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	%	%	%	%	%	%	%	%	%	%
Full-time										
1984-85	69	12	90	7	72	20	53	26	58	24
1994-95	62	15	88	9	70	20	47	26	51	25
2003-04	60	15	86	10	69	19	43	25	47	24
Part-time										
1984-85	5	14	1	2	2	5	4	16	4	14
1994-95	7	16	1	2	3	7	7	20	6	18
2003-04	9	16	2	2	4	8	9	23	8	20
Total										
1984-85	74	26	91	9	74	25	57	42	62	38
1994-95	69	31	89	11	73	27	54	46	57	43
2003-04	69	31	88	12	73	27	52	48	56	44

Source: ABS (Cat no. 6291.0.55.001).

Table C.9 **Part-time employment trends by sector/industry, 1984-85 to 2003-04**

Sector/industry	*Number employed 2003-04*	*Share of industry employment 2003-04*	*Change from 1984-85 to 2001-02*	*Trend average annual growth 1984-85 to 2001-02*	*Change from 2001-02 to 2003-04*
	'000 persons	%	%	%	%
Agriculture, forestry and fishing	94	25.0	45.6	1.4	-14.2
Agriculture	84	26.2	40.6	1.1	-15.0
Horticulture and fruit growing	26	27.1	58.5	2.2	5.9
Grain, sheep and beef cattle	42	25.7	27.7	0.4	-22.3
Dairy cattle	6	30.4	93.3	3.6	-28.4
Poultry	2	24.2	28.6	0.6	-21.7
Other livestock	3	26.4	-5.2	-2.2	-23.7
Other crops	2	20.6	107.5	3.9	-46.4
Services to agriculture	5	18.4	148.8	5.2	-3.5
Forestry and logging	1	11.1	65.0	3.3	-18.2
Commercial fishing	3	20.9	86.3	2.1	-12.1
Mining	4	4.0	33.1	1.3	9.2
Manufacturing	129	12.0	45.2	2.1	8.9
Services	2495	31.2	129.4	4.7	6.7
Total	2721	28.6	117.9	4.4	5.9

Source: ABS (Cat no. 6291.0.55.001).

Table C.10 **Composition of employment by worker age**

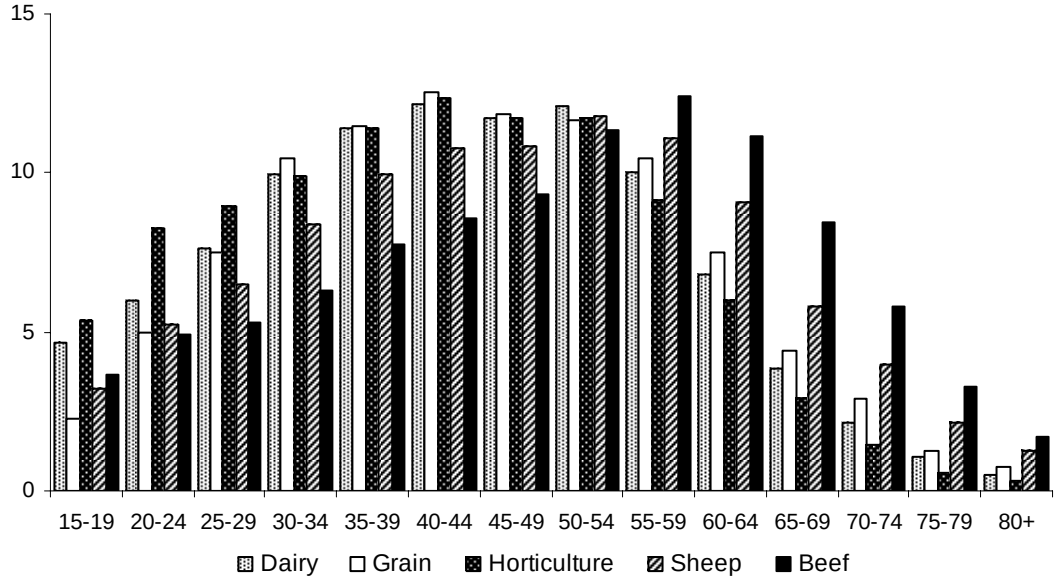
Per cent

	1984-85	*1994-95*	*2003-04*
15-24			
Agriculture	15.6	11.7	11.5
All industries	23.7	19.9	18.0
25-34			
Agriculture	20.5	19.7	17.3
All industries	26.9	25.5	23.0
35-44			
Agriculture	24.5	22.3	20.9
All industries	24.1	25.7	24.1
45-54			
Agriculture	19.1	20.4	21.3
All industries	15.8	19.8	22.2
55 and over			
Agriculture	20.4	25.9	29.0
All industries	9.6	9.1	12.7

Source: ABS (Cat no. 6291.0.55.001).

Figure C.1 **Farmer age distribution by industry, 2001**

Per cent of industry employment



Data source: Unpublished ABS data (2001 Census of Population and Housing).

Table C.11 **Share of employment by occupations, 2003-04**

Per cent

Occupation	*Agriculture*	*Mining*	*Manufacturing*	*Services*	*Total*
Managers and administrators	53	8	10	6	8
Professionals	3	18	10	21	19
Associate professionals	3	10	6	14	12
Trades and related workers	5	21	26	11	13
Clerks, sales and service workers	6	8	13	34	30
Production and transport workers	7	30	17	7	9
Labourers and related workers	24	5	18	7	9

Source: ABS (Cat no. 6291.0.55.001).

D Determining productivity peaks

The substantial volatility evident in agricultural multifactor productivity (MFP) data (discussed in chapter 6) makes it difficult to identify underlying trends in productivity. In order to make a meaningful comparison of productivity over time, it is necessary to make comparisons which lessen the 'noise' created by this volatility.

For the market sector as a whole, the ABS recommends comparing average growth rates between productivity peaks in order to undertake useful comparative analyses.[1] Peak years are defined as peak deviations of the MFP index from its long run trend. The trend series is constructed using an 11 term Henderson moving average (see ABS 2003 for a discussion of the Henderson trend calculations). Deviations (D) are determined as the percentage difference between the original MFP index (MFPA) and the trend series (MFPT); that is:

$$D_t = (MFPA_t / MFPT_t - 1) \times 100 \qquad \{1\}$$

The peak years are determined by the local maxima of this series.

The ABS has estimated peak years for market sector MFP using this approach.[2] However, estimating productivity trends for agriculture across market sector peak years does not adequately control for cyclical factors unique to agriculture such as droughts. For example, at the time of the most recent market-sector peak identified by the ABS — 1998-99 — agricultural MFP was only slightly above trend and continued to rise in three subsequent years to reach 6 per cent above trend in 2001-02. However, 2001-02 was not a peak year for the ABS market sector series. For this reason, as noted in PC (2003, p. 209), 'peak-to-peak periods are probably best constructed on a sector by sector basis'.

To achieve this for the agriculture sector, a Hodrick-Prescott smoothing filter was used to generate a D series {1} from the original MFP estimates. The productivity peaks for agriculture were then determined using a decision rule that identified local maxima.

---

1 Although others, such as Quiggin (2001) have argued for a different basis for determining starting and ending dates for trend analysis.

2 *Australian System of National Accounts*, Cat. no. 5204.0, November 2002.

Following PC 2003, the rule used here to identify the peaks was:

$$\mathbf{PEAK_t = IF\ (D_t > \lambda)\ and\ (D_{t+1} < D_t)\ and\ (D_{t-1} < D_t) = 1} \quad \{2\}$$

where λ is the key threshold value. In PC (2003), λ was set at 1 since the standard deviation of D_t was just above unity for manufacturing. However, choosing a value of 1 for λ is not appropriate for agriculture. The standard deviation of D_t for agriculture (8.3) was much higher than the value recorded for manufacturing, and indeed any other sector (box D.1).

In the first instance the value of λ was set at 9 for agriculture. Using this 'at least one standard deviation' decision rule, between 1974-75 and 2003-04, there were only two productivity peaks — 1978-79 and 1983-84. Following PC (2003), smaller MFP peaks were identified to allow further analysis using a smaller value for λ. When the decision rule was relaxed to at least one-third of a standard deviation above the MFP series (that is, $\lambda = 3$), three additional, smaller, agricultural MFP peaks were identified — 1990-91 and the pre-drought years 1993-94 and 2001-02.

The analysis in chapter 6 is largely based on the three peaks of 1983-84, 1993-94 and 2001-02. These peaks were chosen because they allow ready comparison of the agricultural sector's relative MFP performance over the past two decades.

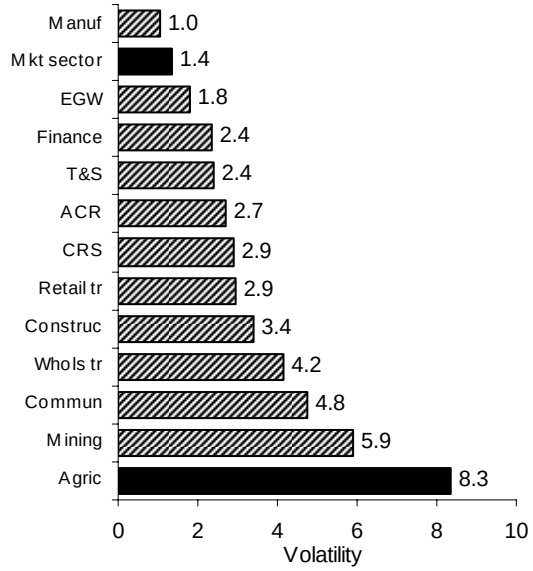
Box D.1 **MFP volatility and sector size**

It could be expected that a sector's size plays some role in its volatility. This is due to aggregation effects which occur when the peaks and troughs for the various industries comprising each sector occur at different times and partially cancel each other out. For example, market sector volatility was lower than all sectors with the exception of manufacturing. Nevertheless, a comparison of the volatility in sectoral MFP suggests that sector size is not the main driver of sectoral volatility. While the largest sector, manufacturing, recorded the lowest volatility, there were a number of small sectors that also recorded low volatility (for example, electricity, gas and water; accommodation, cafes and restaurants and community and recreational services, figure D.1).

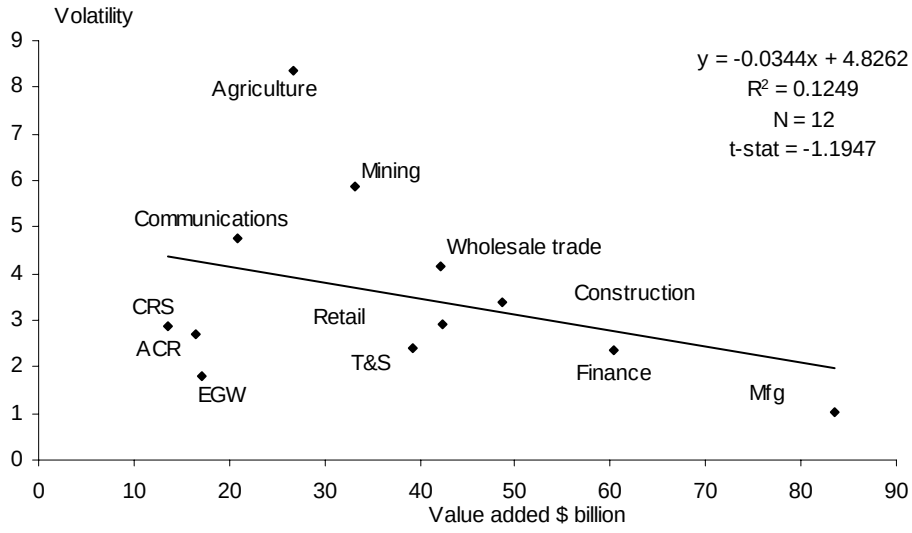
A regression of sectoral volatility against sectoral size (value added in 2003-04, constant 2001-02 prices) found only a weak negative correlation which was not statistically significant at the 5 or 10 per cent level. Hence, it appears likely that characteristics unique to each sector are the major drivers of sectoral MFP volatility.

Figure D.1 **Sectoral MFP volatility[ab] and sector size, 1974-75 to 2003-04**

Sector volatility



Volatility and sector size



a Sector volatility is defined as the standard deviation of D_t — as in {1} above. **b** CRS, ACR, EGW, T&S refer to Cultural and recreational services, Accommodation, cafes and restaurants, Electricity, gas and water, and Transport and storage, respectively.

Data source: ABS Cat. no. 5204.0.

References

ABARE (Australian Bureau of Resource Economics) 2005a, *Australian Crop Report*, June.

—— 2005b, *Australian Commodities: forecasts and issues*, vol. 12 no. 1, March quarter.

—— 2004a, 'Australian sheep industry productivity', *Australian lamb*, November.

—— 2004b, *Australian Commodity Statistics 2004*, Canberra.

—— 2004c, 'Production systems, productivity and profit', *Australian dairy*, September.

—— 2004d, 'Production and sale of beef cattle', *Australian beef*, December.

—— 2004e, *Australian beef industry, productivity*, November.

Abdalla, A., Tran, Q.T., Berry, P. and Foster, M. 2003, 'Agricultural biotechnology, potential for use in developing countries', *Australian commodities*, vol. 10, March quarter, pp. 111-119.

ABS 2004, *Use of information technology on farms*, ABS Cat. no. 8150.0.

—— 2003, *A guide to interpreting — monitoring trends*, ABS Cat. no. 1349.0.

—— 2002a, 'A hundred years of agriculture data', *ABS Year Book Australia*.

—— 2002b, 'ANZSIC and TREC — Two views on trade', *International Merchandise Trade Australia 2002*.

—— 2002c, 'Understanding agricultural exports data', *ABS Year Book Australia*.

—— 2002d, 'Data confidentiality' in international merchandise trade Australia 2002, *ABS Year Book Australia*.

—— 2001, *Census of population and housing*, Australian Bureau of Statistics.

—— 1993, *Australian and New Zealand Standard Industrial Classification (ANZSIC)*, ABS Cat. no. 1292.0.

Agriculture and Agri-Food Canada 2003, *An Overview of the Canadian agriculture and agri-food system*, Canada, http://www.agr.gc.ca/cb/apf/pdf/bg_con_overvu_e.pdf (accessed April 2005).

Alexander, F. and Kokic, P. 2005, *Productivity in the Australian grains industry*, ABARE *e*Report 05.3, prepared for the Grains Research and Development Corporation, Canberra, February.

Andrews, N., Buetre, B., Davidson, A. and McDonald, D. 2003, *Agricultural trade reform: benefits for Australian broadacre agriculture*, ABARE Conference Paper 03.7 presented at Queensland Regional Outlook Conference, Toowoomba, 21 May.

Barber, M. and Cutbush, G. 2005, 'Contract farming: the future of agriculture?', *Farm Policy Journal*, vol. 2, no. 1, February, pp. 4-14.

Barr, N. 2004, *The Micro-dynamics of change in Australian agriculture 1976-2001*, Australian Census Analytic Program, Australian Bureau of Statistics, Canberra.

——, 2003, *Future agricultural landscapes*, paper presented to Leading with Diversity: The National Planning Conference, Adelaide, 31 March – 2 April.

——, 2002, 'Social Trajectories for rural landscaping', *Agribusiness connections – farm, food and resource issues*, Agribusiness Association of Australia, Autumn, http://www.agrifood.info/10pub_conn_Aut2002_5.htm (accessed 8 February 2005).

Bradley, R., and Gans, J. 1998, 'Growth in Australian cities', *The Economic Record*, vol. 74, no. 226, pp. 266–278.

BTRE (Bureau of Transport and Regional Economics) 2004, *Focus on regions no.*

Butlin, N.G. 1962, *Australian domestic product, investment and foreign borrowing 1861-1938/39*, Cambridge University Press, Cambridge.

Cary, J., Barr, N., Aslin, H., Webb, T. and Kelson, S. 2001, *Human and social aspects to capacity to change to sustainable management practices*, Bureau of Resources Sciences, Canberra.

Clark, C., Geer, T. and Underhill, B. 1996, *The changing of Australian manufacturing*, Staff Information Paper, Industry Commission, AGPS, Canberra.

Coelli, T.J. and Prasada Rao, D.S. 2003, *Total factor productivity growth in agriculture: a malmquist index analysis of 93 Countries*, 1980 to 2000, Working Paper no. 02/2003, Centre for Efficiency and Productivity Analysis, School of Economics, The University of Queensland.

Corish, P. 2004, *A 21st Century vision for modern Australian agriculture*, Telstra Address by National Farmers Federation President, 4 August.

Cullen, R.B. and Cullen, M.J. 1994, *An Analysis of qualification profiles in Australian industry: agriculture forestry and fishing*, Occasional Paper 95/1 Australian National Training Authority, Brisbane.

Dairy Australia 2004, *Australian dairy industry in Focus 2004*, Dairy Australia, Melbourne.

Dee, P. and Hanslow, K. 2000, *Multilateral liberalisation of services trade*, Productivity Commission Staff Research Paper, AusInfo, Canberra.

DAFF (Department of Agriculture, Fisheries and Forestry) 2005, *Australian agriculture and food sector stocktake*, Department of Agriculture, Fisheries and Forestry, Canberra.

DFAT (Department of Foreign Affairs and Trade) 2005, *Statistical analysis and retrieval system (STARS) database, market information and analysis section*, Barton.

—— 2004b, *Exports of primary and manufactured products Australia 2003-04*, Canberra.

Dixon, P. and Menon, J. 1995, *Measures of intra-industry trade as indicators of factor market disruption*, Centre of Policy Studies General Paper no. G-113, April.

Economic Research Service United States Department of Agriculture 2001, *agricultural policy reform in the WTO — the road ahead*, Burfisher, M.E. (ed), Agricultural Economics Report no. (AER802), May.

Econtech 2005, *Australia's farm-dependent economy: analysis of the role of Agriculture in the Australian economy*, Farm Institute, Surry Hills, Australia.

Edwards, G. 2003, 'The story of deregulation in the dairy industry', *The Australian Journal of Agricultural and Resource Economics*, vol. 47, no. 1, pp. 75–98.

Ferguson, J. and Simpson, R. 1995, 'The Australian rural labour market' *National Focus*, A National Farmers' Federation Research Paper vol. 9, National Farmers' Federation, November, Canberra.

Freeman, F., Melanie, J., Roberts, I., Vanzetti, D., Tielu, A. and Beutre, B. 2000, *The impact of agricultural trade liberalisation on developing countries*, ABARE Research Report 2000, Canberra.

Garnaut, J., and Lim-Applegate, H. 1998, *People in farming*, ABARE Research Report 98.6, ABARE, Canberra.

—— and Rasheed, C. 1998, 'Computers: use in management and electronic commerce in Australian farming', *Australian Farm Surveys Report*, ABARE.

——, ——, and Rodriguez, G. 1999, *Farmers at work: the gender division*, ABARE Research Report 99.1, ABARE, Canberra.

Gooday, J. 1995, *Women on farms: A survey of women on Australian broadacre and dairy family farms, 1993-94*, ABARE Research Report 95.10, ABARE, Canberra.

Gordon, W. 2005, *Australian wine grape production projections to 2006-07*, ABARE *e*Report 05.2, prepared for the Grape and Wine Research and Development Corporation, Canberra, January.

Grubel, H.G. and Lloyd, P.J. 1975, *Intra-industry trade: the theory and measurement of international trade in differentiated products*, McMillan Press, London.

Ha, A. and Chapman, L. 2000, 'Productivity growth trends across Australian broadacre industries', *Australian Commodities*, vol.7, no. 2, June quarter.

Hallam, D. 2003, 'The organic market in OECD countries: past growth, current status and future potential', *Organic Agriculture: Sustainability, Markets and Policies*, OECD, pp. 179–186.

Harris, S. 1990, 'Agricultural trade and agricultural trade policy', in Williams D.B. (ed) *Agriculture in the Australian Economy*, 3rd edn., Sydney University Press, pp. 342-360.

Higgins, T.J. and Constable, G. 2004, 'Development, regulation and use of genetically modified crops in Australia', *Farm Policy Journal*, vol. 1, no. 2, August quarter, pp. 14-23.

Hogan, J., Shaw, I. and Berry, P. 2004, *A review of the Australian dairy industry*, ABARE *e*Report 04.24, prepared for the Primary Industries Standing Committee Working Group on Dairy, August, Canberra.

Hooper, S., Berry, P. and Martin, P. 2004, *Grains industry, performance and outlook*, ABARE and Grains Research and Development Corporation, March.

——, Blias, A. and Ashton, D. 2003, *Australian prime lamb industry 2003*, Report of the Australian Agricultural and Grazing Industries Survey of Prime Lame Producers, ABARE Research Report 03.2, Canberra.

——, Martin, P., Love, G. and Fisher, B. 2002, Farm size and productivity: where are the trends taking us?', *Australian Commodities*, vol. 9, no. 3, September quarter, pp. 495-500.

IC (Industry Commission) 1998, *Microeconomic reforms in Australia: a compendium from the 1970s to 1997*, Research Paper, AGPS, Canberra, January.

—— 1997, *Assessing Australia's productivity performance*, AGPS, Canberra, September.

—— 1995, *Research and development report*, no. 44, AGPS, Canberra.

Johnson, D.G. 2000, 'Population, food and knowledge', *American Economic Review*, vol. 90, no. 1, pp. 1–14.

Keogh, M (ed), 2005, *Farm Policy Journal*, vol. 2, no 1, February quarter, pp. 1-2.

—— 2004, 'Off the sheep's back and on to the tractor — the changing face of farming in Australia', *Farm Policy Journal*, vol. 1, no. 1, May quarter, pp. 4-16

Knopke, P., Strapazzon, L. and Mullen, J. 1995, 'Productivity growth: total factor productivity growth on Australian broadacre farms', *Australian Commodities*, vol. 2, no. 4, December quarter, pp. 486-497.

Lester, I.H. 1994, *Australia's food and nutrition*, Australian Institute of Health and Welfare, AGPS, Canberra.

Lipton, K., Edmonson, W. and Manchester, A. 1998, *The food and fibre system: contributing to the US and world economies*, USDA Agriculture Information Bulletin No. 742, July.

Lu, L. and Headley, D. 2004, 'The Impact of the 2002-03 Drought on the economy and agricultural employment', *Economic Roundup*, Autumn, pp. 25–43.

Maddock, R. and McLean, I. 1987, *The Australian economy in the long run*, Cambridge University Press, Melbourne.

Martin, P., King, J., Puangsumalee, P., Tulloh, C. and Treadwell, R. 2005, *Australian farm survey results*, March, ABARE, Canberra.

——, Lubulwa, M., Riley, C. and Helali, S. 2000, 'Farm performance: managing risks', *Outlook 2000*, Proceedings of the National Agriculture and Resources Outlook Conference, Canberra, 29 February – 2 March, vol. 2, *Agriculture and Regional Australia*, ABARE, pp. 41–62.

Martin, W. and Mitra, D. 2001, 'Productivity Growth in agriculture and manufacturing', *Economic Development and Cultural Change*, vol. 49, no. 2, pp. 403–23.

McGovern, M. 1999, 'On the unimportance of exports to Australian agriculture', *Australasian Journal of Regional Studies*, vol. 5, no. 2, pp. 229–252.

McLachlan, R., Clark, C. and Monday, I. 2002, *Australia's service sector: a study in diversity*, Productivity Commission Staff Research Paper, AGPS, AusInfo, Canberra.

Murtough, G. and Waite, M. 2000, *The growth of non-traditional employment: are jobs becoming more precarious?*, Productivity Commission Staff Research Paper, AusInfo, Canberra.

NCC (National Competition Council) 2004, *Dairy – Now and then: the Australian dairy industry since deregulation*, NCC Occasional Series, AusInfo, Canberra.

—— 2000, *Securing the future of Australian agriculture: barley*, NCC Community Information, Canberra.

OECD (Organization for Economic Co-operation and Development) 2004a, *OECD Agricultural outlook 2004–2013*, OECD, Paris.

—— 2004b, *OECD Agricultural policies 2004: at a glance*, OECD, Paris.

—— 2003a, *Evolution of Agricultural support in real terms in OECD countries from 1986 to 2002*, Working Party on Agricultural Policies and Markets, OECD, Paris.

—— 2003b, *Farm household income: issues and policy responses*, OECD, Paris.

—— 1998, *Agricultural policy reform and the rural economy in OECD Countries*, OECD, Paris.

—— 1995, *Technological change and structural adjustment in OECD Agriculture*, OECD, Paris.

PC (Productivity Commission) 2004a, *Australian pigmeat industry*, Draft Report, Melbourne.

—— 2004b, *Impacts of native vegetation and biodiversity regulations*, Report no. 29, Melbourne.

—— 2004c, *Trade and Assistance Review 2003-04*, Annual Report Series 2003-04, Productivity Commission, Canberra, December.

—— 2003, *Trends in Australian manufacturing*, Commission Research Paper, AusInfo, Canberra.

—— 2002, *Citrus growing and processing*, Report no. 20, AusInfo, Canberra.

—— 1998, *Battery eggs sale and production in the ACT*, Research Report, AusInfo, Canberra.

Peterson, D., Dwyer, G., Appels, D. and Fry, J. 2004, *Modelling water trade in the southern Murray-Darling Basin*, Productivity Commission Staff Working Paper, Melbourne, November.

Quiggin, J. 2001, 'The Australian productivity "miracle": a sceptical view', *Agenda*, vol. 8, no. 4, pp: 801-817.

Raney, T. 2004, 'Agricultural biotechnology for developing countries: an FAO PERSPECTIVE', *Farm Policy Journal*, vol. 1, no. 2, August quarter, pp. 4–13.

Rasheed, C., Rodriguez, G. and Garnaut, J. 1998, 'Patterns of Employment of men and women in farming', in ABARE, *Australian Farm Surveys Report 1998*, ABARE, Canberra, pp. 43–47.

RBA (Reserve Bank of Australia) 1996, Australian economic statistics, dX Database, Econdata (vendor), released: 20 November 1996.

RIRDC (Rural Industries Research and Development Corporation) 2004, *Annual Report 2003-2004*, RIRDC, Canberra.

—— 2003, *Research priorities 2004-2005*, RIRDC, Canberra.

Roberts, I., Davidson, A., Podbury, T. and Tulpule, V. 2004, 'Uncertainty in trade negotiations — what does it mean for Australian agriculture?', in *Australian Commodities*, vol. 11, no. 1, March quarter, pp. 143–154.

——, Podbury, T., Freeman, F., Tielu, A., Vanzetti, D., Andrews, N., Melanie, J., and Hinchy, M. 1999, *Reforming world agricultural trade policies*, ABARE Research Report 99.12, Canberra.

Rowthorn, R. and Ramaswamy, R. 1997, *Deindustrialization — its causes and implications*, Economic Issues Paper no. 10, IMF, Washington DC.

Rural Industry Working Group 2001, *Skill needs now and in the future in the rural industry*, Prepared for the Honourable Dr David Kemp MP, Minister for Education, Training and Youth Affairs.

Salce, M. 1995, 'Beware the farmer — she's out to change agriculture' in *Outlook 95*, proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 7–9 February, vol. 2, *Agriculture*, ABARE, Canberra, pp. 329–336.

Synapse Consulting Pty Ltd 1998, *Farmer education and training: issues for Research and Development*, RIRDC Publication 98/26, RIRDC, Canberra.

Taylor, J.E. (2001) 'Human capital: migration and rural population change' in Stamoulis, K. G. (ed), *Food, Agriculture and Rural Development: Current and Emerging Issues for Economic Analysis and Policy Research*, FAO.

Tonts, M. and Black, A. 2002, *The impact of changing farm business structures on rural communities*, RIRDC Report 02/027, RIRDC, Canberra.

Treasury (Department of the Treasury) 2005, *Budget strategy and outlook 2005-06, Budget Paper No.*

West, G. 2002, 'Decomposition of exports and GDP into direct and indirect industry contributions', *Australasian Journal of Regional Studies*, vol. 8, no. 2, pp. 143–164.

Wonder, B. and Fisher, B. 1990, 'Agriculture in the economy', in Williams D.B. (ed) *Agriculture in the Australian Economy*, 3rd edn., Sydney University Press, pp. 50–67.

Wynen, E. 2003, *Organic agriculture in Australia — levies and expenditure*, RIRDC Report 03/002, RIRDC, Canberra.