CHANGING STRUCTURE AND LOCATION OF AUSTRALIAN AGRICULTURE

by

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Invited Paper Presented at the
39th Annual Conference
of the
Australian Agricultural Economics Society
Perth, Western Australia
14-16 February 1995

Abstract

Australian agriculture has undergone considerable change in structure and location. However, the broad rate of structural change in Australian agriculture is found to be not significantly different from that of other OECD countries. A major reduction in small farms has occurred and the number of medium and large farms has grown discernibly. Adjustment has been especially strong in cropping, dairying and the intensive sectors. The possible emergence of a farm adjustment problem in Australia's extensive grazing industry is discussed. Dispersion of farm size increased across most of the agricultural sector in the past two decades, although the distribution of farm size has become less skewed. Australian agriculture is becoming more reliant upon cropping and Western Australia and Queensland have been important growth areas. While recently there has been growth in the intensive sector of Australian agriculture, the extensive sector continues to prevail. A vision of the future of Australian agriculture is presented in the final section.

[a] Without implication, the research assistance of Tom Murphy and the comments of Arlene Rutherford are gratefully acknowledged.

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Introduction

Australia's rural sector has faced on-going pressures for change since early development. The key factors contributing to this have been the vagaries of seasons and the environment, the heavy influence of volatile global commodity markets on farm prices and the transmittal of major economic shocks to farm finances. An important element of change in Australian agriculture has been its relocation. As new land development methods and related grazing and farming approaches emerged, new areas of Australia became more important as a contributor to the farm sector. Major adjustments have also occurred in some areas.

The structure of agriculture at any point of time is a consequence of many past decisions relating to land and resource development, farm production, farmer aspirations, social and community development and links with the rest of the economy. In studies of structural change, analysts seek to unravel patterns in order to determine the main systematic influences across farm size, through time across location or across different types of industry. In this paper some economic aspects of structural and locational change of Australian agriculture are analysed, taking a medium to longer-term perspective.

Several hypotheses concerning the changing structure and location of Australian agriculture are developed and tested. The hypotheses are: (1) that Australian agriculture's rate of structural change is comparable with agriculture in other advanced industrial countries (2) that there is a "disappearing middle class" in Australian agriculture (3) that agriculture in Australia has shifted location towards Western Australia and Queensland, has become more intensive and is now more reliant on cropping.

These hypotheses provide the basis for developing a vision of Australian agriculture of the future, which is presented in the final section.

Issues Concerning Changing Structure and Location of Agriculture

The structure of an industry at any point of time is the number and size of firms making up the industry (Martin 1994). Related to this are a number of other concepts including: market shares, industry concentration, share of the overall economy, ease of entry and exit and pricing behaviour. Industrial economists have devoted considerable empirical and conceptual effort to understanding these concepts, especially as applied to industries which are heavily concentrated. Of special concern has been the potential for anti-competitive practices and better understanding the interplay -'the parry and thrust'- between few firms.

Because agricultural production is not heavily concentrated, studies of the structure of agriculture have not been concerned with potential for anti-competitive behaviour. Analysis of the changing structure of agriculture is undertaken for other reasons: primarily to better understand the process of change as it relates to supply, inputs, technologies, incomes and intersectoral transfers. Often the analysis also has a strong concern for equity and social issues, especially farmer well-being, farm poverty, farmer job mobility, and involves

comparisons of change in income for different groups, regions or sub-sectors.

An important pioneering study of structural change in agriculture was that of Schultz (1953). A key argument reviewed was that agriculture's share of an economy will decline with economic development. This has been well documented for Australia (Stoeckel and Miller 1982) and the reasons for such structural change well-considered in Anderson (1987) and Chisholm (1992). For the sake of brevity, the main reasons for the relative decline of agriculture are not repeated here. It is important to bear in mind that the relative decline of agriculture may largely be the result of change in the rest of the economy. Often the relative decline can be associated with quite dynamic growth within the agricultural sector. Australia has recent examples of agricultural sub-sectors which have grown dynamically while the sector was undergoing relative decline overall, including cotton, wine and lot feeding of beef cattle.

The main sources of structural change in Australian agriculture are reviewed in Musgrave (1992) and Wonder and Fisher (1990). Two conflicting views have emerged about the rate of structural change in Australian agriculture. One is that Australia's land settlement pattern led to comparatively large farms, in which the labour-to-land and capital-to-land ratios were lower than for other countries. Consequently, pressures for farm adjustment have been lower (Standen and Musgrave 1968). A counter view to this is that Australian agriculture has faced a much more variable climate and is more subject to export market volatility than farm sectors of most other countries. It has also borne a greater brunt of adjustment emanating in global markets, because other countries have 'exported' their adjustment problems through policies (Tyers and Anderson 1992). This counter view suggests Australia would experience a more rapid farm adjustment, all other things equal.

Comparisons of structural change in agriculture across countries have been undertaken recently by Alston, Chalfant and Pardey (1993). They place special emphasis on the role of technical change as a source of structural change in agriculture. Higher rates of technical change are associated with additional structural change. To the extent that farmers take advantage of economies of size in this process, this adds further to the rate of structural change (Anderson and Powell 1973). Whether Australia's rate of structural change has been higher than for other OECD countries is analysed later in this paper.

An important area for further research is how agricultural price policies affect the rate of structural change. There can be a strong 'whirlpool type' relationship between the rate of structural change and price policies (Miller 1996). When incomes of farmers are low, they apply political pressure to boost incomes, resulting in price policies favouring agricultural sectors. At the same time, the fundamental causes of the low farm incomes remain and pressures for structural adjustment return, whether the industry is protected or not. By delaying the pain, more serious adjustment problems can arise later.

Another important argument of Schultz (1953) was that with economic development, agricultural land, at least the unimproved component, will decline in its importance as a contributor to agricultural production. This is shown to be the case in Powell and Milham (199). Agricultural growth has become increasing more reliant on science-based production changes which are land saving and increasingly less reliant on expansion of the resource base. Ruttan (1989) argued that by the year 2000, virtually all of global agricultural production growth will be attributable to science-based production changes, whereas at the

beginning of this century virtually all of the production growth was from expanding the resource base. Yield-improving technologies, derived from both genetic and management changes, for livestock, pastures and crops have been an important source of productivity change in Australian agriculture (Begg and Peacock 1990).

For Australia, the declining importance of agricultural land has implications for the shares of intensive and extensive production systems in agriculture overall. Evidence suggests that the rate of productivity growth in intensive agriculture exceeds that of extensive agriculture (Herr 1966, Males *et al.* 1990). There are several reasons why this might be the case: (1) the turnover of inputs is more rapid in intensive farming (2) research spillovers from other countries are likely to be more rapid in intensive agriculture, since intensive agriculture prevails in most countries overseas (3) greater control of the inputs in intensive farming systems permits greater opportunity for better management of the new techniques, genetic materials and equipment (4) cash flow is more regular with intensive agriculture. This potential for a different rate of productivity gain suggests that over time the intensive agricultural sector will become increasingly more competitive in comparison with the extensive agricultural sector. The intensive sector is expected to grow more rapidly than the extensive as a consequence.

Competition for land for alternative uses is also an important source of structural change. The obvious examples of this are where urban demand for land has displaced agricultural use. Such pressures on farmland are especially evident in regions of rapid population growth. For example, agricultural activities in South-East Queensland, notably sugar, dairying and horticulture, have adjusted strongly in recent years in response to rapid population growth. On alternative uses of land, especially part-time and hobby farming, our official records are sparse.

Considerable effort has been devoted to understanding the costs of environmental degradation in Australian agriculture (Chisholm 1993; McTainsh and Broughton 1993). Presumably the costs are sufficiently large to have an impact on the rate of structural change in farming. Meinig (1962) provided a classic historical documentation of this in early South Australian wheat farming. The obliteration of the cotton growing industry on the Ord River in the 1970s is a recent reminder of how the environment bites back and can lead to rapid farm adjustment. More subtle opportunity costs associated with lost productivity from environmental degradation must be influencing many Australian farmers in their adjustment decisions. Some evidence on the interaction between the environment and economic viability is reported in Holmes (1990).

There has been surprisingly little analysis of economic issues concerning location of Australian agriculture (the main exceptions being Davidson (1982), studies of optimal transportation flows and ABARE farm surveys). Perhaps interstate boundaries and rivalry between federal and state agencies have discouraged more of this type of research. Agricultural economists working on wider global issues have focussed keenly on resource allocation between different environments (Byerlee and Morris 1993).

Undoubtedly the strongest policy debate on agricultural location in Australia was crystallised by Davidson (1965). He argued that northern enterprises were less efficient than southern and that more development and research effort should be devoted to southern agriculture. However, there are good reasons why this may be changing. First, deregulation

of the Australian economy is lowering the implicit costs borne by exporters. To the extent that northern agriculture was more export-oriented than southern, the competitiveness of northern agriculture will have improved relative to southern. Infrastructure development and related development in mining and tourism is increasing the general level of economic activity in the north, thus tending to reduce the comparative costs of inputs and of marketing output in the north as well as providing extra business opportunities (especially tourism). The proximity of northern agriculture to Indonesia and to other rapidly growing markets in South East Asia also offers locational advantages for some agricultural enterprises (Rutherford 1995). The emergence of a live cattle exporting industry, horticulture on the Ord and the growth of tropical horticultural production are signs of emerging industries that are proving to be competitive.

Since federation, Australia has had a series of regulations, constitutional requirements and *modus operandii* which have often placed economic aspects of location of industry low on the priorities of policy makers. Each state has sought, and often obtained, its fair share of industry. Federalism has generally prevailed in this policy tradeoff, at the cost of a more efficient location of industry. However, new policy initiatives are emerging which suggest that seeking fair shares for states will diminish in priority. The competition policy initiatives of the federal and state governments offer considerable potential for expanded regional competition within Australian industries and markets (Hilmer, 1994). In particular, industries which have thrived on particular state legislative protection or infrastructure assistance are likely to face different circumstances as the competition policy is implemented. Major shifts in location of some industries may occur as a result.

Measurement of Structural Change in Agriculture

The measurement of structural change in agriculture is complicated in numerous ways. The first of these is arriving at an appropriate measure of firm size. Typically, industrial economists use market share as the basis for measuring industry structure (Hay and Morris 1991, Martin 1994). However, market share for any firm in agriculture is usually so small as to render most measures used in analysing secondary industry meaningless. So industry structure has to be summarised using other measures and indicators.

The choice of a measure of farm size depends very much on the objectives of the study. Where the objectives are to consider the welfare of farmers, over time or across industries or size groups, net income may be used as the best indicator of well-being. However, where the objective is to study the broader changes in industry structure, a measure equivalent to market share might be employed. In this case, gross income is a reasonable measure of size of firm. Other measures of farm size, that are more limited than gross income because they are partial, include labour employed per farm, farm area or capital employed.

Data are available on numbers of agricultural establishments (farms, excluding hobby farms) by different levels of estimated gross income from the Australian Bureau of Statistics. The key definition of an agricultural establishment is that it is 'mainly engaged in agricultural activity' (ABS 1994). As a consequence, most hobby farms are excluded. Data are also available on numbers of farms by area. The minimum size of agricultural establishments

included in the ABS census has been increasing over time.[1] These data are published annually and were first compiled in their current format in 1974-75. Data are available from the late 1950s on the size distribution of farms by crop area or numbers of livestock, but these have not been used in this study. Gross income is used as the principal indicator of firm size in considering recent changes in the distribution of farms.

Another difficulty in using published statistics is that individual farms are grouped into particular size categories. Thus summary statistics have to be derived from grouped data using well established formulae (Harrison and Tamaschke 1994).

Dry Sheep Equivalent as a measure of size in agriculture is employed in this paper. The measure is widely used by Australian farmers to summarise the size of properties and has been a well-accepted tool of farm management analysis. The measure is employed in this study because it is computationally simple, is not demanding of data and it is likely to be a reasonable indicator of how the size of agriculture is changing over time. This is for the following reason.

The DSE measures the size of an agricultural enterprise in terms of capacity to produce a volume of output equivalent to that of one dry sheep (and enables different enterprises to be aggregated in a standard *numeraire*). The measure does not incorporate changing agricultural productivity over time; and it also does not incorporate the declining agricultural terms of trade over time (both of these effects would be included in a gross income measure). To the extent that the declining terms of trade and increasing productivity over the longer term move in opposite directions and may be largely offsetting, the DSE measure becomes more useful in making comparisons over time. For example, productivity growth for agriculture from 1965-66 to 1985-85 was 2.8 percent per year (Martin and Savage 1988). Farmers Terms of Trade declined by 3.3 percent per year over the same period (ABARE 1992). To the extent that real prices of products of particular crops or livestock groups do not approximately offset productivity change, the DSE measure will be in error.

The concentration ratio is the percentage of output derived from the n largest firms of an industry, where n is commonly 4, 8, 20 and 50 (at least in the USA). The Herfindahl index (H) is calculated as

$$H = s_1^2 + s_2^2 + s_3^2 + \ldots + s_N^2$$

where s_i is the market share of the ith firm and there are N firms in the industry.

If the industry is a monopoly, the Herfindahl index will be 1. An industry with a duopoly will have Herfindahl index of 0.5 and an industry with a very large number of firms (tending to infinity) will have a Herfindahl index tending to zero. Thus the Herfindahl index is a measure of the 'fewness' of firms in an industry, and is best interpreted when comparing industries dominated by a few large firms.

In this paper, the main interest is in how the size distribution of agriculture has changed and whether the extent of inequality of size has altered. One measure derived from

[1] The minimum size for inclusion in the ABS census was $2,500 prior to 1986-87. From 1986-87 onwards, the minimum has been $20,000 (ABS 1994).

the Herfindahl index was calculated. This is termed the Numbers Equivalent. The Numbers Equivalent is the number of equal-sized firms that would yield a Herfindahl index of a particular value h. It can be shown that the Numbers Equivalent is $1/h$. The greater the inequality of firm size in an industry, the higher will be the actual number of firms relative to the Numbers Equivalent. This ratio was calculated as one measure of inequality of farm size (although is not reported in this paper).

Another measure employed in measuring inequality is the Gini-Coefficient, whose measurement with grouped data is calculated as indicated in Figure 1. While some error may be associated with using grouped data, these have to be weighed against the cost of purchasing and using data for individual enterprises, if available. The other measure employed is the variance of the log of firm size (Levy and Murnane 1992).

Surprisingly, estimates of the degree of skewness of frequency distributions in empirical analysis of income distribution (Levy and Murnane 1992). If the skew of a distribution has altered, that would be further evidence of shifting inequality of income. A relative skewness index was compiled in this paper as the ratio of the square of the third moment about the mean of farm size (the measure of absolute skewness of gross income) to the cube of the second moment about the mean (the variance of gross income). Whether the skew is positive or negative will not be reflected by the measure of relative skewness, but that is not an important issue for frequency distributions of farms.

Structural Change Compared with Other Countries

A comparison between the share of agriculture in the total economy (as a percent of GDP) and in the total workforce is presented for selected OECD countries for the years 1960 and 1992 in Table 1. A review of this table indicates that while there have been major declines in the shares of agriculture in the Australian economy and the Australian workforce, there have been major changes in these broad indicators for a number of countries.

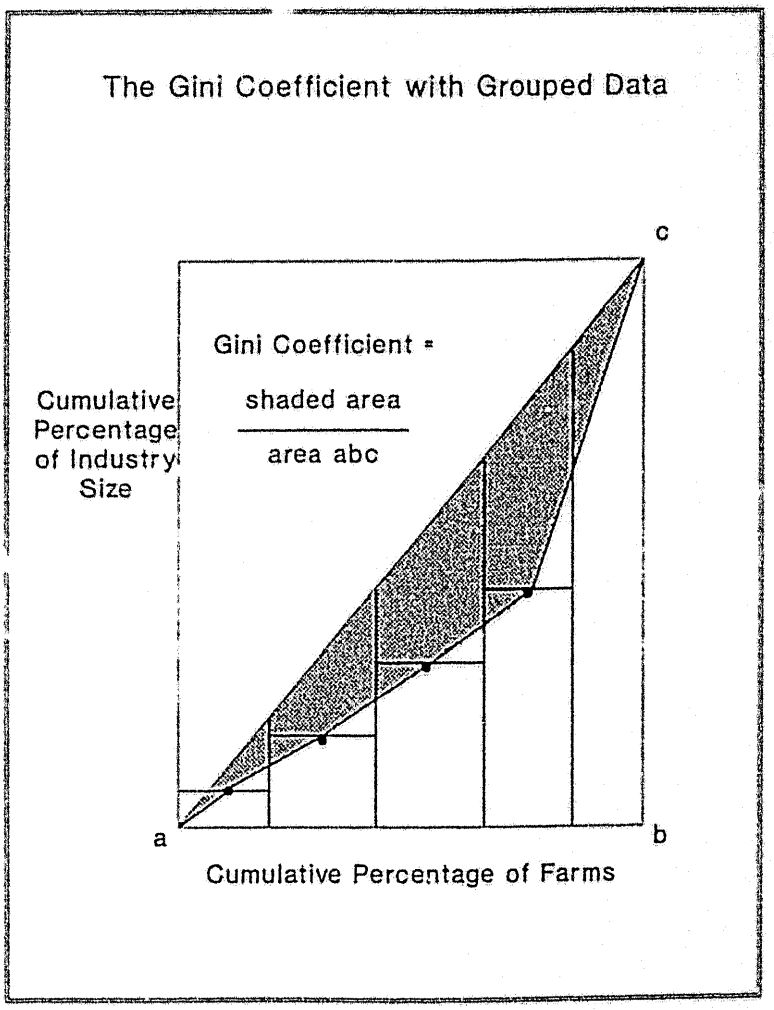
In order to test whether Australia's rate of structural change was significantly different from other OECD countries over the period 1960 to 1992, regression analysis was undertaken. The following model was hypothesised,

$$s_i = \beta_0 + \beta_1 \ln(y_i) + \beta_1 D1960 + \beta_1 DAUST + \epsilon$$

where
s_i = share of agriculture in total GDP for country i (%)
y_i = average income per person in country i (US$ constant 1992/person)
$D1960$ = dummy for year 1960 (1 if 1960, 0 otherwise)
$DAUST$ = dummy for Australia (1 if Australia, 0 otherwise).

Data were obtained for the above variables for 21 OECD countries for 1960 and 1992, but also included years 1965, 1970, 1975, 1980 and 1985 for Australia. The results were as follows,

FIGURE 1


The Gini Coefficient with Grouped Data
c
Gini Coefficient =
shaded area
area abc
Cumulative Percentage of Industry Size
a
b
Cumulative Percentage of Farms

$$s_i = 79.7 - 7.72\ ln(y_i) + 1.83\ D1960 - 0.958\ DAUST$$
$$\quad\quad (-6.69)^{***} \quad\quad (.946) \quad\quad (-.457)$$

where Adjusted-R^2 = .66, F = 30.3***, n = 46 and t-statistics are in brackets.

As anticipated, the share of agriculture in the total economy was negatively and highly significantly related to the log of per capita income. However, the estimated β coefficients were both insignificant up to very high levels of α (.35 for *D1960*, and .65 for *DAUST*). In other words, the relationship between agriculture's share of the total economy and per capita income appears to be stable across the years 1960 to 1992 for the OECD countries. Even more importantly, there is no significant difference between Australia's position in this relationship and that of other countries, given our levels of GDP per capita for years considered.

TABLE 1
Share of Agriculture in Total Economy and in Total Workforce, Selected OECD Countries, 1960 and 1992

	Agricultural Share of Total GDP		Agricultural Share of Workforce	
Country	1960	1992	1960	1992
	(%)	(%)	(%)	(%)
Australia	13.0	3.0	11.0	5.3
Canada	6.9	2.4	13.0	2.4
USA	3.9	2.0	7.0	2.9
Japan	15.0	2.3	33.0	6.4
UK	4.1	1.5	4.0	2.2
France	9.7	2.8	22.0	5.2
Germany	6.3	1.3	14.0	1.3
Italy	15.1	3.1	31.0	8.2
Spain	26.7	4.6	42.0	10.1

Source: World Bank. *World Development Report*; OECD. *OECD in Figures*; UN. *Yearbook of National Accounts Statistics*; ABARE, *Commodity Statistical Bulletin*.

A similar relationship was estimated with the dependent variable being the share of agriculture in the total workforce (sl), while independent variables were the same as above. The results were as follows,

$$sl_i = 180 - 17.7\ ln(y_i) - 0.803\ D1960 - 0.126\ DAUST$$
$$(-9.85)^{***} \qquad (.277) \qquad (-1.71)$$

and Adjusted $R^2 = .76$, $F = 50.8^{***}$, $n = 46$.

In this case the relationship is stable over time, as for the previous equation, but the estimated β coefficient for the dummy for Australia is weakly significant (at the 10% level). In other words, there is no strong evidence to reject the null. Again we can conclude that the agricultural labour share of the total workforce in Australia has been not significantly different from that of other OECD countries. The position of Australia is presented by the open circles in Figures 2 and 3, in this case where the relationship between the agricultural share of the economy (and the workforce) and average income per capita were estimated using separate samples for the years 1960 and 1992.

The main conclusion from the above regression analysis across countries and two time periods is that the share of agriculture in Australia's economy (both GDP and the workforce) has been little different from other OECD countries, when account is taken for different per capita income levels. In other words, the rate of structural change has been similar to other countries. Thus the argument that Australia has been adjusting more rapidly in recent decades is not supported by the evidence. Australian agriculture has been following the broad patterns of adjustment that are observed in many advanced industrial economies.

The Changing Distribution of Farm Size within Australia

The broad changes in the structure of agriculture within Australia from 1950-51 to 1992-93 are presented in Table 2. Whichever set of data on this is employed, some peculiarities will arise. In this table, the base year 1950-51 has a highly inflated gross value of rural production, attributable to the commodity boom at the time. As well, when the definition of agricultural establishments was changed by ABS in 1986-87 about 40,000 farms which had been reported previously as agricultural establishments were lost from the census. Nevertheless, several broad trends can be discerned, (1) the total number of farms has declined, especially since 1970, (2) employment has declined by about 100,000 in the last 40 years, approximately in line with the declining number of farms, (3) real gross value of farm production has remained comparatively stable, other than for the exceptional early period. Average real income per farm has increased generally.

Considerable discussion has centred upon the changing distribution of income in recent decades in different economies (Levy and Murnane 1992; Gottschalk 1993). Essentially, income inequality increased in major economies during the 1970s and 1980s. Studies for Australia have found similarly (Harding 1992; Gregory 1993). The latter found 'a widening dispersion of male real wages, large job loss from the middle of the earnings distribution, as well as rapid employment growth at low earnings'. This has been coined the 'disappearing middle class' effect.

FIGURE 2

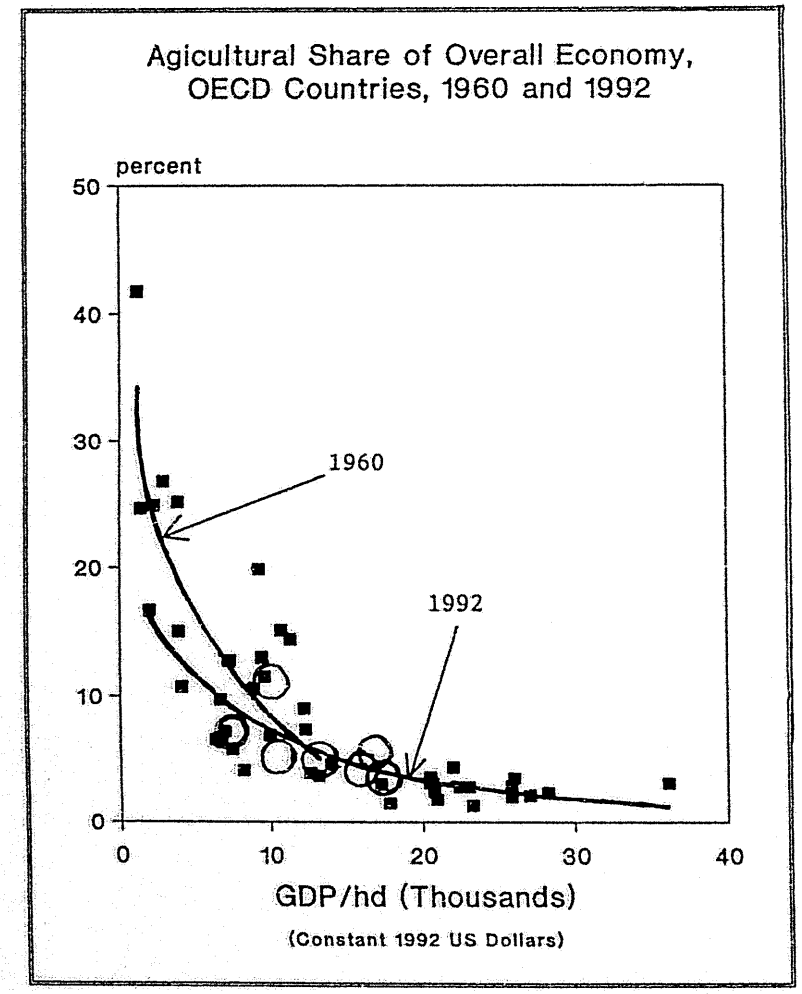


FIGURE 3

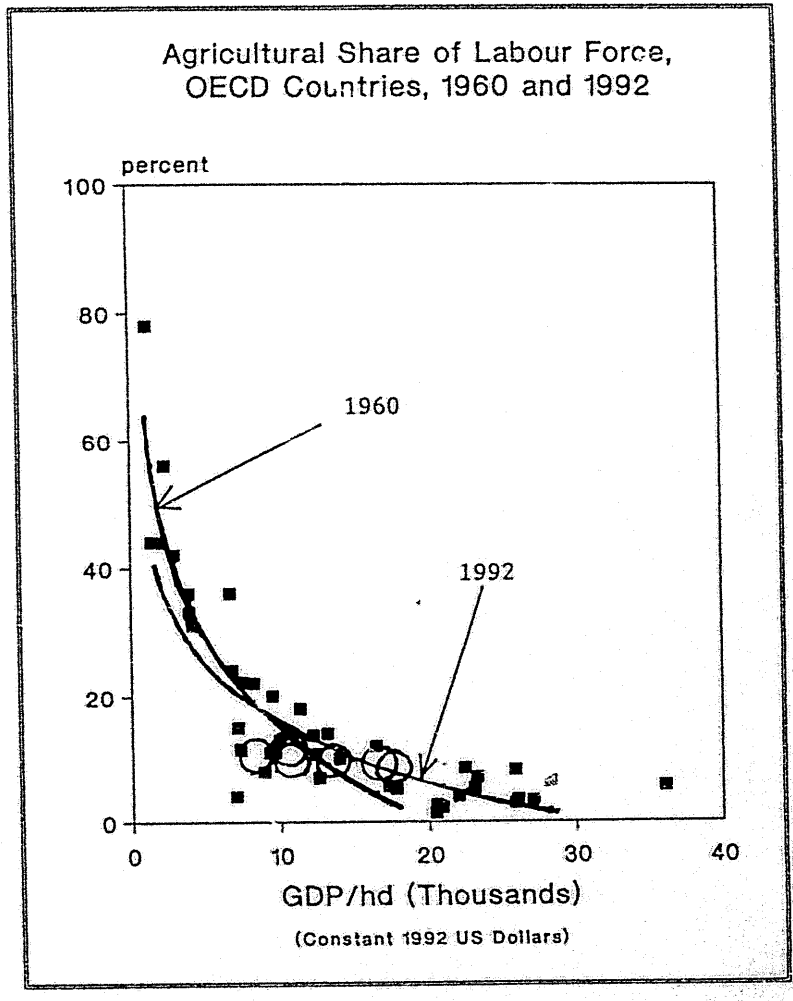


TABLE 2
Broad indicators of the Changing Structure of Australian Agriculture, 1950-51 to 1992-93

	1950-51	1960-61	1970-71	1980-81	1992-93
Total Farms ('000)	204	203	189	176	121[a]
Total Farm Employment ('000 full-time equiv.)	474	448	415	382	375
Gross Value of Farm Production ($b)	2.4	2.7	3.6	11.6	22.5
Index of Prices Paid by Farmers (1992-93=100)	7.4	12.7	15.2	49.1	100
Real Gross Value of Farm Production ($b constant 1992-93)	32.4	21.3	23.7	23.6	22.5
Real GVFP per Farm ($'000 1992-93)	159	105	125	134	186

Source: ABARE, *Commodity Statistical Bulletin* and *Australian Commodities*
(a) Because of the changed procedure for estimating the number of establishments in 1986-87, this figure is artificially reduced by approximately 40,000 farms. See the comparisons in the source of this table.

Tweeten (1984) argued that a dual farming industry is emerging in the USA, a commercial sector with a few 'larger-than-family' farms providing most of the output and another sector with large numbers of small part-time farms accounting for most farms but relatively output. The former remain broadly able to realise a favourable rate of return, while the latter is economically viable only by support from off-farm income. Evidence on this was documented in Barlett (1986).

To analyse the question of the changing size distribution of farms in Australia, frequency distributions and measures of the dispersion and skewness of the distributions were compiled for two years: 1974-75, and 1992-93. These years were chosen to provide the earliest and latest set of data on farm size distribution measured using an estimate of gross income per farm. The year 1974-75 was notable for the low returns of beef producers, while 1992-93 was notable for a very wet season in southern Australia, drought in Queensland and the 'wool crisis of the early 1990s'. Data were taken from ABS (1977) and ABS (1994). An adjustment was made at the bottom end of the frequency distribution of 1974-75 for

comparability with 1992-93. In 1986-87, ABS changed the definition of an agricultural establishment to include any establishment with estimated value of operations greater than $20,000. In real terms, $20,000 in 1992-93 was equivalent to $5,000 in 1974-75 (employing ABARE's *Index of Prices Paid by Farmers*). Thus the frequency distributions in 1974-75 were adjusted to eliminate farms whose estimated value of operations was less than $5,000. Overall this led to 43,600 farms being eliminated from the population in 1974-75.

ABARE's *Index of Prices Paid by Farmers* was also used to inflate the gross income levels to constant 1992-93 dollars. This permits more meaningful presentation of results, although does not affect the relative comparisons of income dispersion and skewness.

Frequency distributions for gross income for Australia and selected states for the years 1974-75 and 1992-93 are presented in Figure 4. There has been a major decline in the number of small farms, those with gross income in real terms less than $20,000. This is especially evident in Victoria and Tasmania, although prevails throughout Australia. There has been a major increase in farms with gross incomes exceeding $200,000. In 1992-93, 5670 farms had a gross income exceeding half a million dollars (ABS 1994). A sizeable share of these would have had gross income in excess of one million dollars, probably around 1,000.

Frequency distributions of gross income are presented for selected farm types in Figure 5. These indicate that major differences exist in the way farm size has shifted during the period of study. Dairying and pig production has experienced major adjustment in terms of farm size, especially when compared to grain and livestock. The case of the dairy industry is especially interesting, because low farm incomes and adjustment problems in this industry were the subjects of much investigation by agricultural economists during the 1960s (Standen and Musgrave 1968). Cotton is an extreme case of an industry with well above average gross incomes (when irrigation water is available). Less adjustment generally is observed for the extensive grazing livestock sector than others. The incomes in this sector have been affected by the beef crisis of the mid 1970s, and the wool crisis of the early 1990s, and the droughts of the early 1990s, so the results of this sector may be distorted by short term events. Nevertheless such crises must be considered part of the equation for this sector.

The evidence across the other extensive livestock categories analysed also suggests (1) that adjustment was considerably less in this sector than in others over the period of study, especially in comparison with cropping, dairying and pigs and (2) that a small farm problem may have emerged in the extensive grazing sector of Australian agriculture. The possible emergence of a small farm problem in the grazing sector requires further study, but the problems in South West Queensland's mulga lands are one example of the point.

Measures of the dispersion of gross income are presented in Table 3. The Gini Coefficients indicate that generally the inequality of farm size has increased over the 18-year time period studied. It should be noted that reduced inequality of farm size is calculated for the following farm types: grain, poultry meat, eggs and pigs. The value of the Gini Coefficient for Australian farms overall, .40 in 1992-93, can be compared with an estimate of .373 for disposable family income in Australia (Harding 1994) and Gini Coefficients for all income earners in the USA which ranged between .446 and .472 during the years 1967 to 1986.

The variance of logarithm of income measure generally delivers similar results to the Gini

FIGURE 4

The Distribution of Farm Size by State, 1974-75 and 1992-93

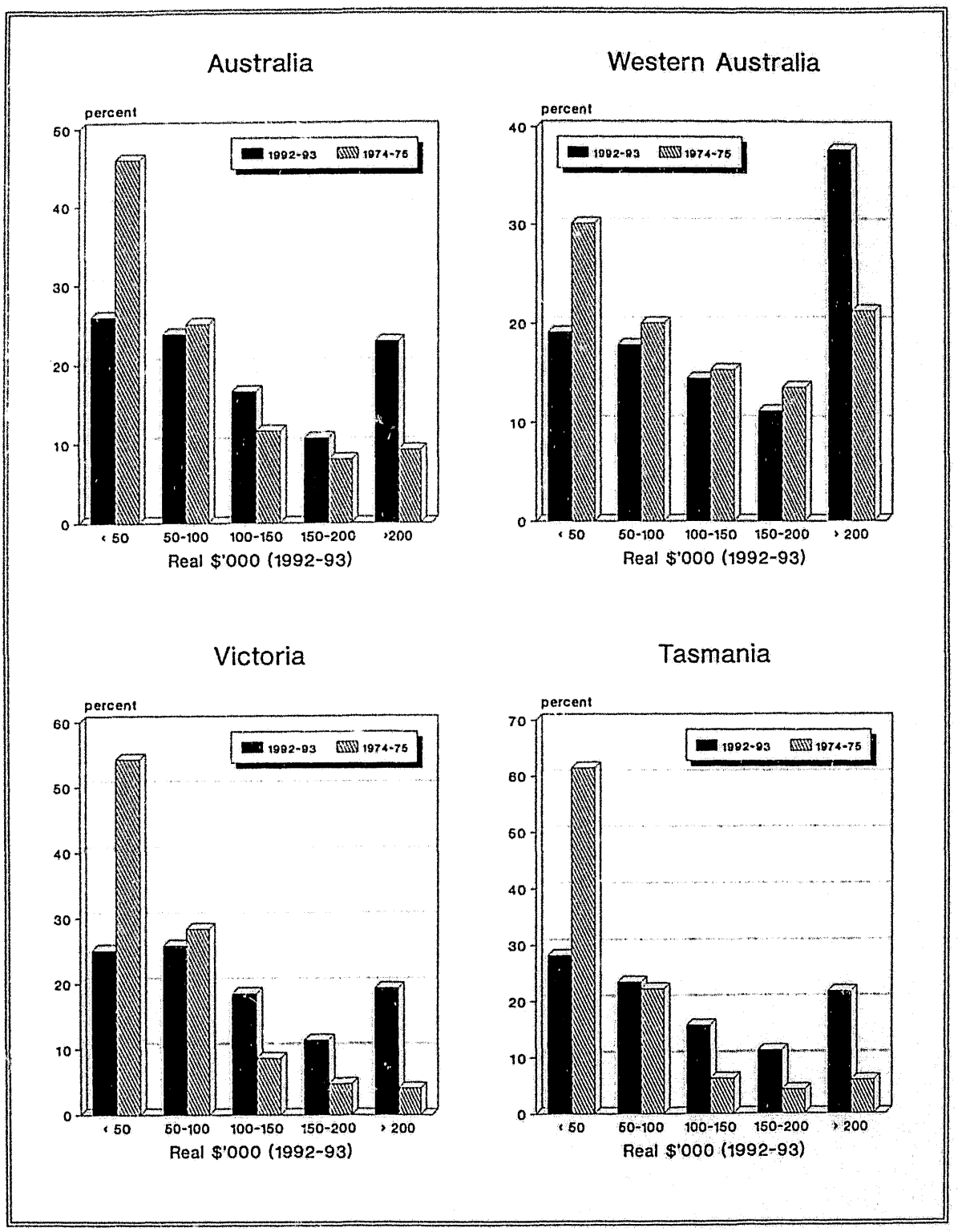


FIGURE 5

The Distribution of Farm Size by Type of Farm, 1974-75 and 1992-93

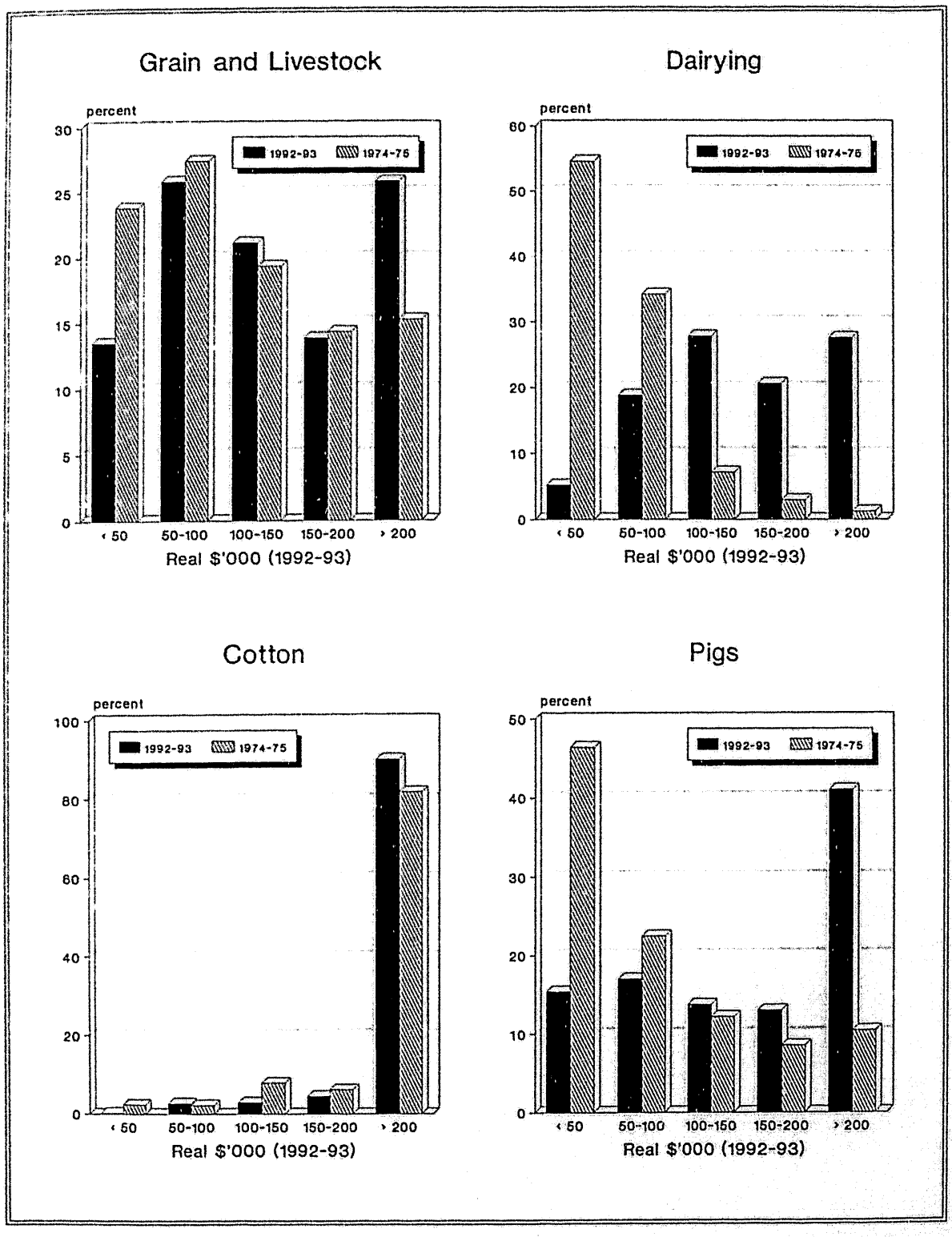


TABLE 3
Measures of Changing Inequality of Gross Income per Farm,
By State and by Main Agricultural Enterprise, 1974-75 and 1992-93

	Gini Coefficient		Variance of Logarithm of Income		Measure of Relative Skewness	
Category	1974-75	1992-93	1974-75	1992-93	1974-75	1992-93
NSW	.33	.43	.71	1.13	14.4	4.1
Victoria	.23	.37	.54	.97	22.8	3.9
Queensland	.37	.39	.81	1.17	9.6	2.8
South Australia	.32	.35	.81	.75	9.8	6.0
Western Australia	.37	.34	.70	1.25	5.2	1.4
Tasmania	.36	.40	.71	1.14	19.3	3.5
Australia	.35	.40	.74	1.16	12.6	1.2
Grain	.33	.29	.72	.94	7.5	1.1
Grain & Livestock	.25	.30	.55	.77	4.4	2.6
Sheep & Beef	.33	.40	.70	.95	11.7	4.8
Sheep	.34	.40	.73	.91	10.3	6.8
Beef	.33	.53	.64	1.29	32.1	7.6
Dairy	.03	.19	.34	.50	32.7	2.1
Poultry Meat	.32	.28	1.01	.77	0.8	1.0
Eggs	.42	.29	1.06	.99	3.5	0.0
Pigs	.40	.34	.85	1.17	12.2	1.0
Sugar	.20	.26	.42	.62	5.4	2.8
Cotton	.19	.24	.57	.35	0.2	0.6
Extensive Livestock	.38	.46	.78	1.13	15.5	6.8
Intensive Livestock	.22	.28	.50	.82	27.8	2.4
Extensive Cropping	.27	.31	.61	.86	5.7	2.0
Industrial Crops	.22	.32	.44	.78	6.0	1.7
Intensive Cropping	.31	.43	.64	1.26	22.8	3.0
Extensive Farming	.36	.42	.79	1.18	9.8	3.7
Intensive Farming	.31	.36	.64	1.05	17.7	2.5
Livestock	.34	.42	.69	1.17	18.7	4.5
Crops	.33	.35	.72	1.03	7.5	2.2

Coefficient. Most farm types are calculated to have experienced increased dispersion of gross incomes across farm size, the exceptions being poultry meat, eggs, pigs and cotton. The relative skewness measures generally decline during the period of interest.

What is behind this general finding that farm size measures of inequality are increasing? An understanding can be obtained by considering Figure 6, which shows the relative shifts in the distribution of farms by gross income category. The large decline in farms with a gross income of less than $50,000 is mainly set against sizeable increases in the percentage of farms with gross incomes above $200,000. The average gross income of smallest size group in this analysis in 1992-93 was $28,600, compared to an average gross income in the top bracket of $452,000. Thus any shift in the distribution toward the higher size categories is likely to increase the dispersion of income, so long as most farms remain in the lower size categories.

Further understanding of implications of the changing distribution of farm size on the median and mean levels of gross income per farm are presented in Table 4. Also shown in this table is the share of output of the largest 20 percent of farms. Generally, these have changed little over the period of the study. However, discernible differences between states and types of enterprise can be observed.

To summarise the findings, there is evidence of a disappearing class of farms in Australia, those in the small size categories. The disappearing middle class phenomenon is not evident. There has been a discernible increase in the number of large farms, as measured by real gross income per farm. The phenomenon described by Tweeten (1984) appears to be evident in Australia as well, although to a lesser degree.

The Changing Location of Agriculture

Evidence on the changing location of Australian agriculture using DSEs is presented in Table 5. This shows calculated DSEs for each state and Australia for the years at the turn of each decade from 1900 to 1990. In 1900, NSW and Victoria represented 72 percent of total DSEs. By 1990, this had fallen to 40 percent. The most striking change concerning locational shift has been the strong growth of Western Australia and Queensland as contributors to Australian agriculture. This is depicted in Figure 7. From about 30 percent of total DSEs early this century, Western Australia and Queensland now represent approximately half of Australian agriculture.

The annual percentage growth rates in DSEs differ across the sub-periods used in the analysis. Australian agriculture grew most rapidly in the period 1950 to 1970, at 2.9 percent per year. From 1970 to 1990 the rate was much lower. However major differences in the rates of growth between states are discernible for this period. In particular, Queensland and Western Australia are estimated to have grown in capacity at 1.9 percent per year, when other states combined grew at a very modest 0.3 percent per year.

The longer term growth rates in total DSEs can be compared with other indicators of growth of Australian agriculture. From data in ABARE (1992, Table 3), the growth rate in real gross farm product from 1962-63 to 1990-91 was 1.9 percent per annum. The growth rate in DSEs calculated from Table 5 for the years 1960 to 1990 was 1.6 percent per year.

For the much longer period, 1902 to 1990-91, the annual growth rate in gross value of rural production was 1.6 percent per annum.[2] The overall growth rate in total DSEs for the years 1900 to 1990 was 1.5 percent per annum. Thus there appears to be considerable comparability between the two measures which suggests that we can have some confidence in the DSE measure.

TABLE 5
Total Dry Sheep Equivalents by State, 1900 to 1990 by Decade

Year	NSW	Vic	Qld	SA	WA	Tas	NT	Australia
					M.DSE[a]			
1900	72	44	50	25	7	4	2	204
1910	94	51	67	30	17	5	3	268
1920	88	56	73	32	27	5	5	286
1930	118	75	82	49	53	5	6	388
1940	120	60	99	43	46	6	7	381
1950	112	64	95	39	52	6	8	377
1960	154	82	120	54	74	8	9	502
1970	207	101	149	67	122	10	10	665
1980	190	94	189	76	149	10	13	720
1990	227	94	215	79	176	10	11	812
					Annual Percentage Growth Rate			
1900-1950	0.9	0.8	1.3	0.9	4.3	0.6	2.8	1.2
1950-1970	3.1	2.3	2.3	2.7	4.3	3.1	0.6	2.9
1970-1990	0.5	-0.4	1.9	0.9	1.9	-0.1	0.6	1.0

[a] The following DSEs were employed: all sheep and lambs, 1; dairy cows, 12; all other cattle, 8; pigs, 2; wheat (ha), 20; barley, oats and other extensive crops (ha), 16; cotton (ha), 200; sugar (ha), 200; grapes, 400 (ha).

[2] Calculated as follows. GVRP in 1902 was $112m (Shaw 1990). Australia's GDP deflator for 1902 was .128 and 1.110 in 1970 (Maddock and McLean 1987, pp. 356-357). The IMF's GDP deflator was 23.3 in 1970 and 139.7 in 1990 (IMF 1994). Combining these and basing the index for the GDP deflator on 1990=100, the value of the GDP deflator for 1900 is calculated to be 3.5. Thus the real value of 1902 GVRP in 1990 constant dollars was 112/(.035)= $3,200m. Actual GVRP was $12,424m in 1990-91. The compound growth rate is thus 1.55 percent per year.

FIGURE 6
Changes in the Percentage of Farms by Size Category,
1974-75 to 1992-93

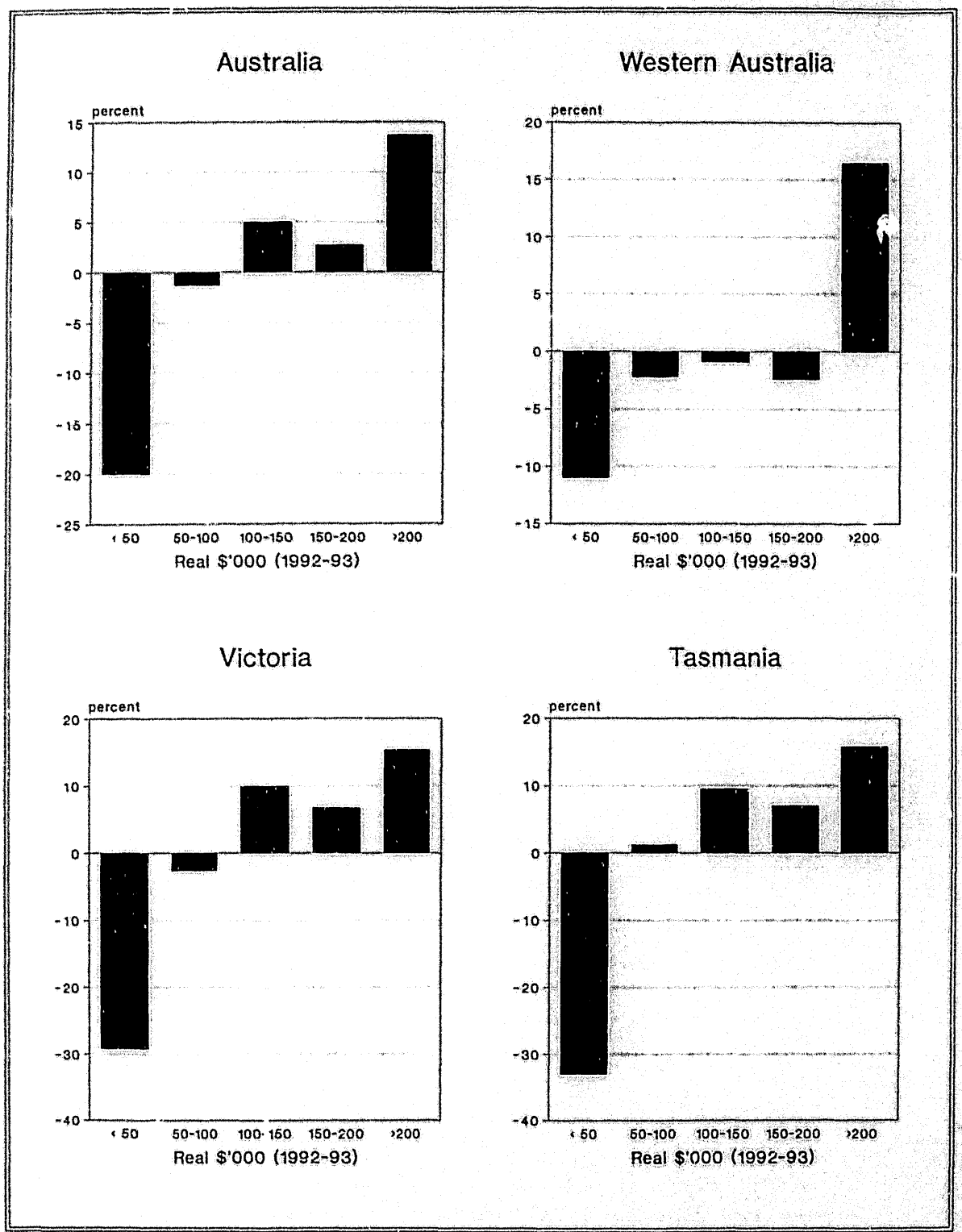


TABLE 4

Median and Mean of Gross Income Per Farm and Output Share of Largest 20% of Farms, By State and by Main Agricultural Enterprise, 1974-75 and 1992-93

	Median		Mean		Output Share of Largest 20% Farms	
Category	1974-75	1992-93	1974-75	1992-93	1974-75	1992-93
	Constant $'000 1992-93				%	%
NSW	53	77	105	149	54	57
Victoria	46	86	85	153	56	54
Queensland	64	93	127	181	53	52
South Australia	68	54	121	128	50	59
Western Australia	100	122	168	230	49	46
Tasmania	37	85	87	163	62	54
Australia	55	88	112	168	54	53
Grain	87	150	146	257	49	42
Grain & Livestock	97	107	149	183	44	47
Sheep & Beef	74	122	122	139	51	57
Sheep	62	64	120	110	51	60
Beef	22	42	68	105	68	70
Dairy	47	123	75	198	54	43
Poultry Meat	271	162	381	291	41	42
Eggs	127	282	234	416	54	35
Pigs	55	140	120	263	56	46
Sugar	139	111	198	190	41	46
Cotton	389	440	534	440	36	27
Extensive Livestock	43	56	97	114	59	64
Intensive Livestock	49	119	92	203	55	46
Extensive Cropping	94	210	148	211	46	46
Industrial Crops	140	122	204	245	42	46
Intensive Cropping	40	83	84	178	59	55
Extensive Farming	59	78	117	151	52	56
Intensive Farming	50	107	102	198	56	50
Livestock	46	73	96	139	58	58
Crops	78	108	134	203	49	49

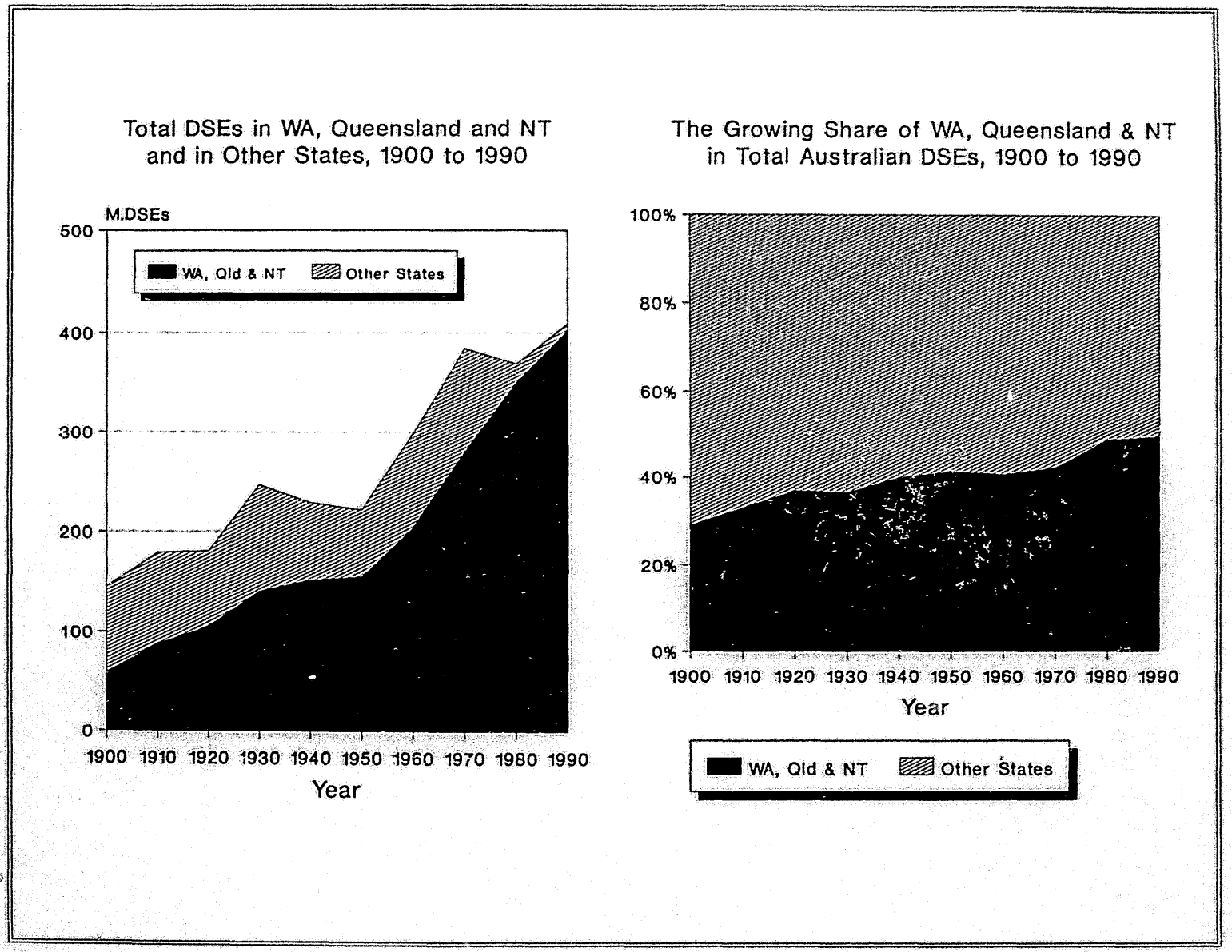


FIGURE 7
The Share of Western Australia, Queensland and Northern Territory in Total Australian DSEs, 1900 to 1990

The Importance of Intensive Agriculture

The share of intensive agriculture in total agriculture was also analysed using DSEs. Total DSEs of intensive agriculture were counted by aggregating the DSEs of sugar, cotton, horticulture and one fourth of crop area not elsewhere considered, as well as dairying and pigs. The DSE analysis is not sufficiently subtle to capture differing degrees of intensity within an agricultural crop or livestock sector. Thus it has not been modified to account for the recent rapid growth of the lot feeding industry for beef. As well it does not account for many intensive crops, which have high values of output per hectare. The measure will probably underestimate the extent of intensification.

The main findings are reported in Figure 8. Intensive agriculture has grown at 1.6 percent per year over the longer term (1900 to 1990), and at 1.4 percent per year since 1950. A more rapid rate of growth of the intensive sector can be discerned in the 1980s (2.8 percent per year). The intensive sector's share of agriculture has fluctuated but generally remained around one-fifth of total agricultural DSEs. Differing degrees of importance of intensive agriculture can be discerned between states. Of the major agricultural states, Western Australia has the smallest share of intensive agriculture. Queensland has the highest, largest because of the importance of the sugar industry.

Essentially, Australian agriculture remains extensive in orientation. While irrigation, sugar and intensive livestock are boosting the size of the intensive sector, the extensive sector prevails. The patterns of intensity of agriculture presented here are some reflection of the differing degrees of land availability, resource availability and thus differing competitive advantages of regions.

The Mix of Cropping and Livestock

Although much of Australian agriculture is of a multi-enterprise nature, combining crops and livestock, the share of cropping in Australian agriculture has been growing through time. This is reflected in the results presented in Figure 9. From just over 35 percent of total DSEs early this century, cropping's share of total agriculture has risen to more than half of total agricultural DSEs in the 1980s. This is a major switch in the longer-term mix of enterprises in Australian agriculture.

A clearer idea of where the major expansion in cropping has occurred is provided in Figure 9. While the share of cropping in total DSEs has grown strikingly in Western Australia, Queensland and New South Wales, the opposite was calculated for the south eastern states. This phenomenon is caused by the strong competition for land from the grazing livestock sector in the south eastern states where carrying capacities for livestock are generally high and drought risk is low. Thus cropping has been more competitive in the areas where land is relatively abundant and farmers can realise economies of size in farming operations, while grazing livestock have been strongly competitive with cropping in the south eastern parts of Australia.

It is likely that labour-saving technologies in cropping have had a greater impact than in livestock. While some livestock operations have been eliminated or radically altered by farmers to reduce labour costs, certain operations retain high labour intensity (including

FIGURE 8
The Share of Intensive Agriculture in Total DSEs,
1900 to 1990

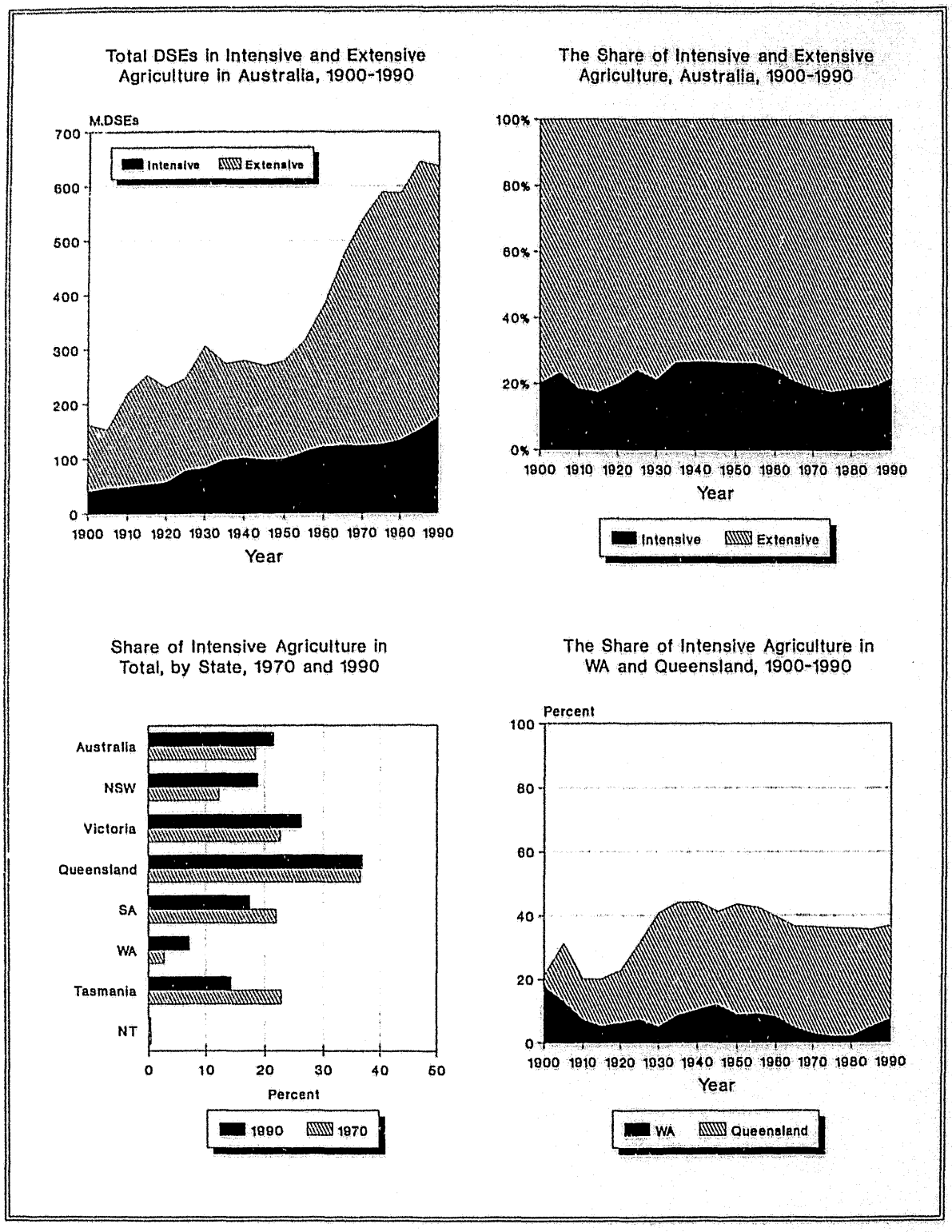
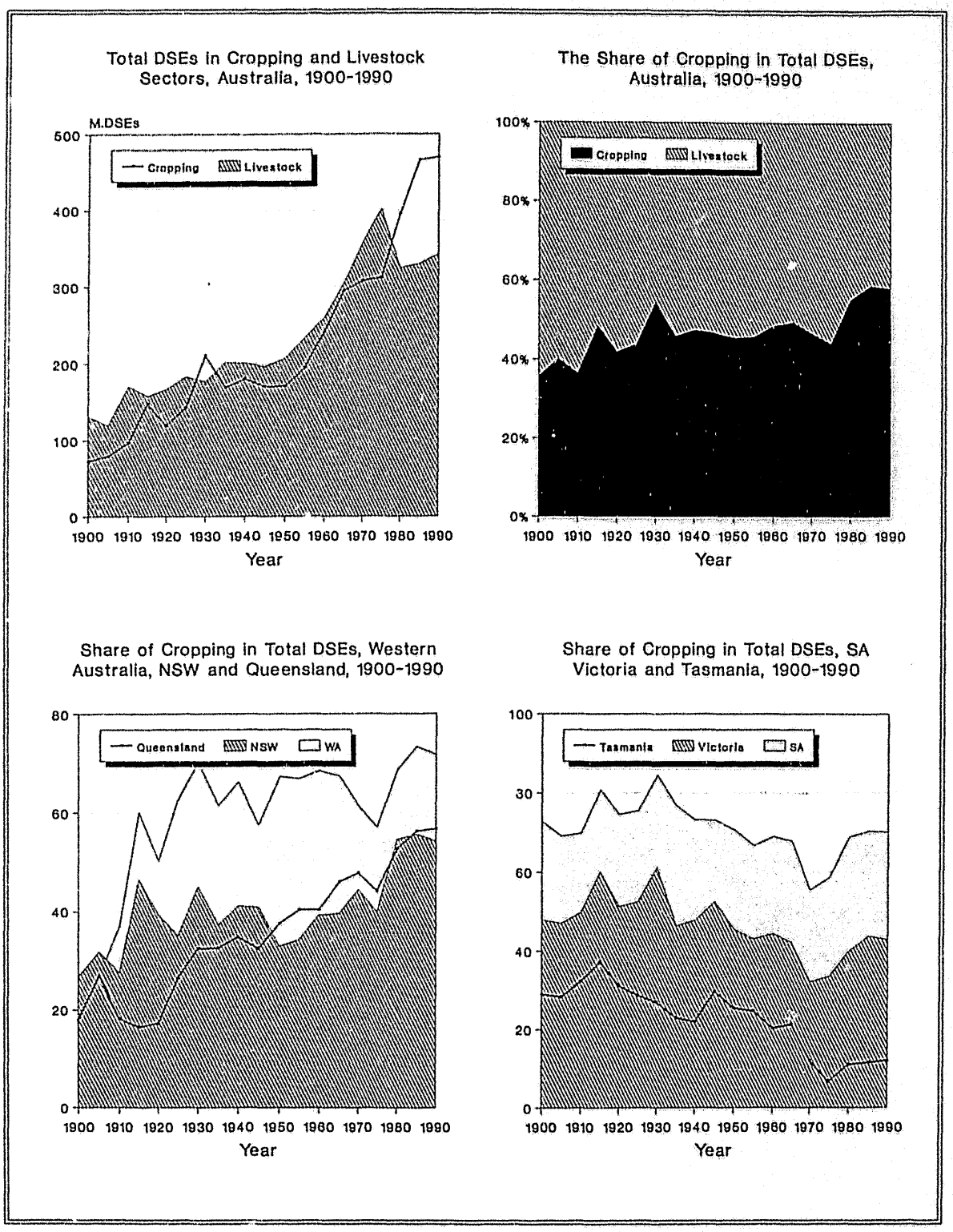


FIGURE 9
The Share of Cropping in Total DSEs,
1900 to 1990



shearing and stock husbandry). In contrast, crop farmers have adopted new machinery and reduced tillage practices which have saved labour inputs to a greater extent than with livestock. Opportunities for adopting labour-saving technologies with large-scale farming equipment have been especially good in those regions where the area of farms is high (notably, Western Australia and west of the Great Dividing Range in Queensland and New South Wales.

Conclusions: The Future of Australian Agriculture

Australian agriculture is continuing to adjust strongly to economic circumstances. Agriculture's declining share of the total economy and of the total workforce is likely to continue well into the future. Most likely these declining shares will be more attributable to changes in the rest of the economy than in agriculture itself. The total real value of agricultural output is likely to remain fairly constant in Australia, with additional volume of output being approximately offset by declining terms of trade of the industry. Virtually all of additional production will be attributable to productivity gains, which will be primarily yield-enhancing and input-saving. Agricultural land will continue to decline as an input of Australian agriculture as a consequence. However, competing demands for land and other resources, especially water, will continue to place upward pressure on relative values of these inputs.

More rapid growth of the intensive sector of Australian agriculture than the extensive sector is likely. The high real cost of capital in the Australian economy, caused by our low savings rates, will favour intensive industries which are less capital demanding. Technical change will favour the expansion of the intensive industry too. The share of cropping will continue to increase over the longer term, with cropping tending to be more intensive than grazing livestock enterprises. Australian agriculture will continue to grow more rapidly in the north and west than in the south east. Within the livestock sector, the intensive sector is likely to grow more rapidly than the extensive. Some major adjustments are likely to occur within the grazing livestock sector in the near future.

The Australian economy has experienced very different rates of economic growth between Western Australia and Queensland combined, and the rest of the economy (Harris and Harris 1994). Population growth and related infrastructure growth is likely to favour agricultural growth in the west and north as a consequence. A further boost to this will be the dramatic economic growth to be experienced in the coming decades in Asia, given the locational advantages of these regions for penetrating Asian markets.

Farming establishments will continue to grow in size, implying that the number of farms will continue to decline over time. It will be common for Australian farmers to have command of assets worth more than $1 million in current values. Most agricultural land in Australia is owned and operated by family farmers. This is likely to continue, although many family farms will be large commercial enterprises. Considerable opportunity will exist for farmers to continue to diversify into complementary activities, such as farm tourism, as communications and access improve in the future. The agricultural landscape will continue to change with a large number of small farms being devoted to residential and hobby farming pursuits. The traditional saying - 'get big or get out' - will be highly relevant for farmers in the 21st Century, although it might be suitably modified to - 'get big or go hobby farming'.

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