# CHANGES IN THE EXTENT OF INTERSTATE DISPARITIES IN GDP PER HEAD IN AUSTRALIA 1977-78 TO 1994-95: A COMPARISON OF THE FINDINGS OF TWO METHODS OF ANALYSIS

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**ABSTRACT** The aim of this paper is to compare the findings that emerge from two different (though related) approaches to analysing changes in the extent of interregional disparities in GDP per head. This is done by examining the situation in Australia over the period 1977-78 to 1994-95, with the eight States and Territories as the regions. The first method of analysis, referred to as the aggregative approach, uses the weighted coefficient of variation as the indicator of change, while the second method, referred to as the disaggregative approach, uses four variables (per capita GDP differentials, population growth rates, GDP growth rates, GDP per head growth rates) and also the unweighted coefficient of variation as indicators of change. In essence the two methods may also be differentiated by noting that the first method is based on considerations relating to the relative importance of changes in the distribution of population and GDP within the nation as a whole, while the second method is based on the relative importance of these kinds of redistributions in the individual States. It might therefore be said that the orientation of the aggregative approach is towards the nation as a whole, and the orientation of the disaggregative approach is towards the individual States or regions. Because of the emphasis on methodology, it has not been possible in this paper to examine any of the causes of the changes that have been noted.

The findings of this paper indicate that the aggregative approach does not identify some of major changes that have occurred in individual States because these States have small proportions of Australia's population and GDP. In contrast the disaggregative approach concentrates on these changes in the individual States, irrespective of their population and GDP proportions.

## 1. INTRODUCTION

The purpose of this paper is to investigate to what extent interstate disparities in Gross Domestic Product (hereafter GDP) per head have changed in Australia over the period 1977-78 to 1994-95, and more importantly, how the findings provided by such an empirical study vary according to the method of analysis used. In this context two method of analysis are proposed. The first is referred to as the aggregative approach, which is based on a method generally attributed to Williamson (1965) and utilises the weighted coefficient of variation (population proportion weights). The second method is referred as the disaggregative approach. In this approach differences in per capita GDP differentials, growth rates of population, GDP, and GDP per head are examined, using the unweighted

coefficient of variation. Given these dual aims not possible in this paper to try to explain, in any causal way, the kinds of changes in interstate disparities that have occurred. However, despite the emphasis on the appropriateness of different methods of analysis, both methods generate information about the extent of changes in interstate disparities in GDP per head in Australia over the period 1977-78 to 1994-95. From this information it is possible to identify the areas where the answers to the causal questions have to be sought.

The data sources are the State Accounts from the Australian Bureau of Statistics(ABS). For the years 1984-85 to 1994-95 ABS estimates of real GDP and real GDP per head for each State are available, with what the ABS refers to as "an experimental series". The constant price estimates for the years 1977-78 to 1983-84 are based those given in Harris and Harris (1994), which have been adjusted to account for two factors. First, those estimates are for GDP at factor cost, and they have been adjusted to conform to the ABS estimates of GDP .Second, adjustments have been made to the GDP(P) deflators used in that study to allow for the fact that the later ABS estimates are based on GDP(I) (Income Estimates) and GDP(E) (Expenditure Estimates) deflators. These adjustments have particularly affected the estimates for the ACT and the Northern Territory.

In analysing this data to assess the degree of disparities amongst Australian States and Territories, the discussion can take three distinct streams. First, empirical analysis can be undertaken over the period 1977-78 to 1994-95 using the so-called Williamson method.

The following discussion is divided into three parts.

The first is concerned with the empirical analysis over the period 1977-78 to 1994-95 applying the so-called Williamson method. In doing this, however, a method is proposed by which the contribution of each State to the change in the value of the coefficient of variation (CV) from one year to another can be calculated. The conclusions from that approach relate not only to how the value of the CV has changed over the period, but also to which States have been mainly responsible (highest contributions) for these changes.

Second, the disaggregative approach is undertaken, and is concerned with four variables in each of the individual States. These variables are per capita differentials (the percentage differences between State GDP per head and Australia's GDP per head), population growth rates, GDP growth rates, and GDP per head growth rates. Interstate differences in growth rates of GDP per head affect the per capita differentials, and interstate differences in growth rates of population and GDP lead to a redistribution of population and GDP among the States. The conclusions which emerge from this kind of analysis are then summarised in relation to each of these variables. It should be noted that the kinds of information generated by this second approach are useful for interpreting the findings of the first approach.

Finally, a comparison of the two sets of conclusions can be undertaken to determine to what degree the disaggregative approach yields different information about interstate changes from that provided by the aggregative CV approach. The

basic conclusion reached is that the aggregative CV approach by itself, at least in Australia, does not identify some of the significant changes in interstate disparities that have occurred in the individual States because of the size of the differences among the States in their population proportions (weights), which in 1994-95 ranged from one per cent to 34 per cent. In this respect the weighted CV approach concentrates on the redistribution of total population and GDP among the eight States and Territories combined, whereas the disaggregative approach concentrates on what has happened in the individual States and Territories.

## 2. CHANGES IN THE EXTENT OF INTERSTATE DISPARITIES IN GDP PER HEAD AS MEASURED BY THE WEIGHTED COEFFICIENT OF VARIATION

### 2.1 Methods

The most commonly used method of calculating the degree of interstate (interregional) disparities in GDP per head uses as the measure the coefficient of variation (hereafter CV) derived from the weighted standard deviation (hereafter SD) of the differences between each State's GDP per head and the GDP per head for Australia (the all States weighted mean), the weights being the population proportion in each State.

In calculating the SD in this study, a method is proposed by which the contribution of each State to the change in the value of the CV from one year to another is calculated. For each year the Australian mean GDP per head has been designated by the index 100, and the estimates for each State have then been expressed as relatives of 100. Since the Australian mean GDP per head is the same (index of 100) each year, the CV is equal in magnitude to the SD. This is useful because it enables comparisons to be made among the States in terms of their contributions to changes in the CV over time. This is done by calculating the proportion which each State contributes to the variation (SD squared) each year, and how that proportion changes over any given period of time.

### 2.2 Changes in the Extent of Interregional Disparities

Estimates of the weighted CV for the period 1977-78 to 1994-95 are shown in Figure 1.

Over the period there is no one-way trend, rather the extent of the disparities has fluctuated about a simple average CV of 2.8 per cent ,ranging from a low of 2.3 per cent in 1992-93 to a high of 3.3 per cent in 1985-86. The value of the CV at the end of the period, 2.9 per cent, is higher than at the beginning of the period, 2.4 per cent. Thus over the 18 year period the extent of this kind of disparity has risen by about 20 per cent. However, as noted previously, this has not been a consistent trend.

When the time series of CVs is considered, the entire period can be divided into

the following five sub-periods.

(i) 1977-78 to 1981-82, the extent of disparities increased from 2.4 per cent to 3.2 per cent (a rise of 33 per cent), so there was a divergent outcome.

(ii) 1981-82 to 1983-84, the extent of disparities decreased from 3.2 per cent to 2.7 per cent (a fall of 16 per cent), so there was a convergent outcome.

(iii) 1983-84 to 1985-86, the extent of disparities increased from 2.7 per cent to 3.3 per cent (a rise of 22 per cent), so there was a divergent outcome.

(iv) 1985-86 to 1992-93, the extent of disparities decreased from 3.3 per cent to 2.3 per cent (a fall of 30 per cent), so there was a convergent outcome.

(v) 1992-93 to 1994-95, the extent of disparities increased from 2.3 per cent to 2.9 per cent (a rise of 26 per cent), so there was a divergent outcome.

The above details indicate a pattern of periodic cycles, and it may be thought that these cycles may have some relationship to national growth cycles. However, an examination of the data does not reveal any meaningful relationships, with the extent of interstate disparities both increasing and decreasing in upturns and in downturns.

## 2.3 An Outline of the Reasons for Changes in the Extent of Interstate Disparities in Real GDP Per Head

Given that the changes in the extent of interstate disparities cannot be "explained" by reference to national growth cycles, it is necessary to consider what has happened in the individual States over this period. In this context it is important to consider the features which influence the observed outcomes.

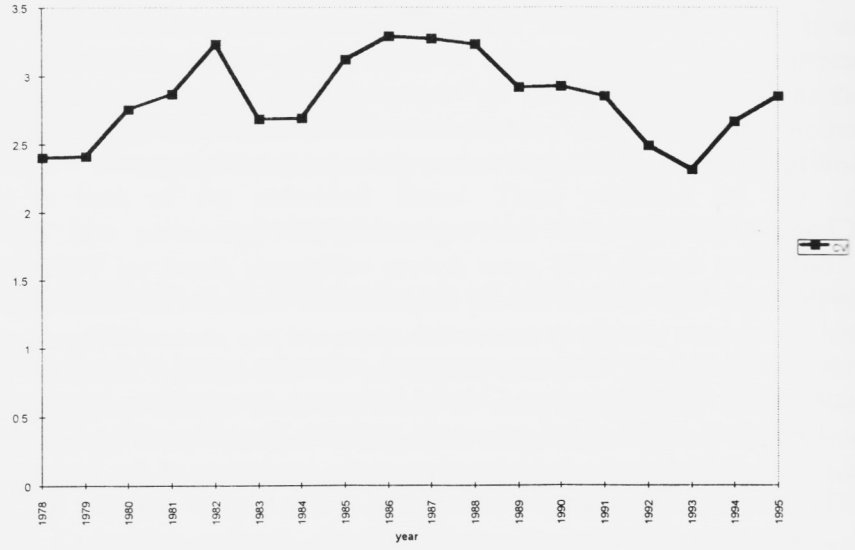



**Figure 1.** Interstate Disparities in Real GDP Per Head of Population: 1977-78 to 1994-95

The contribution of each State to the CV in any year is based on the difference between its GDP per head and the Australian GDP per head (or its per capita differential), and its proportion of Australia's population (or its weight). Changes in this contribution over time therefore result from changes in the per capita differential and/or the weight.

Given that the per capita differential is measured each year as the percentage deviation from 100 and that the SD is equal to the CV, it is proposed here that the contribution of a State to the CV each year is given by multiplying the value of the CV in that year by the proportion which that State contributes to the variation for that year. That is, by the ratio of its weighted per capita differential squared to the sum of the weighted per capita differential squared of all States. These proportions can then be applied to show the contribution in percentage points by each State to the value of the CV in each year. In other words, for each year the CV can be shown as the sum of the contributions from each of the eight States, where those contributions are measured in percentage points (the same as the CV).

In this way the change in the value of the CV from one year to another can be analysed by subtracting the contribution of each State in the initial year from its contribution in the final year. These contribution changes occur because for each State there is a change in the value of its per capita differential and in its population share (weight). In this way the change in the CV is shown as the algebraic sum of the changes in the contributions of each of the eight States over this period, the changes being measured in percentage points contribution to the CV (as determined by changes in the proportion of the variance accounted for by each State).

If a State's contribution increases from one year to another, this will tend to increase the value of the CV and is a divergent contribution to the change in the CV. If a State's contribution decreases from one year to another, this will tend to decrease the value of the CV and is a convergent contribution to the change in the CV.

Using the above approach has led to the identification the kinds of contributions which each State has made to changes in the extent of interstate disparities over time. However, it is important to understand that the magnitude of the changes in these contributions is also influenced by the State population proportions, so that when a State has a very low population proportion its contribution to the change in the CV will be negligible unless the change in its differential is exceptionally large, which is unlikely to occur in practice when short to medium term changes are considered, as with the five sub-periods outlined above.

### 2.4 Contributions of the States to Changes in the Extent of Interstate Disparities in Real GDP Per Head

Using the approach outlined above, it is possible to show what each State has contributed to the CV each year, and to derive the year to year changes in these contributions. It should be noted that the contribution of each State to the change in the value of the CV is measured in percentage points, since the change in the value of the CV is measured in the same way. The data shown in Table 1 do not include

annual contributions to the change in the CV by all States for the following as there are significant differences among the States in the population shares, and because of this the contributions to the CV and changes in the CV by three States - Tasmania, ACT and the Northern Territory - are so close to zero that their impact can be ignored. Further, instead of giving annual data for the other five States, it has been decided to relate the changes in the CV to the five sub-periods identified above. However, every year as some of the more populous States make a very small contribution to changes in the value of the CV (even if they make a relatively large contribution to the annual value of the CV), it has been decided to limit the data to contribution changes regarded as "significant". For these purposes, given that the values of the CV fall within a narrow range of 2.3 to 3.3, a contribution to the change in the CV of at least 0.2 percentage points (positive or negative) has been taken as the point of reference.

The mix of States making "significant contributions to changes in the CV" varied for the five sub-periods, with each of the five more populous States appearing from two to four times in Table 1. Moreover, in each sub-period the States are not the same, and those listed tend to make both convergent and divergent contributions. However, when the change over the entire period is considered, only three States appear in the list, New South Wales, Queensland and Western Australia.

### 2.5 An Assessment of the Changes in the Extent of Interstate Disparities

When the entire period is considered, the divergence (a rise in the CV from 2.4 to 2.9) was due mainly to divergent changes in Queensland (+0.2 percentage points) and Western Australia (+0.6) offsetting convergent changes in New South Wales (-0.4). Thus, when considering what has happened to the extent of interstate disparities in GDP per head over the entire period, the main conclusion is that, while the extent of these disparities has fluctuated over time, there has been no tendency for it to rise or fall on a trend basis. Moreover, to understand what has occurred over the entire period, it appears that the explanation may centre on three States - New South Wales, Queensland and Western Australia.

The increase in the extent of the interstate disparities over the 17 year period has been only moderate, and, if the sequence of previous outcomes is repeated, it can be expected that the value of the CV will soon fall. It could be argued that the period analysed is too short to conclude that regular cyclical fluctuations in the extent of interstate disparities in GDP per head is a "normal" characteristic of the Australian economy over longer periods. All that can be said is that it has been a feature of the 17 years from 1977-78 to 1994-95.

The danger with such conclusions is that they may be interpreted to imply that interstate economic differences did not change much over this period. Given that changes in GDP per head are the combined outcomes of variations in State population and GDP growth rates, the conclusions may be taken to imply that these two kinds of growth rates have not varied much among the States. Thus, it could be suggested that the magnitude of the State per capita differentials have also not

**Table 1.** Significant Contributions to Changes in the Extent of Interstate Disparities in Real GDP Per Head: Sub-Periods as Shown (Percentage Points)*

| Period | CV (%) | | | Significant Contributions | |
|---|---|---|---|---|---|
| | From | To | Change | Divergent | Convergent |
| 1977-78 to 1981-82 | 2.4 | 3.2 | 0.8 | NSW +0.9 | Qld -0.2 |
| 1981-82 to 1983-84 | 3.2 | 2.7 | -0.5 | Vic. 0.8; WA 0.3 | NSW -1.0, Qld -0.2 SA -0.4 |
| 1983-84 to 1985-86 | 2.7 | 3.3 | 0.6 | Qld 1.2 | NSW -0.2 WA -0.3 |
| 1985-86 to 1992-93 | 3.3 | 2.3 | -1.0 | SA 0.2 WA 0.4 | Vic. -0.9 Qld -0.8 |
| 1992-93 to 1994-95 | 2.3 | 2.9 | 0.6 | Vic 0.2 SA 0.2 WA 0.2 | - |
| Entire Period 1977-78 to 1994-95 | 2.4 | 2.9 | 0.5 | Qld 0.2 WA 0.6 | NSW -0.4 |

* a negative number denotes a convergent stream.
a positive number denotes a divergent stream.

altered significantly. In fact neither of these conclusions is valid, and therefore it is necessary to examine changes in each State individually in order to understand more fully what has happened over this period.

## 3. A DISAGGREGATIVE APPROACH TO THE EMPIRICAL ANALYSIS

### 3.1. Four Questions

We now turn to the second method proposed in this paper. In the previous analysis attention was given to only one question, "To what extent has the value of the weighed CV changed over time, and how much has each State contributed to that change?" In answering that question it was concluded that Tasmania, the ACT and the Northern Territory "did not matter very much", and that, if the change from 1977-78 to 1994-95 is considered, only New South Wales, Victoria, Queensland and Western Australia "mattered". However, in carrying out the analysis of the individual States four questions will be posed and all States are relevant in determining the answers.

First, it can be asked "How have the per capita differentials changed over time in each State"? These differentials change because State growth rates of GDP per head differ from the weighted mean rate for all States. In considering the answer to this question it should be noted that the growth rate of GDP per head is the combined outcome of the growth rates of population and GDP. Second. it could be asked "To what extent have population growth rates varied among the States over this

period?" Third, it could be asked "To what extent have GDP growth rates varied among the States over this period?" And finally it could be asked "To what extent have population growth rates and GDP growth rates varied in each State over this period, and so caused disparities in growth rates of GDP per head?"

By answering these four questions a much better understanding of how interstate economic differences have changed over the period being studied is obtained, an understanding which is not obtained by concentrating on a single aggregative method of measuring changes in the extent of interstate disparities in GDP per head.

### 3.2 Changes in Per Capita GDP Differentials

Over the period being examined the eight States fall into three groups with regard to above-average and below-average GDP per head.

New South Wales, Victoria and the ACT had above-average GDP per head for all of the 18 years. Western Australia had above-average GDP per head for 15 of the 18 years, but the differential for the three below-average years was small, and this occurred in the earlier years. We may therefore take these four States to comprise the above-average GDP per head group. Queensland, South Australia and Tasmania had below-average GDP per head for all of the 18 years. The Northern Territory had below-average GDP per head for the first eleven years from 1977-78 to 1987-88, and above-average GDP per head for the remaining seven years. Thus the Northern Territory presents a mixed case.

From 1977-78 to 1987-88 there were four States with above-average GDP per head and four States with below-average GDP per head, and from 1988-89 to 1994-95 there were five States with above-average GDP per head and three States with below-average GDP per head. Only in the case of the Northern Territory were interstate differences in growth rates of GDP per head such that a State changed its grouping. Details of the per capita GDP differentials for each of the eighteen years are shown in Figure 2. The four States in the above average group are shown in Part A and the four States in the below average group are shown in Part B.

The main features of the time series of per capita differentials may be summarised by saying that a State's relative position improves if its positive differential increases or if the magnitude of its negative differential decreases (differential moves away from zero from above or towards zero from below). Conversely a State's relative position deteriorates if its positive differential decreases or if the magnitude of its negative differential increases (differential moves towards zero from above or away from zero from below).

The greatest improvement occurred for the Northern Territory, which moved consistently over time from a differential of -16 per cent in 1977-78 to one of +17 per cent in 1994-95, a change of 33 percentage points. In 1977-78 this State had the lowest GDP per head, and in 1994-95 it had the second highest. The second largest improvement occurred in Western Australia, where its differential rose by 14 percentage points from virtually zero, although this increase occurred mainly from 1987-88 onwards. The third largest improvement occurred in the ACT, with its differential rising by twelve percentage points from eight per cent to 20 per cent.

This State had the highest GDP per head every year. The largest deterioration occurred in Tasmania, where its (negative) differential increased in magnitude by ten percentage points from -12 per cent to -22 per cent. From 1987-88 onwards this State had the lowest GDP per head.

New South Wales experienced a moderate deterioration, its differential decreasing from a high of six per cent in 1981-82 to one per cent to -2 per cent for most years thereafter. Since 1984-85 New South Wales has had the lowest GDP per head of the four or five States in the above-average GDP per head category.

The relative positions of Victoria, Queensland and South Australia did not change significantly over the entire period, the 1977-78 and 1994-95 differentials, though fluctuating on a year by year basis, being Victoria four per cent to five per cent, Queensland from plus nine to minus nine per cent, South Australia from minus 14 to minus 15 per cent.

As a result of the changes outlined above, the range of the differentials rose significantly over the period. From 1977-78 to 1988-89 the range was between 22 and 28 percentage points. Thereafter the range widened to exceed 30 percentage points, and reached 41 percentage points by 1994-95.

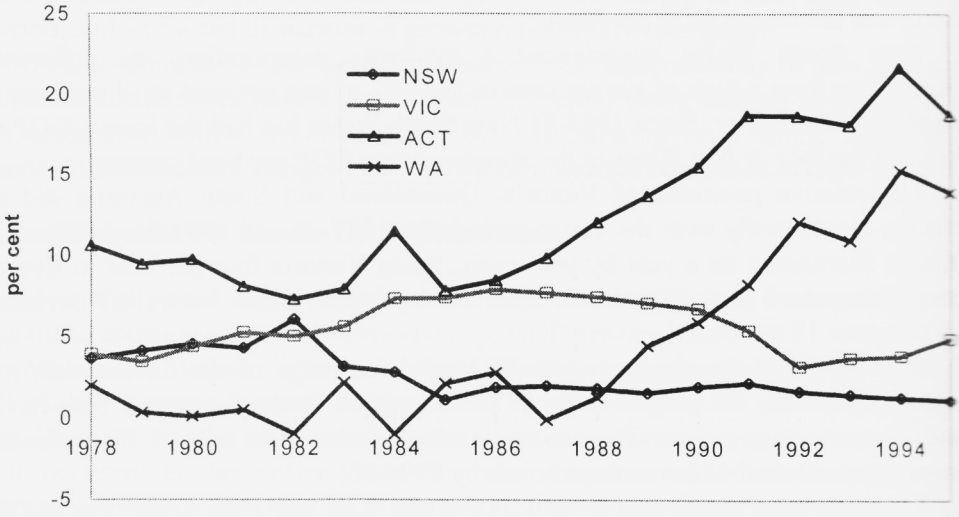
These changes are shown directly if the extent of interstate disparities in GDP per head is measured by reference to the simple mean of the GDP head of the 8 States instead of by reference to the weighted (Australian) mean. When the weighted CV is used the analysis is concerned not only with the difference between the State GDP per head and the Australian GDP per head, but also with the fact that that difference applies to all of the persons in that State. With the unweighed CV the emphasis is on only one person in each State, the "average" or "representative" person.

Changes in the extent of interstate disparities in GDP per head using the unweighted CV as the measure are shown in Figure 3. The respective values of the CV for each year are:

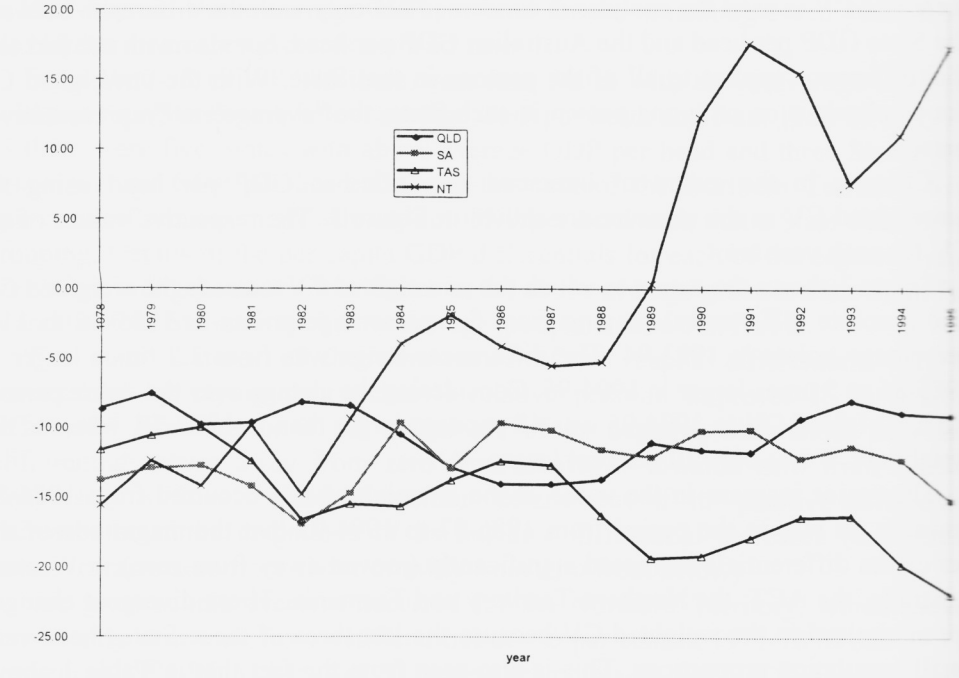
Figure 3 shows the extent to which the unweighted CV exceeds the weighted CV (the absolute differences) ranging from 5.3 percentage points in 1985-86 to 11.3 percentage points in 1993-94. The differences range was from 2.7 times larger in 1985-86 to 5 times larger in 1994-95. Considering the change over the entire period, the unweighted CV in 1994-95 was 48 per cent larger than in 1977-78, whereas the weighted CV was only 20 per cent larger.

The major increase in the value of the unweighted CV occurred from 1986-87 onwards. In was in the period from 1986-87 to 1994-95 that the magnitude of the per capita differentials increased significantly (moved away from zero) in Western Australia, the ACT, the Northern Territory and Tasmania. These divergent changes are minimised in the weighted CV because the last three of these States have very small population proportions. This is also seen from the fact that in Table 1 above the only one of the four States just listed to be listed in sub-periods four and five is Western Australia.

**Figure 2.** Per Capita GDP Differentials for each State 1977-78 to 1994-95
Percent of Australian Mean GDP Per Head




**A**. States with Above Average GDP Per Head




**B.** States with Below-Average GDP Per Head and the Northern Territory (mixed)

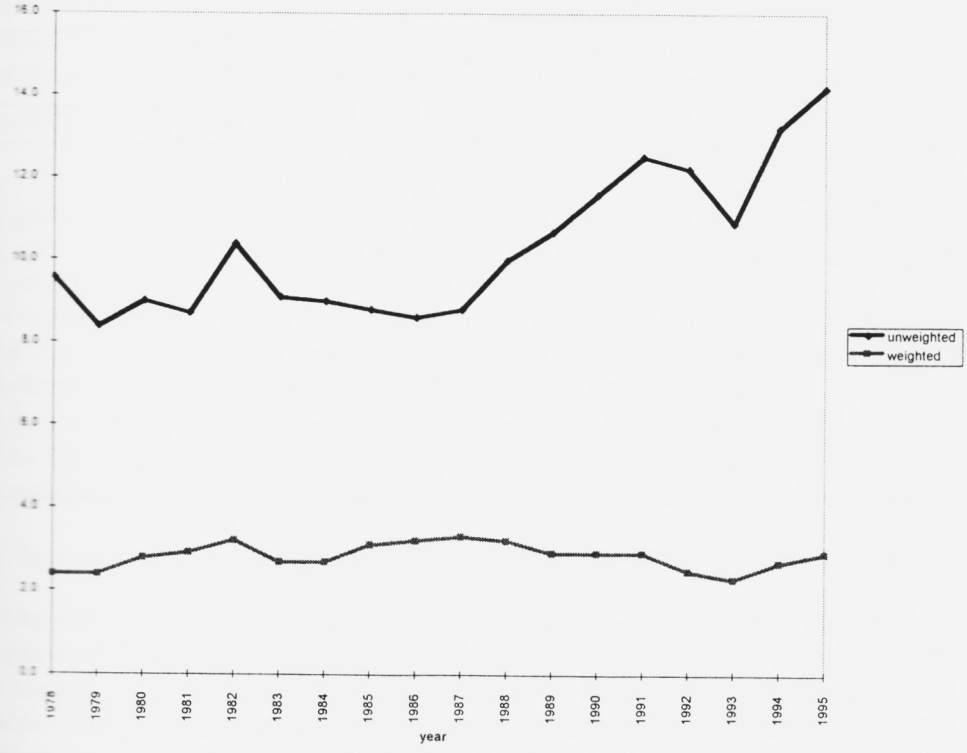



**Figure 3.** Interstate Disparities in GDP Per Head, Unweighted and Weighted CV 1977-78 to 1994-95

Thus an obvious question to be answered from Figure 3 is "Why has the extent of interstate disparities in GDP per head as measured by the unweighted CV diverged since 1986-87, when the extent of interstate disparities in GDP per head as measured by the weighted CV has not changed greatly?" The respective changes were: unweighted CV 8.8 per cent to 14.2 per cent (a divergent change of 61 per cent); weighted CV 3.3 per cent (a convergent change of 12 per cent). Although this question cannot be answered here, it is evident from Table 1 that the convergent change in the weighted CV was due to convergent changes in Queensland and Victoria offsetting divergent changes in South Australia and Western Australia.

In contrast the divergent change in the unweighted CV was due to similar changes in Western Australia, the ACT, the Northern Territory, and Tasmania, where the relatively large changes in the per capita differentials of the last three States did not contribute very much to the weighted CV changes because of their small population proportions.

**Table 2.** Population Growth Disparities

| State | Average Population Growth Rate | Population Proportion | |
|---|---|---|---|
| | % p.a. | 1977-78 | 1994-95 |
| Group 1 | | | |
| Northern Territory | 2.83 | 0.8 | 1.0 |
| Queensland | 2.43 | 15.1 | 18.0 |
| Western Australia | 2.04 | 8.5 | 9.6 |
| ACT | 1.99 | 1.5 | 1.7 |
| Group 2 | | | |
| New South Wales | 1.12 | 35.2 | 33.9 |
| Victoria | 0.90 | 27.0 | 25.0 |
| South Australia | 0.77 | 9.1 | 8.2 |
| Tasmania | 0.73 | 2.9 | 2.6 |
| Australia | 1.35 | | |

### 3.3 Interstate Disparities in Population Growth Rates

Interstate disparities in population growth rates are one part of the growth changes that affect the relative sizes of the per capita differentials. In the weighted CV approach they also affect the population proportions. The other part of the growth changes that affect the relative sizes of the per capita differentials is interstate disparities in GDP growth rates. With regard to population growth rates the eight States may be divided into two groups of four States each.

Group 1 contains Queensland, Western Australia, the Northern Territory and the ACT, States where annual population growth rates have been consistently above the mean rate for Australia. Thus these States have had rising proportions of Australia's population.

Group 2 contains New South Wales, Victoria, South Australia and Tasmania, four States where annual population growth rates have been consistently below the mean rate for Australia. Thus this group of States have had falling proportions of Australia's population.

Over the period 1977-78 to 1994-95, the population growth disparities are listed below.

There were consistent shifts of population (interstate redistribution) among the eight States over this period. A population shift occurs when the population proportion in a State changes over time, because its population growth rate is different from the mean rate for all States. An inward shift (above average growth) for a State means a rise in its population proportion, so its population in the final year is larger than it would have been if its population proportion had remained the same (average growth). Conversely, an outward shift (below average growth) for a State means a fall in its population proportion, so its population in the final year is smaller than it would have been if its population proportion had remained the same. The absolute shift for a State is measured by the difference between its actual population in the final year and what its population would have been if its

proportion had remained the same, and the relative shift is the percentage relation between the absolute shift and the actual population in the final year.

From 1977-78 to 1994-95 the absolute and relative population shifts were -

(a) inward shifts: Queensland +533,000 (+20 per cent), Western Australia +187,000 (+12 per cent), Northern Territory +38,000 (+28 per cent), ACT +31,000 (+11 per cent);

(b) outward shifts: New South Wales -235,000 (-4 per cent), Victoria -351,000 (-7 per cent), South Australia -152,000 (-9 per cent), Tasmania -52,000 (-10 per cent).

For Australia as a whole there was a population redistribution of 790,000 people from the second group of four States into the first group of four States. This constituted a 4.4 per cent shift of Australia's 1994-95 population - i.e., the proportion of Australia's population in the first four States rose by 4.4 percentage points (from 25.9 per cent to 30.3 per cent), and the proportion fell by 4.4 percentage points in the other 4 States (from 74.1 per cent to 69.7.

### 3.4 Interstate Disparities in GDP Growth Rates

The second aspect of growth changes to be considered is interstate disparities in growth rates of GDP, which, given the limitations of length, will be restricted to examining growth over the entire period from 1977-78 to 1994-95. Details are given in Table 3, the States being listed in descending order of growth rates.

The order of the States is almost the same as the order for population growth rates shown in Section 3. The differences relate to Queensland, which had the second highest population growth rate but the fourth highest GDP growth rate, and to the corresponding rise of one place for Western Australia and the ACT. Also the four States which had above-average and below-average population growth rates had, respectively, above-average and below-average GDP growth rates.

There were shifts of GDP among the States over this period in the same direction as the population shifts. Measures of the absolute shift of GDP are not meaningful because the amount depends on the year chosen as the base year for prices, hence only the relative shift is shown. The relative inward shifts were: Queensland (19 per cent), Western Australia (25 per cent), the Northern Territory (78 per cent), ACT (19 per cent). The relative outward shifts were: New South Wales (-6 per cent), Victoria (-7 per cent), South Australia (-11 per cent), Tasmania (-21 per cent).

For Australia as a whole this redistribution or shift amounted to 5.6 per cent of its 1994-95 GDP. This means that the proportion of Australia's GDP produced in the first four States rose by 5.6 percentage points (from 24.8 per cent to 30.4 per cent), and the proportion produced in the other four States fell by 4.4 percentage points (from 75.2 per cent to 69.6 per cent).

**Table 3.** State GDP Growth Rates

| State | Average GDP Growth Rate | GDP Proportion % | |
|---|---|---|---|
| | % p.a. | 1977-78 | 1994-95 |
| Group 1 | | | |
| Northern Territory | 6.69 | 0.6 | 1.1 |
| Western Australia | 4.50 | 8.7 | 10.9 |
| ACT | 4.21 | 1.7 | 2.0 |
| Queensland | 4.20 | 13.8 | 16.4 |
| Group 2 | | | |
| New South Wales | 2.75 | 36.6 | 34.3 |
| Victoria | 2.73 | 28.1 | 26.2 |
| South Australia | 2.44 | 7.8 | 7.0 |
| Tasmania | 1.75 | 2.6 | 2.1 |
| Australia | 3.13 | | |

One further point should be made about GDP growth rates. Whereas there were four States which tended to have above-average population growth rates every year, and four States which tended to have below-average population growth rates every year, no State had an above-average or a below-average GDP growth rate every year. Instead each State had a mixture of years where GDP growth was above average and years when it was below average. For example, the Northern Territory, which had the highest GDP growth rate, had above average growth in 15 of the 17 years and below average growth in only two years. Tasmania, which had the lowest GDP growth rate, had below average growth in ten of the 17 years and above average growth in seven years. The other six States fall within these two extremes.

### 3.5 Interstate Disparities in Growth Rates of GDP Per Head

The average growth rate of GDP per head in each State depends on the relationship between its population growth rate and its GDP growth rate. Growth rates of GDP were larger than population growth rates, so GDP per head also grew, although at a lower rate than GDP because the population also grew. However, there is no unique relation between these three rates of growth, except that higher population growth rates are associated with higher GDP growth rates, but not in a consistent way. That is, the ratio of the GDP growth rate to the population growth rate is not the same in every State. Details are shown in Table 4, the States now being listed in descending order of average growth rates of GDP per head for the period 1977-78 to 1994-95. The main features of these data are summarised below.

The eight States again fall into two groups of four with regard to above-average and below-average growth rates of GDP per head, but there are two differences as compared with GDP and population growth rates. First, Queensland has below average growth of GDP per head, whereas it had above average growth of the other two variables. Second, Victoria has above average growth of GDP per head, whereas it had below average growth of the other two variables.

When the ratios between GDP growth and population growth are considered, it is apparent that they are not the same in all States. The ratio is relatively higher in Victoria and South Australia, but the most striking difference is for Queensland. This State not only has the lowest ratio but it is the only State where the ratio is less than 2.0. It follows from these two conclusions that to "explain" some of the features of these changes in interstate disparities will require an "explanation" of why the value of the GDP to population growth ratio has varied so much in Queensland, South Australia and Victoria from the value in the other States. While no attempt is made to answer this question in this paper, however, it could be the subject of further research.

## 4. A COMPARISON OF THE CONCLUSIONS DERIVED FROM THE TWO APPROACHES

The first approach used in this paper examines the time series of changes in the extent of interstate disparities in Australia over the period 1977-78 to 1994-95 using as the measure the weighted CV derived from the differences between each State's GDP per head and the Australian GDP per head, weighted by the population proportion of each State. In the second approach the emphasis is more on interstate disparities in population, GDP, and GDP per head growth rates, and on the extent to which GDP per head in each State differs from the Australian mean GDP per head. In the second approach involved of the unweighted CV. The conclusions which emerge from these two approaches are summarised below.

**Table 4.** State Growth Rates of GDP and Population

| State | Growth Rate GDP Per Head % p.a. | Growth Rate GDP % p.a. | Growth Rate Population % p.a. | Ratio GDP to Population |
|---|---|---|---|---|
| Group 1 | | | | |
| Northern Territory | 3.76 | 6.69 | 2.83 | 2.4 |
| Western Australia | 2.41 | 4.50 | 2.04 | 2.2 |
| ACT | 2.18 | 4.21 | 1.99 | 2.1 |
| Victoria | 1.81 | 2.73 | 0.90 | 3.0 |
| Group 2 | | | | |
| Queensland | 1.72 | 4.20 | 2.43 | 1.7 |
| South Australia | 1.66 | 2.44 | 0.77 | 3.2 |
| New South Wales | 1.61 | 2.75 | 1.12 | 2.5 |
| Tasmania | 1.01 | 1.75 | 0.73 | 2.4 |
| Australia | 1.76 | 3.13 | 1.35 | 2.3 |

### 4.1. Conclusions from the Weighted CV Approach

There was no consistent trend of an increase or decrease in the value of the CV over time, rather the values showed periodic or cyclical fluctuations, with three sub-periods when the extent of disparities rose and two sub-periods when they fell. Overall, the value of the CV rose from 2.4 per cent to 2.9 per cent, a rise of 20 per cent. On the basis of this evidence it may be concluded that the extent of interstate disparities in GDP per head, while fluctuating over the period, did not show any significant upward or downward trend. With the longer term view it may therefore be concluded that the extent of these disparities did not change very much over this 17 year period. The analysis of the extent of shifts or redistribution of population and GDP illustrate why this change was relatively small, because over the entire period there was only a redistribution of 4.4 per cent of the population and 5.6 per cent of GDP, and much smaller redistributions in the sub-periods. Moreover, these redistributions favoured the less populous regions of the Northern Territory and the ACT, as well as the more populous States of Western Australia and Queensland. Thus, the extent of the shifts out of the two most populous States, New South Wales and Victoria, was not sufficient enough to bring about major redistributions of population and GDP throughout the nation. It is important to understand that, in the final analysis, this is what changes in the weighted CV measure. It should be noted that in 1994-95 New South Wales and Victoria combined still had 59 per cent of Australia's population and produced 61 per cent of Australia's GDP. In 1977-88 the proportions were respectively 62 per cent and 65 per cent.

A method has been proposed by which the contributions of each State to the annual changes in the values of the weighted CV can be calculated. These changes are measured in terms of the percentage points contribution to the change in the CV (also measured in percentage points). When these calculations have been made, it is evident that changes in Tasmania, the Northern Territory and the ACT "do not matter very much", because these States always have a negligible impact on, or contribution to, the annual value of a CV and changes in that value from one year to another. This is due to their very small population proportions. The contributions to change of the other five States vary with the sub-period being considered. However, if the entire period is considered, only three States have "significant" contributions (defined as 0.2 percentage points or more) to the rise in the CV from 2.7 per cent to 2.9 per cent. Queensland (+0.2 percentage points) and Western Australia (+0.6 percentage points) both made divergent contributions to the increase in the value of the CV, and New South Wales (-0.4 percentage points) made a convergent contribution to a decrease in the CV. In other words these three State together contributed to a net increase in the CV of 0.4 percentage points, whereas the total increase was 0.5 percentage points.

It may therefore be concluded not only that the change over the entire period in the extent of interstate disparities in GDP per head was not very large, but also that nearly all of that change was the outcome of what occurred in three of the eight States. It may also be concluded that overall there were relative small changes in the

interstate distribution of population and economic activity throughout Australia over this period. This latter conclusion is based on the fact that the weighted CV reflects the extent to which total population and total GDP have been redistributed among the 8 States and Territories as a group, rather than the extent of the relative impact of these redistributions on the individual States.

### 4.2 Conclusions from the Disaggregative Approach

However, a different picture emerges when a disaggregative approach is taken for the analysis, concentrating on four variables: per capita GDP differentials, GDP growth rates, population growth rates, and GDP per head growth rates in the individual States. The main conclusions are summarised below.

With respect to changes in the levels of the State per capita GDP differentials, measured in terms of the percentage difference between a State's GDP per head and the Australian GDP per head, it is noted that these differentials increased significantly over the period, the range averaging about 24 percentage points until the end of the 1980s, but rising in the 1990s and reaching over 40 percentage points at the end of the period.

The major change in this regard occurred in the Northern Territory, where the differential moved from -16 per cent in 1977-78 to +17 per cent in 1994-95, a change which meant that this State moved from having the lowest GDP per head to having the second highest.

In all years the ACT had the largest GDP per head, and its differential rose over the period from +11 per cent to +19 per cent.There was also a major improvement in Western Australia, where the differential rose from +2 per cent to +14 per cent.The major deterioration occurred in Tasmania, where the magnitude of the differential increased from -12 per cent to -22 per cent.

In the other four States the changes from 1977-78 to 1994-95 in the differentials were much smaller. In New South Wales the change was from four per cent to one per cent; in Victoria from four per cent to five per cent; in Queensland from plus nine to minus nine per cent, and in South Australia from minus 14 per cent to minus 15 per cent.

Thus when changes in per capita differentials are considered, it is seen that the three States that "did not matter very much" when the changes in the weighted CV are considered were three of the four States which had the largest changes in these differentials. In this sense what happened in the Northern Territory, the ACT and Tasmania "did matter" to those States. The distinction is emphasised by considering the values of the weighted and unweighted CV. In 1977-78 the respective values were 2.4 per cent and 9.6 per cent, and in 1994-95 they were 2.9 per cent and 14.2 per cent. Thus whereas the weighted CV increased by 20 per cent over this period, the value of the unweighted CV (which considers only the per capita differentials) rose by 48 per cent.

When differences in population growth rates are considered, it is seen that four States (Queensland, Western Australia, the ACT, the Northern Territory) had above-average growth rates and rising proportions of Australia's population , and

four States (New South Wales, Victoria, South Australia, Tasmania) had below-average growth rates and falling proportions of Australia's population.

Overall there was a redistribution or shift of 4.4 per cent Australia's population over this period (790,000 people). In other words the proportion of Australia's population living in the first four States rose by 4.4 percentage points (from 25.9 per cent to 30.3 per cent) and the proportion living in the second four States fell by 4.4 percentage points (from 72.1 per cent to 69.7 per cent).

When differences in GDP growth rates are considered, it is seen that the four States which had above-average population growth rates also had above-average GDP growth rates, so their proportions of Australia's population and GDP both rose. In turn the other four States had below-average GDP growth rates and so their proportions of Australia's population and GDP both fell. Overall, there was a redistribution or shift of 5.6 per cent of Australia's GDP over this period. In other words the proportion of Australia's GDP produced in the first four States rose by 5.6 percentage points (from 24.8 per cent to 30.4 per cent) and the proportion produced in the second four States fell by 5.6 percentage points (from 75.2 per cent to 69.6 per cent).

When the combined outcomes of population and GDP growth are considered in terms of the growth of GDP per head, we note that in each group only three of the four States either had above average or below average growth of GDP per head respectively. The two exceptions were Queensland, which was in the above average population and GDP growth group but in the below average GDP per head growth group, and Victoria, which was in the below average population and GDP growth group but in the above average GDP per head growth group.

However, while Queensland's GDP per head growth rate differed considerably from the GDP per head growth rates of Western Australia, the ACT and the Northern Territory, (States, which like Queensland, had above average population and GDP growth rates), Victoria's GDP per head growth rate did not differ very much from the GDP per head growth rates in New South Wales and South Australia (States, which like Victoria, had below average population and GDP growth rates). So this phenomenon was more significant in the case of Queensland.

## 5. CONCLUSIONS

When the two sets of conclusions listed above are compared, it is evident that the broad conclusions from the weighted CV approach, namely that the overall changes were relatively small, do not reveal the extent to which the situation changed in the individual States. Thus, over the period being investigated, there were significant changes in individual States resulting from the interstate redistribution of population and GDP, both of which favoured four States (Queensland, Western Australia, the ACT, and the Northern Territory). Overall these four States increased their combined share of Australia's population by 4.4 percentage points and their combined share of GDP by 5.6 percentage points. The significance of these redistributions in the each State is not apparent from the weighted CV analysis because they represent relatively small redistributions of

Australia's total population and GDP. However, the relative shifts in the individual States were sometimes quite large. For example, in the Northern Territory the relative inward shifts were: population 28 per cent and GDP 78 per cent. Thus, exceptionally large changes in the Northern Territory had a negligible impact on the changes in the values of the weighted CV because the Northern Territory only had about one per cent of Australia's population.

There were also significant changes over the period in the extent to which GDP per head in the individual States exceeded or fell short of the Australian mean GDP per head, which again is not apparent from the weighted CV analysis because in that approach per capita differentials are weighted by population proportions. These changes led to changes in the rankings of the eight States with regard to the levels of GDP per head, although this was due mainly to the high growth rate of the GDP per head in the Northern Territory which, as a consequence, moved from having the lowest GDP per head in 1977-78 to having the second highest GDP per head in 1994-95.

In conclusion therefore it can be said that, at least in the case of this study, the evidence from the weighted CV approach has not been as informative as the evidence from the disaggregative approach, which also utilises the unweighted CV. In other words there were, over this period, significant differences in the extent of changes in the levels of population, GDP and GDP per head of the individual States which are important for understanding what happened in Australia over this period with respect to interstate disparities in the variables included in this study. By merely concentrating on the aggregative approach these changes in the individual States have not, in this study, become apparent. While from an Australia-wide viewpoint the interstate redistribution of population and GDP may not have been very large, so that the changes have not been very significant on a national basis, from the viewpoint of the individual States some of these redistributions have very large, and have been highly significant for those individual States.

The conclusion from this analysis is probably best illustrated by a truism, namely "that the purpose of the analysis determines the most appropriate method of analysis to be applied." The method of analysis should not be predominant or used without reference to the purpose. Thus, in this study, two aspects of the analysis of changes have been distinguished in the extent of interstate disparities in GDP per head, one aspect concentrating on the overall impact of these changes on Australia as a whole, and the second aspect concentrating on the impact on the individual States. In Australia the first approach is best served by the weighted CV method, and the second approach (including the unweighted CV) by an analysis of each of the four major variables which are related to these changes in the individual States.

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## Data Appendix

| Interstate Disparities in Real Per Capita GDP | |
|---|---|
| Year Ended | CV |
| 1978 | 2.4 |
| 1979 | 2.4 |
| 1980 | 2.8 |
| 1981 | 2.9 |
| 1982 | 3.2 |
| 1983 | 2.6 |
| 1984 | 2.7 |
| 1985 | 3.1 |
| 1986 | 3.2 |
| 1987 | 3.3 |
| 1988 | 3.2 |
| 1989 | 2.9 |
| 1990 | 2.9 |
| 1991 | 2.8 |
| 1992 | 2.5 |
| 1993 | 2.3 |
| 1994 | 2.7 |
| 1995 | 2.9 |

| Interstate Disparities in Unweighted and Weighted Per Capita GDP | |
|---|---|
| Year Ended | CV |
| 1978 | 9.6 |
| 1979 | 8.4 |
| 1980 | 9.0 |
| 1981 | 8.7 |
| 1982 | 10.4 |
| 1983 | 9.1 |
| 1984 | 9.0 |
| 1985 | 8.8 |
| 1986 | 8.6 |
| 1987 | 8.8 |
| 1988 | 10.0 |
| 1989 | 10.7 |
| 1990 | 11.6 |
| 1991 | 12.5 |
| 1992 | 12.2 |
| 1993 | 13.2 |
| 1994 | 10.9 |
| 1995 | 13.2 |
| 1995 | 14.2 |