

In Australia's services-dominated economy, should policymakers take any notice of agriculture?

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Abstract

At the start of the twentieth century, agriculture was a very significant sector of the Australian economy, both in Gross Domestic Product (GDP) and export terms. By the middle of that century, manufacturing had become dominant. By the end of the century, both had been overshadowed by the services sector, which since the 1970s has progressively expanded to the point where it is claimed to now account for almost 70% of national economic output, four out of every five jobs, and one fifth of exports.

These statistics suggest that sectors such as farming and mining no longer matter in the national economy, and yet as the recent drought and the current minerals boom demonstrate, the national economic impact of shocks in these sectors can be much more significant than statistics suggest should be the case. A review of available statistics concerning the Agricultural sector, and linkages between different sectors of the economy provides some indications about why Agricultural sector shocks impact more widely on the economy. It also leads to the conclusion that there is a need for a much better understanding of the interdependencies of different sectors within the economy.

Introduction

In a review of the impact of the 2002-03 drought on the national economy by the Australian Government Department of Treasury, (Lu & Hedley 2004) the authors stated *'The drought has had a significant contractionary impact on the economy, far greater than the relative size of the farm sector might suggest.'* Later in the same report, the authors concluded *'The 2002 drought had a significant impact on the Australian economy. The farm sector subtracted around 1 percentage point from GDP growth, and around $\frac{3}{4}$ of a percentage point from employment growth in 2002-03. These macro-economic effects are very large in comparison with the size of the farm sector – typically around $3\frac{1}{2}\%$ of GDP'.*

These comments reflect the reality of the Australian economy in that in pure GDP terms, sectors such as mining and agriculture are no longer dominant sectors (not that they have been for most of the last century). But they also raise some interesting issues about the national economy, prompting as they do (with apologies to George Orwell) questions such as *'Are some sectors of the economy more equal than others?'* In other words, are some sectors of the economy more prone to shocks than others, and are shocks impacting on some particular sectors (such as a major drought, a slump in international mineral prices or even a new tax or regulation) likely to have a larger impact in national GDP terms than a similar-sized shock affecting another sector of the economy? A related, but perhaps more complex question is whether structural changes in the economy over time are likely to increase or decrease the flow-on impacts of shocks to particular sectors of the economy.

A starting hypothesis for this paper is that Agricultural sector shocks are more frequent and relatively severe than shocks in other sectors of the economy, and over time they are likely have a proportionally greater impact on the rest of the economy, as the Agricultural sector becomes more integrated with other sectors as a consequence of more intensive input use, increased use of services, the outsourcing of some functions to other economic sectors, and the increased levels of value-adding incorporated into agricultural products purchased by Australian and international consumers.

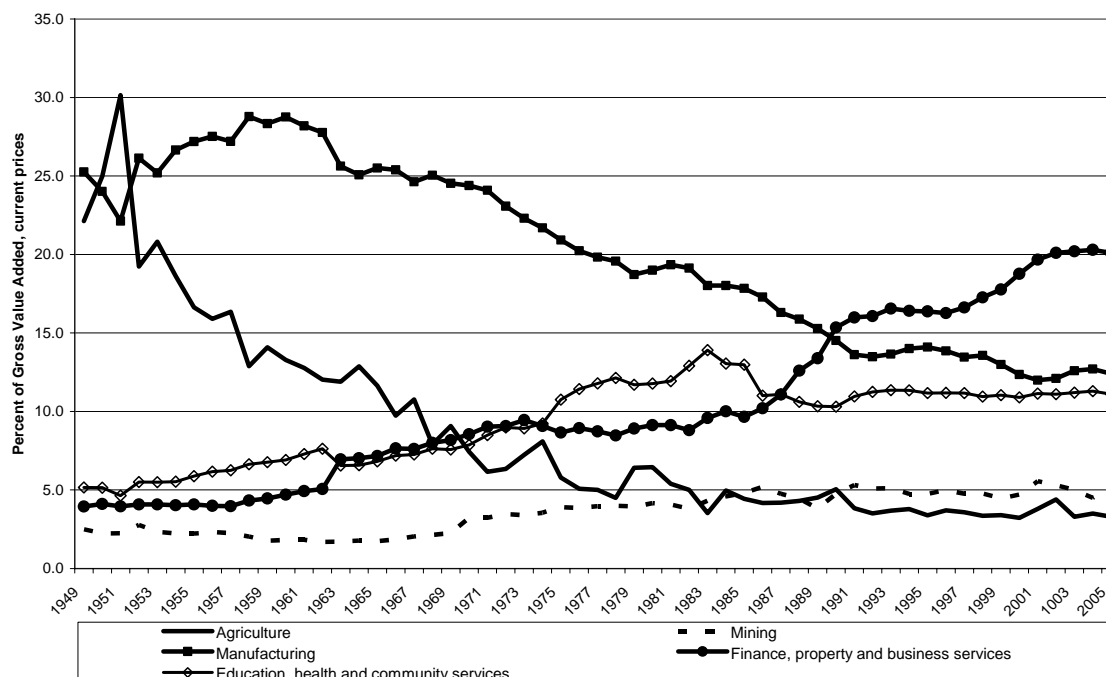
This paper will firstly review available statistics about the changing significance of various industry sectors in the national economy, and the propensity of different sectors to deliver shocks to the economy. The paper will then examine available evidence about the nature of interactions between agriculture and the rest of the economy. Finally, the recent drought and other Agricultural sector shocks will be used as case studies to examine how Agricultural sector shocks impact on the national economy.

Change in the national economy

The extent to which a particular sector of the economy is likely to have an impact on other sectors depends on the significance of the sector in the economy, and also on what might be termed the volatility of the sector – the propensity for output from that sector to change dramatically over time.

Looking firstly at the significance of different sectors of the economy, statistics reveal that substantial change has occurred to the structure of the Australian economy over the past 50 years, and in particular to the contributions made by various industry sectors.

Figure 1. Changes in selected industry sectors contribution to national GDP (%): 1949-2005



Source: Bain, 2006.

Throughout the first half of the twentieth century, agriculture accounted for between 20 and 30 percent of national GDP, with significant contractions occurring in 1901 (a major drought) and 1915 (the start of world war one), and significant expansion occurring in 1919 (the end of world war one) and in 1950-51 (the Korean war boom). From 1950 to 1990, agriculture progressively declined as a proportion of GDP as first manufacturing, and then other sectors of the economy experienced growth rates that were much more rapid than that of agriculture. Over the same period, agriculture's share of the total value of Australian exports declined from 65% in 1960, to approximately 20% in 2000.

Since 1990, the 'Agriculture, forestry and fishing' sectors share of national GDP has remained relatively constant, fluctuating at around 3.5%, with a trendline indicating a slow but small annual decline in national economic significance. The recent decline in output as a consequence of the 2002-04 drought came after a period extending from the mid 1990s during which the sector's share of the economy had been trending upwards.

It should be noted that while discussing the relative 'decline' of agriculture in the national economy, in absolute terms the volume of agricultural output has more than doubled since 1970, (Productivity Commission 2005), and at the same time the quality of produce has increased substantially, with for example, grain protein and oil levels increasing, wool fibre diameter becoming finer, and certainly a perception that quality standards in meat, horticulture and vegetable production have improved considerably. The 'decline' is largely a consequence of lower real unit prices for agricultural produce over the period in question, while significant growth has also been occurring in other sectors of the economy.

The manufacturing sector grew rapidly in significance over the first half of the century, contributing almost 30% of national GDP by 1960. Since that time, however, the sector's contribution has progressively declined to a level of approximately 10% as measured by the

Australian Bureau of Statistics (ABS). Mining, on the other hand, contributed over 10% of Australian GDP at the start of the century, then declined to a level of around 3% by 1930, however since the 1960s has increased in significance to now constitute approximately 5% of GDP.

The contribution of the Services sector over the past century is not as easily analysed due to changes in sector classifications over time, however it may surprise many to learn that in 1900-01, the Services sector was measured as accounting for 50% of GDP (Bain, 2006). Since 1970, however, there has been steady growth in the significance of the sector, to a point where it is now contributing approximately 70% of annual GDP, depending on the sub-sectors included in the category. Since 1960, the Services sector has increased its share of the total value of Australian exports from 13% to approximately 20%.

In examining the changed contributions of both the manufacturing and services sector at a more disaggregated level over the past thirty years, several points become evident. The first is that the relative contributions of each of the sub-sectors of the Manufacturing sector have declined steadily over the period, with the '*Textiles, clothing and footwear*', '*Machinery and equipment*' (which includes car manufacturing) and '*Food, beverage and Tobacco*' sub-sectors having declined in significance to a slightly greater degree than other sub-sectors of manufacturing.

Within the services sector, the '*Property and business services*', '*Finance and insurance*' and '*Health and community services*' sub-sectors are responsible for most of the increased significance of the services sector. The '*Property and Business Services*' sub-sector includes a broad range of activities, including property development and real estate, research, legal and accounting services, computer services and marketing and business management services. The significance of, and the relative growth of this sub-sector of Services is perhaps contrary to common perceptions of Service-sector growth predominantly involving growth in personal services or tourism-related industries.

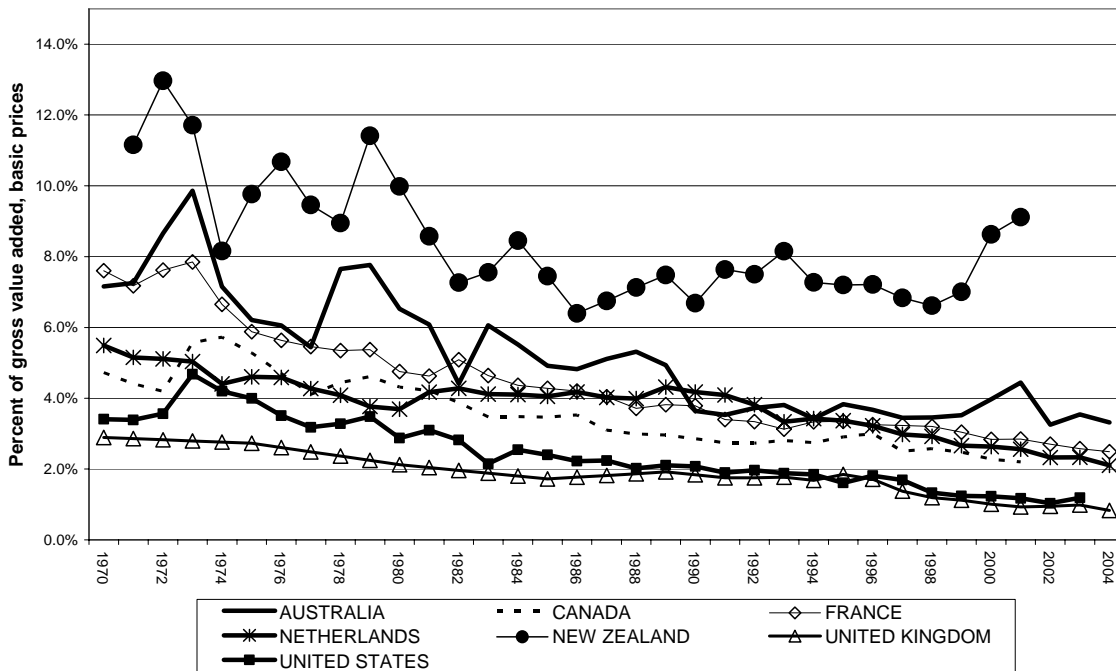
These changes in national economic structure are not confined to Australia, and nor are they surprising. In most OECD countries, the Services sector now accounts for between 65 and 75% of national GDP, and has been growing in relative terms since the 1970s (OECD 2005). Even nations such as Canada and New Zealand, which are both recognised as having substantial primary industry sectors, now have in excess of 65% of national economic output contributed by their Services sector.

The reason why the Services sector has become increasingly significant in national economic output as individual wealth has increased has been the subject of considerable academic discussion. From an agricultural sector perspective, the main reasons for the decline of agriculture relative to services have been outlined by Watson (2000). These are;

- Food has a low income elasticity of demand, with average daily intake plateauing at between 3,200 and 3,500 calories per day, irrespective of how wealthy individuals are. As incomes rise, demand for services associated with food increases, but not demand for food per se.
- The supply of food (both in aggregate and per capita terms) has increased substantially as economic and technological development (the replacement of manual labour with machinery) has occurred, both within nations and globally.
- The combination of stable demand for food and increasing supply has led to declining real prices for agricultural (and for many manufactured) products, while demand for services is more income elastic, and many activities in the Services sector as are less suited to the replacement of labour with machinery or computers.

Developed nations which are internationally competitive in agricultural production are able to maintain a relatively more significant agricultural sector via exporting agricultural products, and it is notable that amongst OECD countries, agricultural exporters such as Australia and New Zealand have agricultural sectors that have not declined in relative economic significance to the same degree as other developed nations agricultural sectors have.

Figure 2. Change in the relative shares of the ‘Agriculture, forestry, fishing and hunting’ sectors in the national economies of selected OECD countries: 1970-2005.

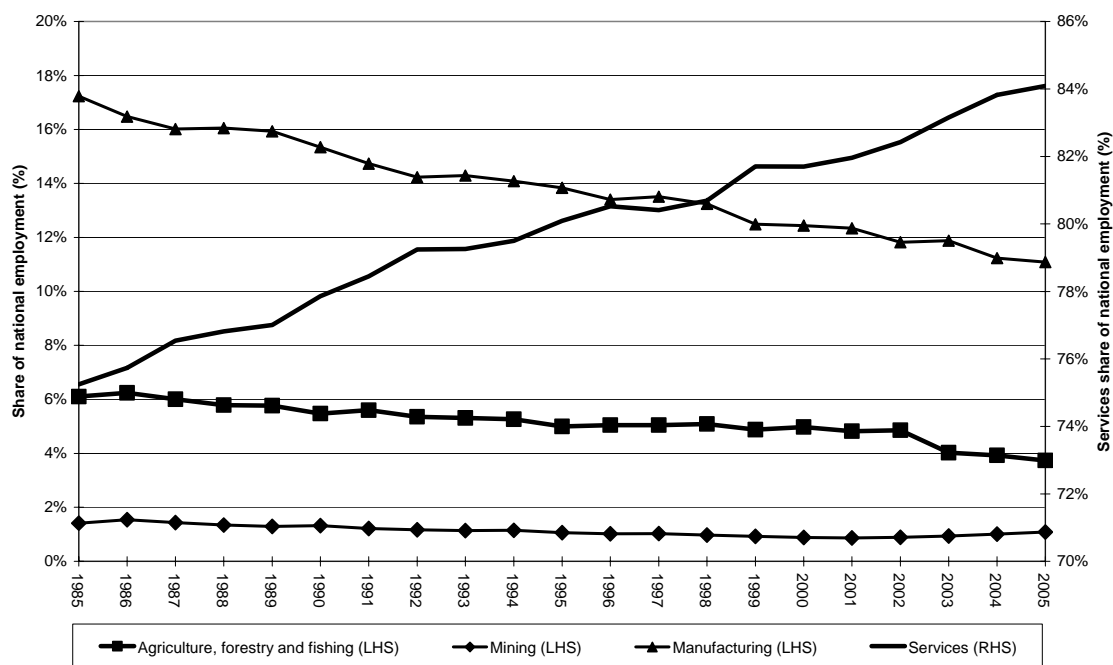


Source: OECD STAN database.

Changes in employment within different sectors of the economy in recent decades have largely mirrored changes in sector contributions to GDP, although the relative significance of ‘Agriculture, fisheries and forestry’ has declined from 6.11% of total employment in 1985 to 3.74% in 2005, a larger proportional change than has occurred in the sector’s share of GDP. It is notable that a significant decrease in Agricultural sector employment occurred in 2002, seemingly as a consequence of the drought.

The greatest increase in the significance of sectors in total employment has been the ‘Property and Business Services’ sector, which has grown from being 6.4% of total employment in 1985 to 11.5% in 2005. The largest sectoral decline in employment significance has occurred in the Manufacturing sector, which comprised 17.2% of employment in 1985, and 11.1% in 2005.

Figure 3. Changes in employment over time within sectors of the Australian economy: 1985-2005.



Source: ABS, Catalogue No. 6291.0 Labour force, Australia.

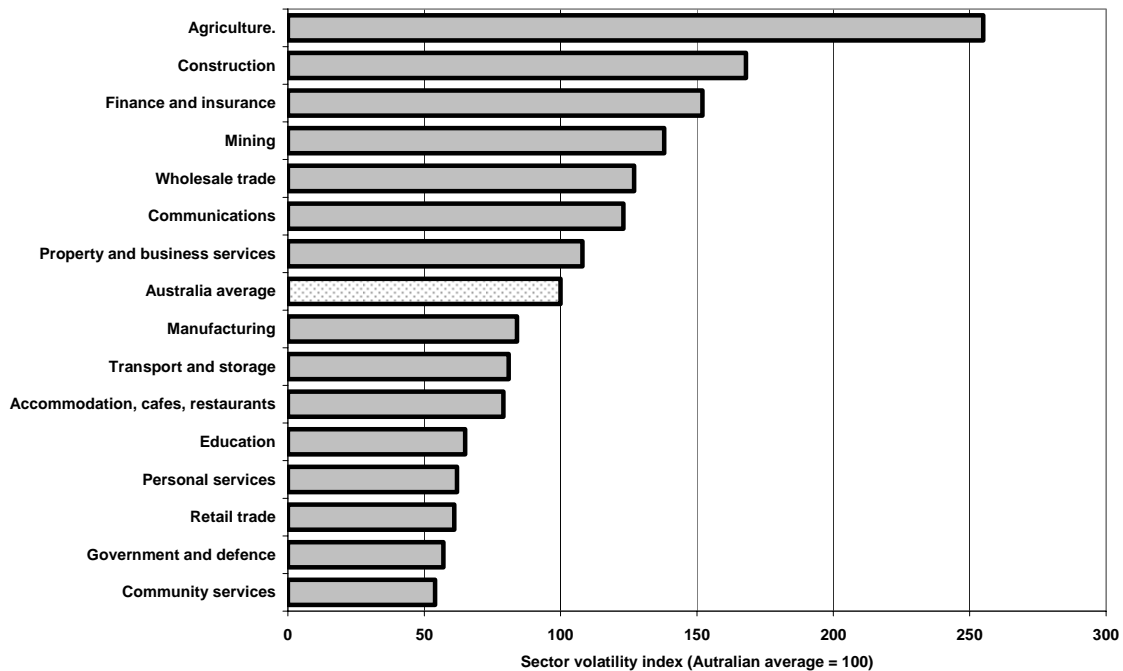
While official statistics record changes in the significance of different sectors of the economy, there is a danger in perceiving that economic sectors exist in isolation. There is a large amount of interaction between the different sectors, with outputs from some sectors becoming inputs for others and vice versa. For example, it has been estimated that service sector inputs represent a steadily increasing proportion of the total value of Australian Manufacturing sector output, rising from 15% in the early 1970s to 23% by the mid 1990s (OECD 2005). This is also observed in other OECD countries, and is a reflection of the manufacturing sector outsourcing activities such as market research, design and engineering that were previously carried out in-house.

The way various economic activities are classified can also result in some of the recorded changes. As a simple example, if a horticulture producer who previously employed staff to pack fruit on the farm decides to contract a local packing shed to do this work, the recorded outcome should be a decline in Agricultural sector output, and an increase in service sector output, despite the actual activities being carried out and the end product being identical.

In assessing the likely impacts of a sectoral economic shock on the entire economy, the size of the sector incurring the initial shock is obviously important. However, the propensity of various sectors of the economy to deliver a shock which impacts more broadly is also related to the relative volatility of that sector of the economy in comparison with other sectors.

Some sectors of the economy, such as the energy utility sectors of electricity and gas, have remained relatively constant in terms of their significance in the national economy over an extended period, but also remain relatively constant from year to year in terms of the gross value added they contribute to national GDP.

Figure 4. Relative volatility* of sectors of the Australian economy over the period from 1974-5 to 2003-4.



Source: Productivity Commission, 2005.

* The Productivity Commission has estimated sectoral volatility by calculating the standard deviation of the percentage difference between the actual and the trendline output (constant price) for each sector of the economy on an annual basis, indexed to 100 for the entire economy.

As would be expected, industries such as agriculture and mining that are dependent on international markets and incur exchange rate risks are more volatile than other sectors of the economy, in particular the Services sector. Agriculture, in addition, is exposed to climatic risk.

It is perhaps not surprising therefore that agriculture is easily the most volatile sector of the economy, and experiences two and a half times the average level of volatility of all sector of the economy, as can be observed from Figure 4. This figure represents volume of output volatility, utilising constant 2002-03 prices. Adding price volatility to this output volatility would seem likely to further widen the volatility gap between agriculture and other sectors of the economy.

The above data and analysis leads to the conclusion that the declining significance of agriculture in the national economy should result in a diminished potential for Agricultural sector shocks to have a marked impact on the wider economy, although the data on sector volatility suggests that shocks occur much more frequently in the Agricultural sector than in any other sector of the economy.

While measured changes in national economic structure provide important information, it is of limited use in explaining the full economic impact of shocks, such as a drought. That requires a more complete understanding of how a sector such as agriculture interacts with the rest of the economy.

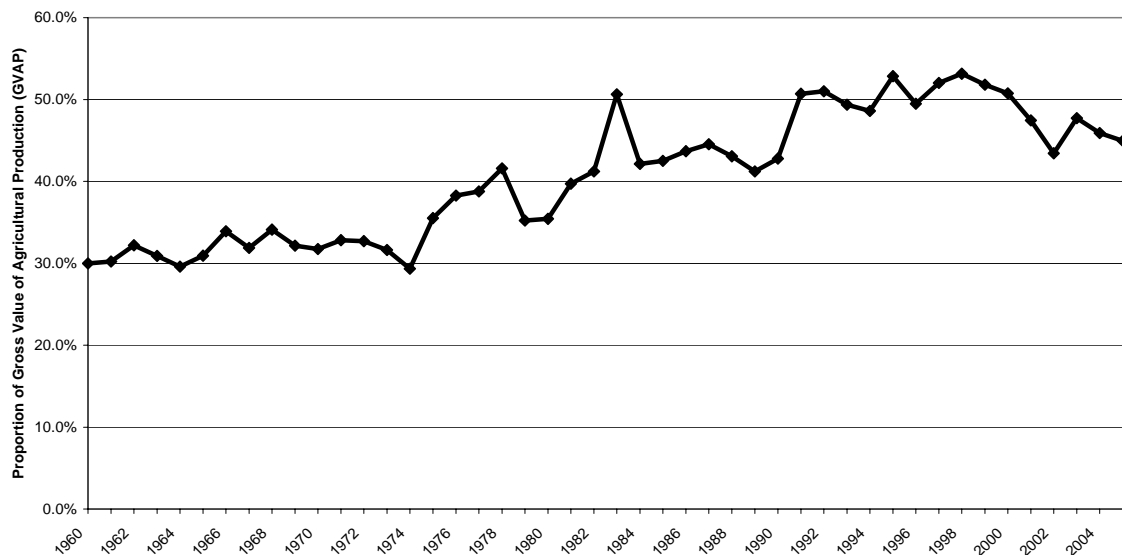
Interactions between agriculture and the wider economy

Analysis of changes in the inputs used by the Agricultural sector, and the way in which Agricultural sector outputs are utilised provides useful information that can assist in better understanding interactions between the Agricultural sector and the rest of the economy. Such analysis involves direct transactions between farmers and farm suppliers (the farm input sector), as well as direct transactions between farmers and businesses involved in purchasing, processing marketing, distributing and exporting farm produce (the farm output sector). It also involves flow-on or tertiary effects arising from changes in both these sectors that extend through the wider economy. In addition, within regional areas, agricultural employee and farm household expenditure can also be significant, especially for service providers in smaller regional centres.

The farm input sector

One aspect of changes in interactions between agriculture and the wider economy is changes over time in the use of inputs into farm production. The ABS maintains data dating back to 1960 as part of the national accounts (ABS 2005) which provides some long-term, although crude measures of changes that have been occurring over that period. Of particular interest are trends in the value of farm inputs, expressed as a proportion of the gross value of agricultural production over that period (Figure 4).

Figure 4. Trends in the cost of farm inputs as a proportion of the gross value of agricultural production: 1960-2005.



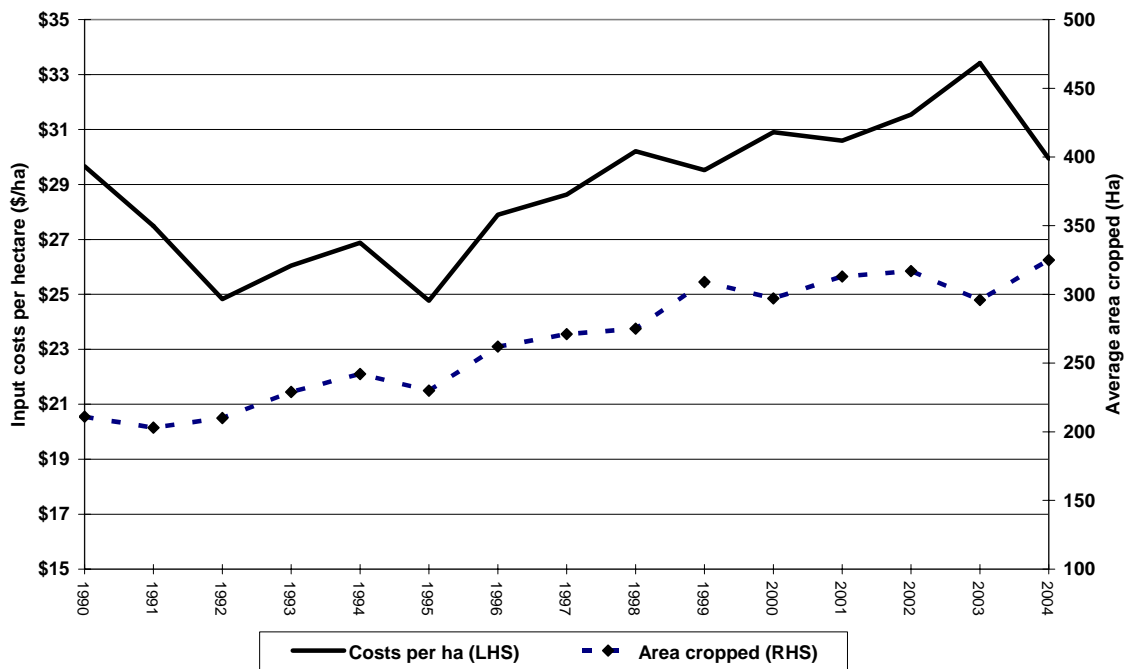
Source: ABS Catalogue No. 5206.0

The figure highlights the progressively greater reliance of the Agricultural sector on purchased inputs (goods and services) over the past forty years. This is not surprising, probably reflecting both an intensification of agriculture over this period through mechanisation and the increased use of chemicals and fertilisers, and changes in enterprises as crop and horticulture production has expanded through the 1980s and 1990s, and broadacre livestock production has declined in

relative terms. The apparent relative decline in input costs relative to output in recent years is a consequence of stronger prices for farm outputs (and hence a higher GVAP figure) rather than a decline in real input costs during that period.

More detailed data on changes in the nature of farm inputs used by agriculture is available from annual farm surveys conducted by the Australian Bureau of Agriculture and Resource Economics (ABARE), although this data extends over a more limited timeframe, and its scope does not include agricultural enterprises such as intensive livestock or horticulture. The ABARE data is also limited to cash costs.

Figure 5. Changes in real farm input costs (net of livestock trading expenses) per hectare, and cropping areas (average per farm): 1990-2004 (Australian broadacre farms, 2004 dollars)

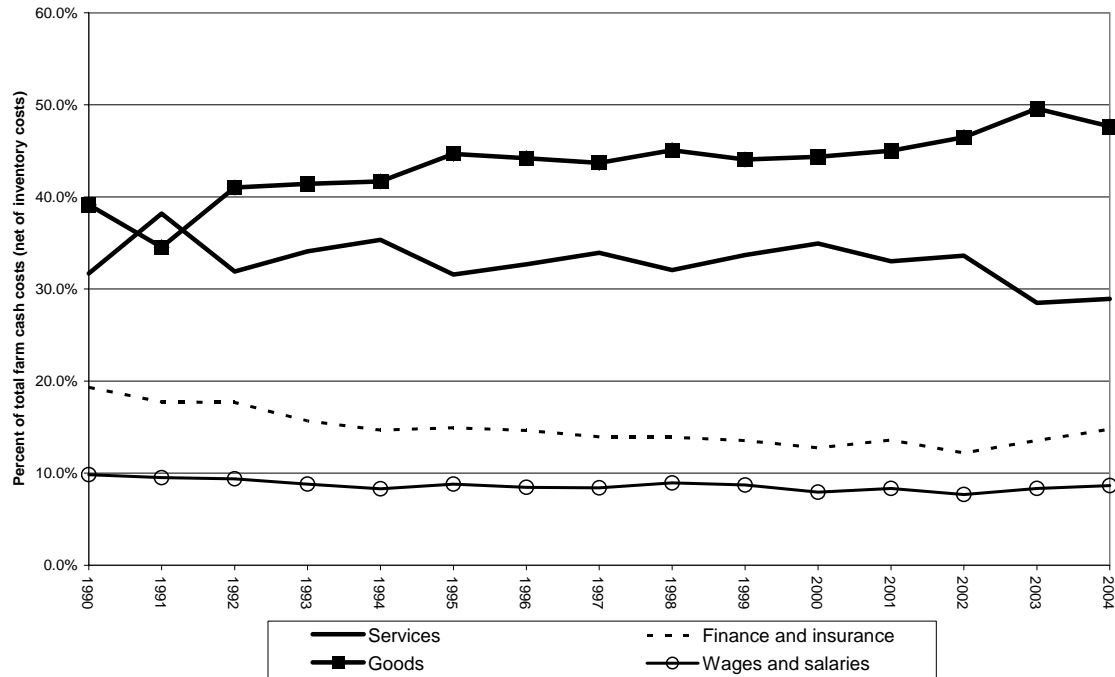


Source: ABARE – Agsurf database.

Figure 5 confirms that input intensity has progressively increased for broadacre farms over the last fifteen years, and highlights that it is likely that the observed increase is related to expansion in the average area cropped per farm. At the aggregate level, total input costs (net of livestock trading) for broadacre farms have not increased as a proportion of gross farm receipts, indicating that the 10% expansion in average farm size that has occurred over this period has delivered economies of scale.

Figure 6 shows changes in the relative proportions of different categories of farm cash costs (excluding livestock trading costs) as a proportion of gross cash costs for average broadacre farm businesses over the past fifteen years. The figure indicates there has been a trend towards an increasing proportion of farm cash costs being attributable to items categorised as goods rather than services.

Figure 6. Trends in the proportion of total broadacre farm cash costs attributable to goods, services, finance and employment: 1990-2004.



Source: ABARE – Agsurf database.

Note: Cash costs associated with livestock trading were excluded from total costs. All other costs were allocated to broad categories based on normal ABS categorisation. “Repairs and maintenance” costs were allocated to the ‘Goods’ category, on the assumption that a significant proportion of these costs involve replacement parts or materials. Shearing costs were included in employee costs.

An analysis of ABS Input/Output data for the Agricultural sector over the five years from 1998/9 to 2003/4 was recently carried out (Econtech 2005), in order to develop estimates of the scale of the national economy linked to the Agricultural sector. Analysis of the ‘Farm-input’ sector of the economy indicated it was equivalent to approximately 0.8% of national GDP, of which inputs from those sectors defined by the ABS as ‘Services’ made up approximately 75%, and the balance was predominantly from the Manufacturing sector – mainly chemical inputs. This analysis excluded employee costs, and the value of inputs derived from the Agricultural sector itself. Given the limited timeframe of the data used, no discernable trends were evident over time in either the total size of the farm input sector, or the relative shares of inputs from different sectors of the economy.

Table 1. Australian Farm Input sector: 1998-99.

Input sector (Used by agriculture)	Value (\$ millions)	Proportion of total inputs
Forestry and fishing	35	0.7%
Mining	17	0.3%
Manufacturing		
Chemicals	744	16.7%
Other manufacturing	248	5.6%
Trade and Transport		
Wholesale trade	440	9.9%
Retail trade	454	10.2%
Transport and storage	666	15.0%
Other services		
Electricity, gas and water	328	7.4%
Finance and insurance	650	14.6%
Property and business services	471	10.6%
Other services	399	9.0%
Total – farm input sector	4,453	100%

Source: Econtech, 2005

Analysis of ABS Input/Output data for the most recent year available (1998-99) by the Productivity Commission (Productivity Commission 2005) included inputs to agriculture from within the Agricultural sector. It identified that to produce \$100 of output, the Agricultural sector utilised \$42.10 worth of inputs, with almost half of these being inputs from the Services sector.

Table 2. Source and extent of inputs required by broad industry sectors to produce \$100 of outputs (ABS Input/Output data: 1998-99)

Producing sector \ Supplying sector	Agriculture	Mining	Manufacturing	Services	Total intermediate inputs
Agriculture	\$11.10	\$0.10	\$11.14	\$19.40	\$42.10
Mining	\$0.10	\$9.20	\$8.00	\$22.70	\$40.00
Manufacturing	\$6.50	\$3.70	\$21.70	\$21.20	\$53.30
Services	\$0.30	\$0.60	\$7.80	\$31.0	\$39.80

Source: Productivity Commission, 2005

The research also provided evidence of the changing nature of interactions between agriculture and other sectors of the economy. By comparing ABS Input/Output tables for agriculture in 1980-81 with those for 1996-97, it was identified that service sector inputs to agriculture had almost doubled in significance over the period, increasing by 9 percentage points to approximately 18% of total inputs.

This suggests that agriculture, along with other sectors of the economy, is increasingly utilising service sector inputs as part of its production processes, and appears to contrast with the data displayed in Figure 6. The differences may arise as a consequence of the ABARE data being limited to broadacre farms, while the ABS data includes all agricultural businesses, including the high-input sectors such as intensive livestock and horticulture.

The farm output sector

Analysis of the changing scale and source of inputs to the Agricultural sector provide only part of the information necessary in order to understand changing interactions between agriculture and the rest of the economy. Interactions between the Agricultural sector and downstream sectors of the economy are potentially just as important to understanding the impact of changes in agriculture on the wider economy.

There have been a number of studies carried out that attempt to document or model interactions between agriculture and downstream sectors of the economy, although most of these have been carried out at either a state, regional or commodity level, rather than for the entire national Agricultural sector.

Research by the Western Australian Department of Agriculture (Islam 1997), had the objective of investigating the potential for increased value-adding of Western Australian agricultural output as a means of expanding the Western Australian economy. An initial part of that research involved investigating the 'value chains' post farmgate for all of the major agricultural commodities produced in Western Australia.

The research identified that the total value added by the Agricultural sector in Western Australia in 1994-95 was approximately \$1.8 billion (Table 3). By developing models of post farmgate value flows for each of the major farm commodities, and utilising a range of assumptions about profit margins and industry structures, it was estimated that the agriculture-dependent non-farm sectors added a further \$2 billion in value-added to the Western Australian economy. Table 3 shows the estimates of farm and post-farm value added that were developed as part of the research.

Table 3. Farm and post-farm value added - Western Australia: 1994-95.

Commodity sector	Farm value added (\$ million)	Post-farm value added (\$ million)	Post-farm value added per dollar of farm value added.
Cereals	824	268	0.32
Pulses and oilseeds	79	66	0.83
Meat	422	1,111	2.64
Horticulture	75	252	3.37
Dairy	73	153	2.10
Wool	330	138	0.40
WA Total	1,818	1,987	1.09

Source: Islam, 1997

It is notable that the extent of post farmgate value added was much higher for commodities such as meat and dairy, which is as would be expected given that these commodities generally undergo processing prior to sale in either domestic or export markets. The post farm valued added for horticulture was high due to the influence of potatoes and winegrapes, both of which are significant in Western Australia, and both of which undergo local processing prior to sale.

These results indicate that a change away from low-input broadacre commodities such as wool to more input-intensive commodities (as has been the case in Australia over recent decades) is likely to result in increased integration between agriculture and other sectors of the economy, in both the farm input and farm output sectors.

A similar study was recently carried out of the horticultural sector (including fruit, vegetable and nut production) in Queensland (CDI Pinnacle Management and Street Ryan and Associates 2004). The focus of the research was to detail the extent of the horticultural sector and its economic significance to the Queensland economy.

The study found that the annual value of horticulture production in Queensland exceeded \$1.4 billion, and that in the ten years to 2001 the area of horticulture production had increased by 44%, while the value of horticulture production had increased by 78%. This indicates a significant intensification of production over the period. The research also highlighted the significant employment growth that has occurred in the sector in Queensland over the past decade. While the research utilised Queensland Input/Output multipliers to estimate the total state wide economic significance of horticulture, no comparison of changing economic significance over time was provided.

Research commissioned by the Australian Farm Institute in 2005 (Econtech 2005) developed an estimate of the size of what was termed 'Australia's farm-dependent economy', being those sectors of the economy having close links to agriculture. As part of that research, an estimate was developed of the scale of those sectors of the Australian economy 'downstream' from the Agricultural sector that utilise Agricultural sector outputs (the farm output sector) using ABS Input/Output data.

The research identified approximately 8% of national GDP originating from those sectors of the economy that could be classified as having a significant reliance on inputs from the Agricultural sector. For example, one of the largest users of Agricultural sector inputs is the food processing sector, which is the biggest sub-sector of the Australian manufacturing sector, and adds approximately \$16 billion of value adding to Australian GDP, or approximately 2.3% of national GDP. It is also the main source of inputs for the food and liquor retailing sector, which makes up almost half of Australia's total retail sector. Available data did not permit precise identification of the responsiveness of these sectors to shocks in the Agricultural sector.

The changing nature of Australian agricultural exports also provides some evidence of increasing integration between agriculture and the farm output sectors of the economy. Available export data (Productivity Commission 2005) highlights that an increasing proportion of the value of agricultural exports have undergone some degree of processing prior to export (Table 4).

Table 4. Share of processed food in key export markets: 1990-91 and 2003-04.

Market	1990-91	2003-04	Change
Japan	37%	59%	+22
United States	76%	89%	+13
China	3%	14%	+11
United Kingdom	49%	92%	+43
New Zealand	64%	82%	+18
ASEAN	50%	54%	+4
EU 25 (Excl. UK)	7%	31%	+14

Source: Productivity Commission, 2005.

While some of this growth arises from the increased value of processed meat exports to Japan over this period, the statistics highlight the increased propensity of wealthier markets to import at least partially processed food, suggesting a closer level of integration is developing between agriculture and the distribution and manufacturing sectors in Australia. Supporting this, ABS statistics highlight that while the food manufacturing sector has been declining as a proportion on

the total economy, in absolute terms it has grown significantly, with the total value of output increasing by 32% over the five years to 2001, and total employment increasing by 19% over the same period. (ABS, Catalogue No. 8225.0, various years)

Data compiled by the Productivity Commission (Productivity Commission 2005) provides some indication of the potential responsiveness of the national economy to shocks in the Agricultural sector. The research segmented the economy into four main sectors (Agriculture, Mining, Manufacturing and Services) and utilised ABS Input/Output tables to identify how much of the output of each of those broad sectors becomes intermediate inputs of other sectors, or goes to private consumption, Government consumption, Investment or Exports. The results of that analysis are displayed in Table 5.

Table 5. Utilisation of outputs from broad sectors of the national economy: 1998-99.

Use \ Origin	Intermediate inputs (%)	Private consumption (%)	Government consumption (%)	Investment (%)	Exports (%)
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

Source: Productivity Commission, 2005.

The data highlights that 60% of output from the Agricultural sector is utilised as intermediate inputs by other sectors, and 24% is exported. In contrast, only about 40% of service sector outputs become intermediate inputs for other sector of the economy, and instead a much greater proportion goes to private or government consumption.

This tends to suggest that, in the event of a shock such as a drought where agricultural output is restricted, and where export demand is quite strong (such as was the case during the recent drought) there will be a significant impact on downstream sectors, especially if import substitution is not realistic in the short-term. Whether this impact is proportionally greater now that perhaps it might have been in the past would require some analysis of changes in this data over time.

The impact of recent Agricultural sector shocks on the national economy

The above data provides some useful information about the interrelationships between agriculture and other sectors of the economy, which assists in obtaining a better understanding of how Agricultural sector shocks impact on the wider economy. More direct evidence about these interactions is avail from events which have impacted on the Agricultural sector over recent years.

During the past decade, the Australian economy has experienced a period of sustained growth, with stable and low interest rates, low inflation, and few international economic events having any unusual effects on the economy. During this period, however, the Agricultural sector has experienced a period of relative volatility. After a widespread drought in 1994-95, good seasonal conditions and strong grain prices in 1995-96 significantly boosted measured agricultural output. In 2000-01, good seasonal conditions in combination with relatively strong livestock and grain prices also resulted in dramatically increased agricultural output. From 2002 to 2004, however, a widespread and severe drought resulted in a major reduction in agricultural output, with the

impact greatest in the grain sector in the eastern States. This volatility, against a backdrop of relatively stable national economic conditions, provided an opportunity to observe the impact of Agricultural sector changes on the rest of the economy.

The ABS analysed the economic impact of the 1995-6 farm season on the national economy in a paper published in 1998 (ABS 1998). That analysis included the impact of increased farm income (primary effects), the impact of the resulting increased economic activity in the farm input and farm output sectors (secondary effects), and the downstream impacts of these effects through the rest of the economy (tertiary effects), via multiplier effects.

The analysis found that the constant price increase in farm output between 1994-5 and 1995-6 was \$3,131m, an increase of 14.1%. While it would be anticipated that farm input use would also increase substantially in a good season, it was found that farm input use for that season was \$358m, an increase of only 3.5% on the previous season. Using Input/Output multipliers calculated by the ABS, the increased farm output was calculated to have boosted the value of wholesale trade and transport by \$134m and \$182m (including tertiary effects). Depending on assumptions that are made about how the additional farm income would be spent (either to retire debt, invest in additional capital, or simply as increased consumption), the total impact of the 1995-6 farm season was estimated to be between \$4,300m and \$5,800m, or between 1 and 1.3% of GDP. Of this, 0.8 percentage points were due to the primary effect of increased farm output, 0.2 percentage points were due to growth in the farm input sector and related impacts, and 0.3 percentage points were due to increased final expenditures by farmers.

The ABS noted that limitations to this methodology include the fact that multipliers assume a constant relationship between total inputs and total outputs of an industry, and that multipliers are, of necessity, based on dated information (in this case five to six year old data). Assumptions also need to be made about how and when farmers use the extra income, which will obviously depend on prevailing levels of debt, and decisions about the need for capital investment. It was also unclear from the analysis whether the ABS calculated the flow on impacts in all sectors, or only calculated effects for major output sectors such as warehouse and transport sectors.

The 2002-2004 drought followed the 200-01 farm season during which farm cash incomes (funds available for farm investment and consumption after all costs including interest but excepting any payments to family workers) were the highest recorded for almost thirty years. The resulting relatively high level of cash reserves and lower debt meant farmers were able to offset the reduced income arising as a result of perhaps the worst drought in a century, yet the impact of the drought on the national economy was still substantial, as a number of analyses have identified.

Based on surveys of broadacre farms (ABARE, 2004), farm cash income declined by over 42% in 2002-03 compared with 2001-02, with the greatest declines occurring in New South Wales, Victoria, Queensland and the Northern Territory. These figures do not include horticulture, vegetable production and intensive livestock, sectors normally somewhat insulated from drought through access to irrigation water, although lack of water supplies and large increases in feed grain prices are likely to have also reduced output and profitability in all these sectors.

ABS data for the twelve months to June, 2003, showed that farm GDP fell by 24.3%, rural exports fell by 26.6%, and agricultural income fell by 46.2%. In addition, the drought is estimated to have directly reduced Agricultural sector employment by 85,000 persons, or almost 25% of pre-drought employment. (Lu & Hedley 2004). Of the jobs lost, 75% were in the broadacre grain, sheep and beef cattle industries. The fall in farm GDP directly subtracted 0.9 of a percentage point from national GDP growth, a larger decline than occurred during the 1994-5 drought. Also

as a direct impact of the drought, food prices (in particular cereals, fruit and vegetables and eggs) increased by between 7 and 12%, contributing significantly to an increase in the Consumer Price Index in late 2003.

In assessing the economic impact of the drought, the ABS (ABS, 2005) did not attempt to estimate the full flow-on impacts, noting however that these are likely to be less than in earlier droughts as the value of farm inputs used did not decrease by a substantial amount, and lower demand for transport and storage as a consequence of dramatically reduced crop production would have been offset by increased transport demand arising from early and increased stock turnoff, and transport of feed-grain.

Research by the Centre of Policy Studies at Monash University (Horridge et al. 2003) utilising computable general equilibrium (CGE) modelling aimed to calculate the full impact of the 2003 drought on the national economy. The modelling utilised estimates of the impact of the drought based on meteorological data and ABARE forecasts (the research was conducted in late 2003 before robust statistics were available about the actual impact of the drought on farm production), and divided Australia into 45 regions, each with 38 economic sectors. The model used 1997 ABS Input/Output data to establish relationships between sectors, and other more detailed ABS commodity data.

The researchers estimated that the direct impact of the drought on agricultural output was likely to lower Australian GDP by 1 percentage point, and that the flow-on impacts through the rest of the economy would result in an additional 0.6 percent lowering of GDP. At a regional level, the model predicted that 18 of the 45 regions would experience severe contractions with gross regional production (GRP) declining by more than 5%, and of these, 11 would experience GRP declines of over 10%.

This modelling only projected small drought-related employment losses, something which subsequent ABS statistics have proved to be incorrect. The modelling also projected significant employment losses in the farm output sectors. While data on this projection remains inconclusive (statistical data does not enable an easy separation of agriculture related activity in these sectors), anecdotal information suggests this has occurred in the meat and fruit processing sectors.

Discussions and conclusions

Throughout much of the first half of the twentieth century, Australia was said to be ‘riding on the sheep’s back’, because of the dominant role agriculture, and in particular agricultural exports played in the national economy (Cashin & McDermott 2002). Agriculture no longer has such a dominant role in the economy, and the overall impact of Agricultural sector shocks has greatly diminished, despite the continuing significance of agricultural exports.

Despite this, Agricultural sector shocks continue to have a significant impact on the broader economy for two reasons. The first is the inherent volatility in the value of output from the sector, which is the most volatile sector of the economy and more than twice as volatile as the average for all sectors of the national economy. The Agricultural sector is therefore much more likely to experience an economic shock than any other sector of the economy within a given period.

The second reason that the Agricultural sector is likely to have a significant impact on the national economy is the degree of integration between agriculture and other sectors of the economy, although changes in the degree of integration over time are not easily measured. The sector is steadily increasing the intensity of input use, meaning that growth is occurring in the

farm input sector. At the same time, a much bigger proportion of Agricultural sector outputs are utilised as intermediate inputs in other sectors of the economy than is the case for the outputs of any other sector, and some evidence is available to indicate an increased propensity for agricultural outputs to undergo some form of processing prior to export.

There is also some evidence to indicate that Agricultural sector outputs destined for domestic markets are undergoing increased transformation, as wealthier consumers pay for an increasing proportion of 'value-added' in the food they purchase, and food preparation in the home is increasingly replaced by the purchase of semi-prepared or pre-cooked food.

The extent to which these changes will mean that Agricultural sector shocks such as drought will have a proportionally greater impact on the national economy remains unclear. Businesses involved in farm output sectors where import-substitution is not a realistic option in the short-term appear to be most vulnerable to Agricultural sector shocks, although this will depend on the nature of the shock.

Droughts typically have greatest impact on broadacre farms involved in beef, sheepmeat, wool and grain production, however risk management strategies, such as grain feeding and early livestock turnoff are available, and modern transport and communications means that sourcing livestock from other regions less affected by drought is also an option for processors. Grain production is perhaps most vulnerable to the impact of drought, although it is largely exported in unprocessed form, meaning that the extent of involvement in the post-farm chain by manufacturers and processors is much less than for other sectors of agriculture.

An Agricultural sector shock such as the closing of major export markets due to quarantine or political factors would have a potentially greater impact than drought, as risk-management strategies may not be readily available, and it could be expected that plant closures and staff layoffs would quickly occur in the farm output sector, with significant impacts especially in regional areas.

There has been significant growth in the output of more intensive sectors of agriculture such as cattle feedlots, pork and poultry production, and horticulture. These sectors all have a greater reliance on purchased inputs than broadacre production, and the intensive livestock sectors are closely integrated with post-farm processing, distribution and retail sectors. Horticulture also appears to be becoming more closely integrated with downstream sectors, as post-farm handling and storage technology has developed and consumers increasingly eat out, or purchase semi-prepared food such as bagged salads. These sectors are relatively immune from drought, however quarantine or trade shocks could have a significant impact which would be quickly transmitted to both the farm input and farm output sectors.

Analyses and modelling of these interactions are constrained by a number of limitations. Firstly, as has been pointed out by many researchers, the use of ABS Input/Output data to predict the response in one sector to a change in another sector has considerable limitations, as relationships between sectors are not necessarily constant, especially in sectors where demand for inputs is relatively inelastic.

Secondly, the Input/Output data provides only aggregate information for broad economic sectors, which is of reduced value in the case of a non-homogenous sector such as agriculture, in which a drought may differentially impact sub-sectors such as grain production or particular regions, with differing outcomes for the rest of the economy.

Thirdly, Input/Output data that is used as the basis of most CGE modelling is usually somewhat dated by the time it becomes available. The use of such aged data implies a necessary assumption of relatively stable sectoral interrelationships, something which will not necessarily be applicable for more volatile sectors such as agriculture.

Fourthly, the structure of Input/Output tables means it is not possible to accurately assess the extent of secondary and tertiary shocks in related sectors of the economy. For example, agricultural products are important inputs into the “*Accommodation, cafés and restaurant*” sector, but it is not possible to easily separate the impact of drought-related higher food prices from other changes that may be occurring in that sector due to, for example, trends in tourism.

In conclusion, while there is scope for considerable further research into this question, the relative volatility of the Agricultural sector, and the degree of integration between agriculture and other sectors of the economy mean that the sector will continue to have the ability to have a significant impact on national economic outcomes, despite its relatively minor measured role in the economy. Whether the potential relative impact of Agricultural sector shocks is increasing over time is not able to be determined from available data.

These conclusions perhaps serve as a reminder to policy-makers that while the Agricultural sector makes up a relatively small proportion of the national economy, economic shocks emanating from the sector continue to have the potential to result in significant changes in national economic outcomes.

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