Interstate Comparison of Output and Productivity in the Australian Agricultural Sector, 1991 to 1999

Dr. Boon Lee*
School of Economics and Finance
Queensland University of Technology
Brisbane, Qld 4001, Australia
Tel: (+ 61 7) 3864 5389;
Fax. (+61 7) 3864 1500;
Email: bl.lee@qut.edu.au

The paper examines the output and productivity performance of the Australian Agriculture sector by state from 1991 to 1999. The aim of the paper is two-fold. First, the paper is a pioneer in a series which compares the performance of each Australian state by sector starting with the Agriculture sector. Second, it introduces the Geary-Khamis (GK) method for derivation of appropriate currency converters or purchasing power parities (PPPs) to enable proper quantification of real output and productivity at the multilateral level. It is essential to use appropriate PPPs as the differences in prices of farm commodities across states pose the problem of aggregation of real output. For the benchmark year 1996-97, gross value of agricultural production reveal that Victoria was 73% of NSW level, based on Australian Bureau of Statistics data when price differentials are not taken into consideration. However, when appropriate PPPs were used, results showed that Victoria's level had gone up to 88% of NSW level. In terms of value added, Victoria's level with respect to NSW was 89% based on actual values and 106% based on Geary-Khamis PPPs.

JEL Classification: C43, O47

1. Introduction

This paper is the first in a series of inter-state comparisons which aims to cover all the major sectors within Australia from 1991 to 1999 starting off with Agriculture. There have been several studies relating to Australia's agriculture performance, such as Mullen and Cox (1996), Strappazzon, Mullen and Cox (1996), and Knopke, O'Donnell and Shepherd (2000). Their studies mainly focused on either at broadacre level or more specific regions like wheat-sheep zone or by type of crop

* Corresponding author: Dr B.L. Lee, School of Economics and Finance, Queensland University of Technology, GPO Box 2434, Brisbane, QLD 4001. Tel: (07) 3864 5389; Fax: (07) 3864 1500; email: bl.lee@qut.edu.au. The author would like to thank participants at the 32nd Conference of Economists, 29 September – 2 October 2003, Australian National University, for helpful comments.

such as grains. These studies mainly used the Theil-Tornqvist method to derive productivity indices. This "short" paper, however, employs a different method, although still using an index approach. Essentially, the paper is a cross-sectional study which implies that a multilateral index formula must be used. While it may seem straight-forward to simply compare each state's output values as a form of output performance, there is still the need to remove the price differentials of products across states. Furthermore, any study which involves more than two regions/countries must satisfy the properties of 'transitivity' and 'base-invariance'.

While the basic issues regarding the conversion of value aggregates into a comparable form is recognised, other index number problems arise in a multilateral context. Index formulas like Fisher and Tornqvist index are best suited for bilateral comparisons, but not at the multilateral level as they do not satisfy the transitivity property (Coelli, Rao and Battese, 2002). Transitivity is an important requirement that ensures internal consistency of comparisons between all pairs of countries in the context of a multilateral comparison (Kravis, Heston and Summers (1982), and Diewert (1988)).

An algebraic illustration is presented below. Assuming I_{xy} to be an index number formula, where X and Y are two countries/regions, transitivity requires that for all triplets (sets of three countries - *X, Y and Z*):

$$I_{xy} = I_{xz} \times I_{zy}$$

In this equation, $I_{xz} \times I_{zy}$ is an indirect comparison between countries X and Y through a third country Z, whereas I_{xy} is a direct comparison. Therefore, transitivity requires that the direct and indirect comparisons provide the same index.

An additional requirement, often considered important in the context of multilateral country comparisons, is the symmetric treatment of all the countries, often referred to as the 'base-invariance' property. This property guarantees that all regions/countries are treated equally in the comparisons exercise, regardless of the order in which the regions/countries enter into comparisons.

The purpose of the paper is two-fold; first, to highlight the difference in output levels when price change is not taken into consideration as compared to the use of a common dollar based on the Geary-Khamis method; second, to compare the output and productivity performance of each state.

The paper is organised as follows. Section 2 provides a description of the methodology employed in this paper. Section 3 explains the data used and some of its

limitations. Section 4 presents and discusses the empirical results. The paper concludes with some brief remarks.

2. Methodology

The Geary-Khamis[1] (GK) method, developed by Geary (1958) and Khamis (1972), is one of the multilateral index formula adopted in this study, due to its sound statistical and analytical properties. It is the most widely used index number method for international comparisons (see Kravis, Heston and Summers, 1978 and 1982; OECD, 1990).

Geary (1958) provided the framework underlying this method based on the idea of the purchasing power parity (PPP) of a currency. This framework was further refined by Khamis (1972) who described the mathematical and statistical properties of the GK method.

The GK method derives PPPs for different currency units (PPP for the currency of country *j*), and average international prices for each of the commodities included (P_i for commodity *i*). While the current study is an interstate comparison rather than an international comparison, the application is still feasible as different states have different price levels for all commodities which indicate that one Australian dollar will still have a different purchasing power between states. The GK method is appealing as it produces PPPs for converting principal aggregates, as well as interstate average prices for each commodity which allows for more disaggregated level of comparison. The PPPs and interstate average prices P_i are expressed as functions of the observed price and quantity data from different states using the following interdependent system of equations. For the currency of state *j*, the PPP is defined as:

$$PPP_j = \frac{\sum_{i=1}^{N} p_{ij} q_{ij}}{\sum_{i=1}^{N} P_i q_{ij}} \qquad (1)$$

Where: p_{ij} and q_{ij} are, respectively, the price and quantity of *i*-th product for state *j*.

[1] See Rao (1993) or Rao, Maddison and Lee (in Maddison. Rao and Shepherd (eds), 2002) for a detailed description of the computational procedures and properties of the Geary-Khamis method.

Equation (1) shows the number of currency units of state j that are equivalent in purchasing power to one unit of the numeraire currency unit in which the interstate average prices are specified. The interstate prices (P_i) are each expressed as:

$$P_i = \frac{\sum_{j=1}^{M} \left(p_{ij} q_{ij} \Big/ PPP_j \right)}{\sum_{s=1}^{M} q_{ij}} \qquad (2)$$

Geary-Khamis equations (1) and (2) are an independent system of equations which are solved by using observed price and quantity data on *N* commodities from *M* states to determine:

(i) *M* purchasing power parities: PPP_1, PPP_2, ..., PPP_M; and

(ii) *N* commodity interstate average prices: P_1, P_2, ..., P_N.

Khamis (1972) proved that if one of the PPPs is set to unity, then the rest of the unknown parities and interstate prices can be solved uniquely. This offers a choice as to which state's currency is set to unity. In the current study, New South Wales (NSW) is used as the reference state for which the PPP is set to unity (ie. equalling 1). Solving equations (1) and (2) will lead to numerical values of PPPs and P_is respectively. The interstate prices are average prices for all commodities across all states involved in the multilateral comparisons. For purposes of comparing value aggregates across states, the Geary-Khamis method offers the flexibility of using PPPs directly for conversion or using interstate prices to revalue the quantities. Alternatively, the interstate prices (P_is) can be applied to each state's production level to derive a value output at interstate prices for each commodity. Aggregating each state's value output for each commodity at interstate prices leads to gross value of output at interstate prices in a common currency unit.

Rao (1993) identified that from gross value of output, final output and agricultural value added can be derived. By deducting feed and seed, farm inputs which are in fact commodities that are initially produced for further input use, final output is derived. By deducting non-farm inputs such as fertilizers and pesticides, Agricultural GDP is derived. This approach was however not employed as it requires detailed price and quantities of inputs which were not available.

3. Sources and Data Limitations

The data source for the benchmark year 1996-97 was drawn from the Australian Bureau of Statistics, *Agriculture*, Cat no. 7113.0. The source provided detailed information for quantity produced and value output of which a sample of 65 commodities out of 77 was used in deriving the PPPs. Not all commodities were included due to the following reasons.

The first problem in the data was that of "holes". These "holes" are simply data which was either not collected or not published, or that the state produces an insignificant amount or simply does not produce that commodity. As such, the current study focuses on six states, namely New South Wales (NSW), Victoria (Vic), Queensland (Qld), South Australia (SA), Western Australia (WA) and Tasmania (Tas). Northern territory and the Australian Capital Territory were not included due to the above-mentioned data problems. Another data problem was that some commodities had production estimates but had no gross value[2]. This implied that the derivation of the PPPs and interstate average prices for the benchmark year 1996-97 is based on a selected number of commodities which is less than the total number of agricultural products produced.

While the sample of commodities may not account for all agricultural products, based on the data used for 1996-97, the gross value for each state at each state's price shows that the proportion of data used is above 70% which is a good coverage in deriving decent PPPs. For each state, the ratio of the sample gross value to total gross value, for 1996-97 are as follows: NSW (73%), Vic (86%), Qld (83%), SA (87%), WA (83%), Tas (72%).

For time-series analysis, gross agricultural product at 1996-97 constant prices is needed. To derive the constant prices, each state's gross agricultural product (at current price) is deflated using the gross agricultural product price deflator. Essentially, gross agricultural product price deflator would be used, but this was not available. Hence, the gross state product price deflator is used under the assumption that it is representative of the gross agricultural product price deflator.

Productivity analysis in this paper focuses on both labour productivity and land productivity. Labour estimates were drawn from the ABS, *Agriculture Financial*

[2] For example, commodities such as beetroot and peas (see ABS, Agriculture 1996-97, cat. No. 7113.0, p. 60 and 62).

Survey but only for the years 1994-95 to 1998-99 as there were no available state employment figures from 1990-91 1993-94. Hence, labour productivity focuses on the years 1994-95 to 1998-99. A note on the employment figures is that in the *Agriculture Financial Survey*, the total employee number is an aggregation of both full-time and part-time employees. As such it was not possible to apportion the number of part-timers into full-timers. Furthermore, labour productivity analysis would have been better with the use of average number of hours worked but such data was not available. In regards to land productivity, data were drawn from ABS, Agriculture 1996-97 and 2000-01. Comparisons were for years 1994-95 to 1998-99 as 1990-91 to 1993-94 data were not available. The definition of land use in agriculture adopted in the paper comprises of crops sown, and land sown to pastures and grasses harvested for hay and seed.

4. Empirical results

In this section, a comparisons of output based on two sets of price is compared. The results in terms of output and productivity performance for the six Australian states are also presented. Purchasing Power Parities for the benchmark year 1996-97 are derived first before applying them to each state's gross agricultural product to arrive at the gross agricultural product at GK interstate prices for all other years.

Gross Agricultural Product based on PPPs and 1996-97 constant prices

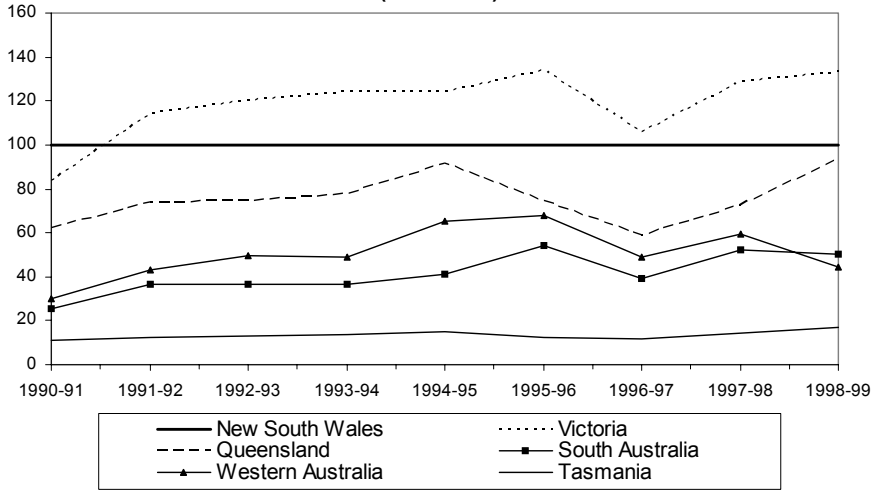
In this section, a basic illustration using gross agricultural product based on 1996-97 constant prices and based on Geary-Khamis interstate prices are compared. From ABS, *Agriculture* 1996-97, using the gross value of agricultural production values at each state's price with New South Wales indexed at 100, Victoria's value output was 73.4 while Queensland was 68.7. Converted using PPPs of Table 1 with NSW equalling 100, Victoria's output was 88 while Queensland was 64. Such discrepancy in results is clear indication that in any type of cross-sectional comparison, appropriate converters must be employed. Appendix Table 1B presents the gross agricultural product based at 1996-97 constant prices for years 1990-91 to 1998-99. Using the PPPs of Table 1 on the values of Appendix Table 1B derives the gross agricultural product at Geary-Khamis interstate prices which are presented in Appendix 1C. There are some differences in output performance between these two

Tables. In Appendix Table 1C, for most states, the values have in fact increased, especially for Victoria. As for Queensland and Western Australia, their values have fallen largely due to their PPPs being above NSW (see Table 1).

Comparisons of Output and Productivity

Results of output performance from 1991 to 1999 are presented in Appendix Table 1C. The results are illustrated in Figure 1 with NSW as the base state. In 1990-91, NSW contribution of gross agricultural product was the highest but was overtaken by Victoria in 1991-92. On the whole, output in Victoria had been increasing throughout the 1990s, except for 1996-97. For the rest of the states, there was slight catch-up until the mid-1990s, before experiencing a drop in output. In terms of average annual growth rate, NSW experienced a negative growth rate of -4%. South Australia had the best growth rate of 4.9%, with Victoria at 2% in second place. This is followed by Tasmania (1.7%), Queensland (1.3%) and Western Australia (1.1%). The most interesting feature of figure 1 is the drop in output from 1995-96 to 1996-97 for most of the states. This is largely explained by Gleeson and Topp (in ABARE, 1997) whereby farm financial performance for broadacre industries was expected to worsen in 1996-97. As such this would result in a built-up of stocks which would indicate to farmers to reduce production levels in 1996-97. Figure 1 results are essentially derived from the PPPs of Table 1.

Figure 1
Gross Agricultural Product by state, 1990-91 to 1998-99
(NSW=100)



Source: Appendix Table 1C.

From Table 1, the PPP of Victoria implies that $0.83 in Victoria has the same purchasing power as one dollar in NSW. From this table, it shows that a state with less than 1.00 indicates that its dollar value has more purchasing power than NSW and vice versa.

Table 1: Geary-Khamis Purchasing Power Parities, 1996-97

NSW	Vic	Qld	SA	WA	Tas
1.00	0.83	1.08	0.94	1.01	0.78

Source: Appendix Table 5.

In terms of economic performance, both labour productivity and land productivity are analysed. Labour productivity is measured by agricultural GDP per unit of number of agricultural labour. The results of labour productivity from 1994-95 to 1998-99 are presented in Table 2. In terms of average annual growth rate, South Australia performed the best at 10%. This is followed by Tasmania (6%), Queensland (4%) and NSW (3%). Victoria and Western Australia were the worst performers at -1% each. The negative labour productivity growth rate of WA complements the findings of Islam (2000) whereby he also found negative growth rate of labour productivity for WA.

Table 2: Gross Agricultural Product per person engaged (million 1996-97 Geary-Khamis interstate dollars)

	1994-95	1995-96	1996-97	1997-98	1998-99
New South Wales	37,106	41,468	51,079	42,686	41,558
Victoria	59,433	78,516	65,345	61,103	56,985
Queensland	40,347	38,274	36,338	36,001	46,856
South Australia	34,311	60,483	51,365	50,252	49,684
Western Australia	52,305	72,143	60,784	65,853	50,106
Tasmania	57,345	52,475	58,803	68,501	71,544

Source: Appendix Table 3.

To explain the differences in labour productivity performance between states, other productivity analysis is required, namely capital productivity. However, gross capital stock figures by state for the time-frame were not available. Furthermore, the labour productivity analysis used number of persons engaged. Average number of hours worked would no doubt provide robust results especially in agriculture, as there are

usually a significant number of seasonal and casual workers and that their contribution is based on an hourly rate.

Turning to comparisons of productivity of land, measured by gross agricultural product per hectare of agricultural land use, Table 3 provides the results for years 1994-95 to 1998-99.

Table 3: Gross Agricultural Product per hectare of agricultural land use, 1994-95 to 1998-99 (GK interstate dollars)

	1994-95 (a)	1995-96	1996-97	1997-98	1998-99
New South Wales	393	456	449	339	301
Victoria	613	809	736	656	657
Queensland	537	568	450	380	493
South Australia	252	397	323	327	303
Western Australia	195	243	191	174	132
Tasmania	640	678	765	683	774

(a) For 1994-95, figures for land sown to pastures and grasses harvested for hay and seed were not collected. Figures for land sown to pastures and grasses harvested for hay and seed are based on averages of 1995-96 to 1998-99.
Source: Appendix Table 4 and Appendix Table 1C.

Land productivity average annual growth rate show South Australia (5%) and Tasmania (5%) outperforming the rest. Victoria's growth rate was 5% whereas Queensland and NSW were -2% and -7%, respectively. Western Australia's land performance was the worst with an average annual growth rate of -10%. There may be some correlation in terms of the size of a state and land productivity. Tasmania, being the smallest state, had the best land performance by 1998-99 with a value of $774 per hectare of agricultural land use. This is followed by Victoria with $657 per hectare. Western Australia, with the largest land area, had land productivity of only $132. NSW and South Australia has similar figures in 1998-99, whereas Queensland with a slightly larger land area had higher gross agricultural product per hectare. The results from Table 3 are indicative that smaller states are probably adopting very intensive nature of agricultural operations which would thus use the limited land optimally.

5. Conclusion

This study provides an interstate comparative estimate of real output, labour productivity and land productivity in the Australian Agriculture from 1991 to 1999.

The main focus of the paper was to provide an approach which would ideally satisfy a multilateral comparison of output and productivity. For the benchmark year 1996-97, the result reveal that NSW had the greatest output based on Australian Bureau of Statistics data when price differential are not taken into consideration. However, when the GK PPPs were used, results showed that Victoria's output was 6% above that of NSW level. Over the period 1992 to 1999, Victoria's output was the highest amongst all other states. In terms of productivity growth, South Australia and Tasmania had the best performance, whereas Western Australia performed the worst in both land and labour productivity. However, caution should be exercised in drawing strong conclusions from the current paper's productivity estimates based on the nature of the available data and the use of partial productivity analysis. A multi-factor productivity would have provided a better analysis and conclusion which will be adopted when such data becomes available.

References

ABARE, 1997. *Agriculture: Outlook 97*. Proceedings of the National Agricultural and Resources Outlook Conference, Canberra, 4-6 February, vol. 2.

Coelli, T., Rao, D.S.P. and Battese, G. 2002. *An Introduction to Efficiency and Productivity Analysis*. Kluwer Academic Publishers, Boston.

Diwert, W.E. 1988. *Microeconomic Approaches to the Theory of International Comparisons*, mimeographed paper presented at the Expert Group Meeting on ICP Methodology, Luxembourg, 6 -10 June.

Geary, R.C. 1958. *A Note on the Comparison of Exchange Rates and Purchasing Power Parities Between Countries*. Journal of the Royal Statistical Society, Vol. 121, pt. 1.

Islam, N. 2000. *An Analysis of Productivity Growth in Western Australian Agriculture*. Discussion Paper 00.15, Department of Economics, University of Western Australia, Nedlands.

Khamis, S.H. 1972. *A New System of Index Numbers for National and International Purposes*. Journal of the Royal Statistical Society, Vol. 135, No. 1.

Knope, P., O'Donnell, V. and Shepherd, A. 2000. *Productivity Growth in the Australian Grains Industry*, Grains Research and Development Corporation, ABARE Research Report 2000.1, Canberra.

Kravis, I.B., Heston, A. and Summers, R. 1978. *International Comparisons of Real Product and Purchasing Power*. John Hopkins University Press, Baltimore.

---------- 1982. *World Product and Income*. John Hopkins University Press, Baltimore.

Maddison, A., Rao, D.S.P. and Shepherd, W. (eds) 2002. *The Asian Economies in the Twentieth Century*. Edward Elgar, Cheltenham.

Mullen, J.D. and Cox, T.L. 1996. *Measuring Productivity Growth in Australian Broadacre Agriculture*. Australian Journal of Agricultural Economics, Vol. 40(3).

Organisation for Economic Cooperation and Development (OECD). 1990. *National Accounts - Main Aggregates 1960-1988*. Vol 1, Paris.

Rao, D.S.P. 1993. *Intercountry Comparisons of Agricultural Output and Productivity*. FAO Economic and Social Development Paper, No. 112, Rome.

Strappazzon, L., Mullen, J.D. and Cox, T.L. 1996. *Comparing Measures of Productivity Growth for Australian Broadacre Agriculture*, Paper presented to the 40th Annual Conference of the Australian Agricultural and Resource Economics Society, Melbourne, 13-15 February.

APPENDIX TABLE 1A

GROSS AGRICULTURAL PRODUCT (current prices $m)

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
New South Wales	4529	3323	3494	3652	3105	3747	4505	3725	3787
Victoria	3261	3246	3609	3896	3264	4229	3988	3926	4078
Queensland	3068	2670	2874	3137	3135	3049	2854	2910	3781
South Australia	1074	1151	1227	1292	1239	1920	1674	1834	1763
Western Australia	1410	1460	1780	1859	2076	2611	2218	2260	1691
Tasmania	382	318	353	392	360	355	421	424	499

APPENDIX TABLE 1B

GROSS AGRICULTURAL PRODUCT (constant 1996-97 prices $m)

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
New South Wales	5,034	3,604	3,767	3,901	3,264	3,849	4,505	3,678	3,699
Victoria	3,509	3,439	3,783	4,048	3,378	4,301	3,988	3,941	4,102
Queensland	3,354	2,858	3,024	3,271	3,216	3,076	2,854	2,854	3,718
South Australia	1,196	1,237	1,301	1,342	1,266	1,958	1,674	1,814	1,757
Western Australia	1,531	1,580	1,895	1,937	2,151	2,633	2,218	2,215	1,667
Tasmania	430	351	383	421	375	363	421	419	494

Note: Aggregation of gross farm product does not give the farm value added for Australia as the territories were not taken into account.
Source: Gross farm product at current prices drawn from ABS, Australian National Accounts: State Accounts, Cat No. 5220.0, Table 37 (via www.abs.gov.au/ausstats). Gross farm product at constant prices derived using gross state product deflators to deflate the gross farm product at current prices.

APPENDIX TABLE 1C

GROSS AGRICULTURAL PRODUCT (million 1996-97 Geary-Khamis interstate dollars)

	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
New South Wales	5,034	3,604	3,767	3,901	3,264	3,849	4,505	3,678	3,699
Victoria	4,207	4,122	4,535	4,852	4,049	5,155	4,780	4,723	4,917
Queensland	3,119	2,658	2,813	3,042	2,991	2,861	2,654	2,654	3,458
South Australia	1,266	1,311	1,378	1,422	1,341	2,074	1,773	1,921	1,861
Western Australia	1,513	1,562	1,873	1,915	2,126	2,603	2,192	2,190	1,647
Tasmania	552	450	492	540	481	466	540	538	634

Source: Appendix Table 1 and PPPs from Table 1.

APPENDIX TABLE 2

CROPS AND PASTURES	GK Interstate $ per Mt[a]
Cereals for grain	
Barley	204.5
Grain sorghum	171.7
Maize	196.4
Oats	142.7
Rice	247.9
Triticale	169.0
Wheat	216.5
Legumes	
Lupins for grain	164.8
Field peas for grain	274.1
Crops cut for Hay	
Cereals for hay	121.7
Non cereals for hay	121.5
Oilseeds	
Canola	398.9
Other crops	
Sugar cane for crushing	28.7
Peanuts (in shell)	691.8
Tobacco	6,279.0
Pastures and grasses cut for Hay	
Lucerne	135.8
Other	136.7
HORTICULTURE	
Citrus	
Oranges	531.4
Lemons and Limes	991.4
Mandarins	1,165.8
Pome	
Apples	1,229.6
Pears (excl. Nashi)	738.5
Stone	
Apricots	1,765.8
Cherries	5,472.0
Nectarines	1,986.9
Peaches	910.4
Plums and prunes	1,572.0
Other orchard nei.	
Avocados	2,042.8
Mangoes	1,900.2

CROPS AND PASTURES	GK Interstate $ per Mt[a]
Nuts	
Almonds	7,614.5
Macadamia	3,336.0
Kiwifruit	1,973.8
Raspberries	10,945.9
Strawberries	5,121.1
Tropical	
Bananas	1,032.7
Papaw	951.6
Grapes	824.1
VEGETABLES	
Asparagus	5,177.0
Beans, French and runner	1,116.7
Broccoli	1,651.7
Cabbages and brussels sprouts	671.5
Capsicum, chillies and peppers	1,221.9
Carrots	607.7
Cauliflowers	786.9
Celery	759.6
Cucumbers	1,026.4
Lettuces	710.7
Marrows, squashes and zucchinis	1,536.0
Melons	
Water	329.3
Rock and cantaloupe	784.4
Mushrooms	4,014.4
Onions, white and brown	502.1
Potatoes	388.0
Pumpkins	424.3
Sweet corn	427.1
Tomatoes	450.2
LIVESTOCK SLAUGHTERINGS	
Cattle and calves (no.)	387.1
Sheep and lambs (no.)	38.5
Pigs (no.)	154.1
Poultry (no.)	3.2
Wool	4,003.6
Whole milk (L)	0.3
Eggs (doz)	1.6
Beekeeping	
Honey produced	1,765.3
Beeswax produced	5,704.7

(a) units are in MT unless otherwise specified.
Source: ABS, Agrculture 1996-97, Cat No. 7113.0. Interstate prices derived using GK method as explained in the tex

APPENDIX TABLE 3

NUMBER OF PERSONS ENGAGED[a] (number)

	1994-95	1995-96	1996-97	1997-98	1998-99
New South Wales (incl ACT)	87,974	92,812	88,196	86,168	88,998
Victoria	68,129	65,657	73,154	77,303	86,291
Queensland	74,121	74,742	73,042	73,734	73,800
South Australia	39,084	34,292	34,524	38,237	37,459
Western Australia	40,653	36,078	36,069	33,250	32,879
Tasmania	8,385	8,882	9,190	7,860	8,860

(a) No. of persons engaged figures consist of Proprietors partners, Permanent full time employees, Seasonal casual part time employees and Unpaid workers.

GROSS AGRICULTURAL PRODUCT PER PERSON ENGAGED (at 1996-97 Geary-Khamis interstate dolla

	1994-95	1995-96	1996-97	1997-98	1998-99
New South Wales	37,106	41,468	51,079	42,686	41,558
Victoria	59,433	78,516	65,345	61,103	56,985
Queensland	40,347	38,274	36,338	36,001	46,856
South Australia	34,311	60,483	51,365	50,252	49,684
Western Australia	52,305	72,143	60,784	65,853	50,106
Tasmania	57,345	52,475	58,803	68,501	71,544

Source: Gross Agricultural Product from Appendix Table 1C and no. of persons engaged from ABS, Agricultural Finance Survey (various years).

APPENDIX TABLE 4

LAND USE (' 000 ha)

	1994-95 (a)	1995-96	1996-97	1997-98	1998-99
New South Wales	8,308	8,444	10,025	10,855	12,287
Victoria	6,611	6,375	6,497	7,204	7,488
Queensland	5,572	5,038	5,904	6,982	7,018
South Australia	5,318	5,227	5,493	5,885	6,139
Western Australia	10,916	10,691	11,492	12,548	12,499
Tasmania	752	687	706	788	819

Note: Land use comprises of crops sown, and land sown to pastures and grasses harvested for hay and seed.
(a) For 1994-95, figures for land sown to pastures and grasses harvested for hay and seed were not collected. Figures for land sown to pastures and grasses harvested for hay and seed are based on averages of 1995-96 to 1998-99.
Source: ABS, *Agriculture* 1996-97 and 2000-01.

Appendix 5
Agricultural Commodity Production in 1996/97 (MT[a])

	NSW	Vic	Qld	SA	WA	Tas
CROPS AND PASTURES						
Cereals for grain						
Barley	1,483,000	1,189,000	429,000	1,923,000	1,635,000	35,000
Grain sorghum	417,000	3,000	1,003,000	0	2,000	0
Maize	256,000	7,000	130,000	0	5,000	0
Oats	607,000	304,000	26,000	156,000	546,000	14,000
Rice	1,248,000	6,000	0	0	0	0
Triticale	317,000	167,000	6,000	141,000	35,000	7,000
Wheat	8,363,000	2,262,000	1,980,000	2,795,000	7,516,000	8,000
Legumes						
Lupins for grain	96,000	52,000	0	102,000	1,272,000	0
Field peas for grain	18,000	213,000	0	195,000	26,000	1,000
Crops cut for Hay						
Cereals for hay	229,000	189,000	52,000	330,000	413,000	6,000
Non cereals for hay	15,000	26,000	21,000	23,000	19,000	4,000
Oilseeds						
Canola	331,000	132,000	0	53,000	108,000	0
Other crops						
Sugar cane for crushing	2,231,000	0	36,232,000	0	170,000	0
Peanuts (in shell)	1,000	0	46,000	0	0	0
Tobacco	0	4,000	5,000	0	0	0
Pastures and grasses cut for Hay						
Lucerne	412,000	187,000	179,000	84,000	21,000	12,000
Other	355,000	1,255,000	66,000	249,000	325,000	204,000
HORTICULTURE						
Citrus						
Oranges	231,543	88,963	16,126	180,683	5,308	0
Lemons and Limes	5,679	5,371	6,428	13,706	794	0
Mandarins	5,566	5,319	44,566	16,004	1,472	0
Pome						
Apples	83,231	118,968	28,045	28,865	38,218	55,649
Pears (excl. Nashi)	3,195	146,060	1,496	6,136	9,932	742
Stone						
Apricots	926	8,936	277	15,235	341	205
Cherries	3,439	2,008	2	948	101	185
Nectarines	8,030	7,033	2,556	1,362	2,859	41
Peaches	15,411	43,487	3,297	7,694	2,191	17
Plums and prunes	10,409	4,618	1,972	4,271	3,912	6

Appendix 5 - continued
Agricultural Commodity Production in 1996/97 (MT[a])

	NSW	Vic	Qld	SA	WA	Tas
Other orchard nei.						
Avocados	4,199	1,793	11,744	901	1,445	0
Mangoes	273	0	28,366	0	1,095	0
Nuts						
Almonds	144	3,731	1	2,014	3	0
Macadamia	9,675	0	6,374	0	3	0
Kiwifruit	418	2,255	255	0	453	0
Raspberries	31	208	10	5	2	105
Strawberries	210	3,376	3,755	1,322	2,444	129
Tropical						
Bananas	38,914	0	143,748	0	13,360	0
Papaw	124	0	5,793	0	174	0
Grapes	209,901	329,687	4,530	374,589	21,796	1,497
VEGETABLES						
Asparagus	2,534	4,252	821	123	111	13
Beans, French and runner	2,197	2,038	18,391	128	690	14,154
Broccoli	3,407	19,198	9,116	1,828	2,649	4,253
Cabbages and brussels sprouts	11,124	25,375	13,920	7,131	5,075	3,376
Capsicum, chillies and peppers	559	3,353	24,403	1,542	2,226	8
Carrots	13,765	99,274	28,522	40,307	52,992	22,546
Cauliflowers	11,691	17,409	10,518	3,709	16,213	4,851
Celery	195	22,403	11,717	4,247	5,922	389
Cucumbers	5,264	795	6,778	1,153	1,726	157
Lettuces	12,967	36,557	42,251	6,085	10,197	2,457
Marrows, squashes and zucchinis	1,859	1,035	8,942	163	750	669
Melons						
Water	6,058	1,155	55,262	463	22,950	0
Rock and cantaloupe	11,094	7,856	36,890	3,703	10,454	0
Mushrooms	12,260	14,237	4,165	2,653	1,315	856
Onions, white and brown	13,816	15,615	21,789	65,274	20,321	59,677
Potatoes	136,173	315,727	115,435	285,344	116,004	317,448
Pumpkins	19,731	4,595	38,688	6,895	14,513	1,885
Sweet corn	34,273	7,366	14,822	1,294	1,668	5,352
Tomatoes	102,795	167,563	109,911	3,069	9,038	682
LIVESTOCK SLAUGHTERINGS AND LIVESTOCK PRODUCTS						
Livestock products						
Cattle and calves (no.)	2,297,000	2,373,000	2,639,000	385,000	413,000	248,000
Sheep and lambs (no.)	8,862,000	8,786,000	1,762,000	4,066,000	4,716,000	748,000
Pigs (no.)	1,338,000	1,197,000	1,002,000	427,000	550,000	75,000
Poultry (no.)	133,364,000	86,733,000	61,089,000	28,008,000	36,360,000	0
Wool	195,481	175,209	45,850	89,579	160,022	18,876
Whole milk (L)	1,192,000,000	5,622,000,000	797,000,000	535,000,000	349,000,000	529,000,000
Eggs (doz)	74,870,000	44,670,000	22,225,000	10,706,000	15,684,000	4,001,000
Beekeeping						
Honey produced	12,620	4,403	4,190	3,036	1,729	1,012
Beeswax produced	234	76	68	58	40	14

Source: ABS, Agrculture 1996-97, Cat No. 7113.0.
(a) units are in MT unless otherwise specified.
"0" indicates either data was not collected or not published.

Appendix 5 - continued
Value Output ($mill), 1996/97

	NSW	Vic	Qld	SA	WA	Tas
CROPS AND PASTURES						
Cereals for grain						
Barley	332.6	242.0	66.7	358.6	299.6	6.6
Grain sorghum	77.2	0.6	179.0	0.0	0.3	0.0
Maize	51.1	1.8	25.4	0.0	1.3	0.0
Oats	87.3	42.7	4.6	19.2	70.7	2.2
Rice	307.6	2.7	0.0	0.0	0.0	0.0
Triticale	49.2	29.1	1.0	20.8	5.1	1.3
Wheat	1,746.8	484.9	421.6	602.1	1,621.1	1.4
Legumes						
Lupins for grain	21.1	12.2	0.0	23.0	193.0	0.0
Field peas for grain	4.4	52.7	0.0	47.7	6.0	0.1
Crops cut for Hay						
Cereals for hay	24.9	22.4	6.2	39.0	48.9	0.9
Non cereals for hay	2.2	3.8	2.3	1.7	2.2	0.2
Oilseeds						
Canola	126.5	48.1	0.0	21.4	42.6	0.0
Other crops						
Sugar cane for crushing	71.6	0.0	1,112.0	0.0	2.9	0.0
Peanuts (in shell)	0.8	0.0	34.1	0.0	0.0	0.0
Tobacco	0.0	24.8	28.8	0.0	0.0	0.0
Pastures and grasses cut for Hay						
Lucerne	47.0	27.7	21.7	12.3	4.3	3.0
Other	30.4	154.7	10.1	43.7	30.5	26.3
HORTICULTURE						
Citrus						
Oranges	116.2	48.3	11.0	86.1	2.2	0.0
Lemons and Limes	9.9	3.1	7.3	10.2	0.5	0.0
Mandarins	7.1	7.0	56.7	13.9	2.1	0.0
Pome						
Apples	98.0	124.4	26.8	48.7	41.3	54.2
Pears (excl. Nashi)	1.8	87.1	1.0	7.4	8.1	0.6
Stone						
Apricots	2.5	6.5	0.5	32.1	0.5	0.4
Cherries	13.8	8.3	0.0	8.4	1.1	2.2
Nectarines	14.0	12.3	4.8	3.6	6.4	0.1
Peaches	15.6	27.4	5.2	8.2	3.7	0.0
Plums and prunes	16.8	5.0	3.1	6.6	7.0	0.0

Appendix 5 - continued
Value Output ($mill), 1996/97

	NSW	Vic	Qld	SA	WA	Tas
Other orchard nei.						
Avocados	7.7	3.3	24.7	2.4	3.9	0.0
Mangoes	0.7	0.0	54.9	0.0	4.8	0.0
Nuts						
Almonds	0.8	24.9	0.0	13.4	0.0	0.0
Macadamia	36.8	0.0	18.0	0.0	0.0	0.0
Kiwifruit	0.8	3.6	0.4	0.0	1.2	0.0
Raspberries	0.3	2.0	0.3	0.0	0.0	0.7
Strawberries	0.9	13.3	22.0	8.3	10.8	0.6
Tropical						
Bananas	53.0	0.0	140.6	0.0	18.9	0.0
Papaw	0.1	0.0	5.7	0.0	0.4	0.0
Grapes	156.8	214.7	14.4	298.3	29.2	3.0
VEGETABLES						
Asparagus	12.5	18.3	4.9	0.8	0.7	0.1
Beans, French and runner	1.9	4.4	27.8	0.3	1.6	5.5
Broccoli	6.0	28.0	15.1	2.9	3.5	5.2
Cabbages and brussels sprouts	4.6	11.5	10.5	7.6	5.1	2.4
Capsicum, chillies and peppers	0.5	3.4	28.6	4.5	3.3	0.0
Carrots	5.6	61.2	14.5	20.4	32.1	8.3
Cauliflowers	6.0	11.5	4.8	3.1	19.9	2.7
Celery	0.1	16.5	6.2	3.1	4.7	0.4
Cucumbers	3.4	1.1	7.2	1.6	2.7	0.4
Lettuces	10.9	20.7	29.5	4.6	7.4	2.5
Marrows, squashes and zucchinis	2.4	2.4	10.7	0.4	1.9	2.4
Melons						
Watermelon	1.9	0.7	18.0	0.1	8.8	0.0
Rock and cantaloupe	6.4	6.8	25.4	3.2	13.5	0.0
Mushrooms	39.0	59.7	15.0	11.5	5.7	0.1
Onions, white and brown	5.8	5.8	12.8	41.8	8.9	16.3
Potatoes	49.4	123.5	52.3	100.6	38.0	84.8
Pumpkins	9.7	1.1	15.6	3.8	6.5	0.5
Sweet corn	8.5	7.2	6.7	1.2	1.9	0.9
Tomatoes	16.9	36.6	111.9	4.8	5.8	1.0
LIVESTOCK AND LIVESTOCK PRODUCTS						
Livestock products						
Cattle and calves	772.6	662.5	1,232.9	137.6	282.1	75.1
Sheep and lambs	247.5	347.3	53.2	134.5	237.1	18.9
Pigs	214.3	168.6	160.3	54.4	73.5	np
Poultry	467.5	240.7	166.5	89.2	89.4	np
Wool	989.4	512.9	180.8	280.2	574.6	82.1
Whole milk	494.0	1,536.9	329.5	172.7	142.6	132.6
Eggs	123.1	57.8	36.7	14.4	29.3	9.0
Beekeeping						
Honey produced	21.5	7.5	7.0	5.2	2.6	2.0
Beeswax produced	1.3	0.4	0.4	0.3	0.2	0.1

Source: ABS, Agrculture 1996-97, Cat No. 7113.0.

Note: Beetroot and Parsnips not included as value output figures were not available.
(a) NSW figure includes ACT.
"0" indicates either data was not collected or not published.