CHANGES IN INCOME INEQUALITY: AUSTRALIA, 1968–69 TO 1973–74

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The period 1968–69 to 1973–74 saw a redistribution of incomes in Australia. This is evidenced first by declining differentials between dissimilar persons and secondly by changes in two measures of income inequality, the Gini and Theil coefficients.

The inequality coefficients are decomposed into components which distinguish between that part of total inequality due to income differences between dissimilar persons and that part due to inequality between similar persons. It is found that the reduction in inequality was due to the reduction in differentials between dissimilar persons and that inequality between similar persons probably did not change over the period.

INTRODUCTION

Surveys of income were carried out in 1969 and 1974 by the Australian Bureau of Statistics to provide information on pre-tax incomes in the two years July 1968 to June 1969 and July 1973 to June 1974. The information obtained permits a comparison of incomes and income distributions in these years. An analysis of the data for these two periods shows that the inequality of income distribution declined over the period under consideration.

The inequality statistics used are decomposed into two components, that due to income differences between persons with the same attributes, and that due to the differences in mean incomes between groups with different attributes. This decomposition first permits us to state that the three variables used to classify the population—sex, age and educational achievement—singly and jointly explain a large part of income inequality. Secondly we use the decomposition to identify the source of the decline in inequality and suggest that it was due to a reduction in differentials between persons with different attributes. Thirdly it is suggested that some differentials between persons with different attributes may be acceptable on grounds of either equity or efficiency, whereas differentials between persons with the same attributes may be regarded as less acceptable. This distinction is in turn related to the two components of the inequality coefficients to comment on the reduction in inequality which occurred in Australia.

THE MEASURES OF INEQUALITY USED AND THEIR INTERPRETATION

Two measures of inequality have been calculated and form the basis of the subsequent discussion. These measures are the Gini coefficient and Theil's

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coefficient. The properties and deficiencies of these, and other inequality coefficients, are well known[1] and will not be discussed here.

These coefficients have been used for this analysis primarily because it is possible to decompose them into components which distinguish between inequality arising from income differences within subgroups and inequality arising from income differences between subgroups. The Theil coefficient decomposes naturally into these two elements. The decomposition of the Gini coefficient is however less straightforward as it decomposes into three elements, one of which depends only upon the differences in subgroup mean incomes, one of which depends on the inequality within subgroups, and the third of which depends on overlaps between groups.

In each case the coefficients can be decomposed providing the population can be classified and split into distinct subgroups such that each member of the population is placed in one and only one subgroup. A population may of course be classified in many different ways. Where the classificatory variables do not bear any relation to incomes, i.e., mean incomes in subgroups are equal, the decomposed inequality coefficient would show that none of the total inequality arises from mean income differences but that it arises entirely from inequality within the groups (in the case of the Theil coefficient) and within group inequality plus the overlap component (in the case of the Gini coefficient). By contrast a hypothetically perfect classification system might be found in which all individuals in each subgroup had identical incomes and each subgroup had different incomes. In this situation there would be no within group inequality, nor would there be any overlapping of incomes. Consequently the decomposition would show that inequality was due entirely to differences in subgroup mean incomes.

More usually we would expect that if a system of classification for the population is used where the classificatory variables have some relation to incomes, part of the inequality in the total population can be seen as being due to mean differences and part as being due to inequality within the subgroups. If data on the population is available for different periods then it is possible to consider not only whether inequality in the population has changed but also the source of the change. In particular, a decrease in inequality within the population can be due either to decreases in inequality within the subgroups—i.e., between similar persons—or due to decreases in the differences between mean incomes of the subgroups—i.e., between dissimilar persons.

The approach can be seen to be an attempt to explain observed inequality in terms of two components, differentials which exist between persons with different attributes and a residual element. Essentially we are attempting to find a limited set of attributes which explain a large part of total inequality. The reasons for the size of the differentials are not examined here but any more comprehensive attempt to explain inequality would have to focus on the reasons for these differentials.

The decomposed inequality coefficients can also provide a basis for developing alternative, but not value-free, measures of the inequality of income dis-

[1]These are discussed in, e.g., Atkinson [1]. Detailed discussions of the Gini coefficients and its decomposition are given in Pyatt [17] and Paglin [14], while Theil ([19], ch. 4) provides a detailed discussion of the Theil coefficient and its decomposition.

tributions. Some income differences between individiuals may be regarded as acceptable on grounds of efficiency, e.g. those arising from differences in payment for skills, while some may be regarded as acceptable on grounds of equity, e.g. those arising from differences in effort devoted to income-earning activities. Such differences will be termed acceptable differences and the income distributions associated with them will be termed acceptable distributions. If all acceptable differences for either efficiency or equity are quantified then the inequality coefficient of the acceptable distribution can be calculated and will be greater than zero. If the existing differentials between sub-groups in a population are regarded as the only acceptable differences then that part of the inequality coefficient due to between-group mean income differences would be the acceptable inequality coefficient and the residual part of the inequality coefficient would then usefully be considered to be unacceptable inequality. The results presented below are used to illustrate this use of the decomposed coefficients.

For completeness we should note that the distinction between acceptable and unacceptable inequality in the paragraph above rested on the assumption that existing differentials were regarded as acceptable. If existing differentials are not regarded as acceptable then that part of total inequality due to observable mean income differences is not acceptable inequality as discussed here. It would then be necessary to specify an acceptable inequality coefficient based on acceptable differences. The divergence between this coefficient and the calculated inequality coefficient could then be regarded as the measure of unacceptable inequality.

Thus the decomposition of the inequality coefficients given here may be used in three ways. It may be used to explain and identify first the sources of inequality, and secondly changes in these sources over time. Thirdly it may be used as the basis for defining concepts of acceptable and unacceptable inequality. All of these uses are illustrated below using Australian data for the periods 1968–69 and 1973–74.

Methods of Calculation

The Theil coefficient of income inequality[2] is given mathematically by:

$$I = \sum_{i=1}^{N} y_i \log N y_i \tag{1}$$

where y_i is the income share of the ith individual, and there are N such individuals. The coefficient has extreme values of zero (identical incomes) and $\log N$ (one individual has all the income). If the individuals are grouped into G mutually exclusive sets S_g, with N_g individuals and income share y_g then it can be shown that:

$$I = \sum_{g=1}^{G} y_g \log y_g(N_g/N) + \sum_{g=1}^{G} y_g \left[\sum_{i \in S_g} (y_i/y_g) \log N_g(y_i/y_g) \right] \tag{2}$$

These two terms are readily interpreted as a between-group and a within-group component. The first term on the right hand side is what the inequality measure

[2]A detailed discussion of this coefficient is given in Theil ([19], ch. 4).

would be if all individuals in a particular group had identical incomes. Its calculation requires knowledge only of mean incomes and numbers in subgroups. The second term is the sum of within-group inequality coefficients—the term in square brackets—weighted by group income shares. This is referred to subsequently as the adjusted Theil coefficient.

The Gini coefficient can be calculated and interpreted in a number of ways. Recently Paglin [14] and Pyatt [17] have independently provided closely related decompositions of this coefficient. Pyatt ([17] pp. 244–5), shows that "the Gini coefficient is the average gain to be expected, if each individual has the choice of being himself or some other member of the population drawn at random, expressed as a proportion of average level of income."

If the population is divided into G mutually exclusive and exhaustive groups the Gini coefficient[3] can be calculated as:

$$\mathrm{LG} = \sum_{i=1}^{G} \sum_{j=1}^{G} (1/\bar{Y}) p_i E_{ij} p_j \tag{3}$$

with $\bar{Y}$ being the population mean income, p_i the proportion of the population in group i, and E_{ij} the average expected gain for a member of group i when compared with a member of group j.

This can be decomposed into:

$$\mathrm{LG} = \sum_i \sum_j \pi_i E'_{ij} p_j + \sum_i \pi_i E^2_i p_i + \sum_i \sum_{j \neq i} \pi_i E^3_{ij} p_j \tag{4}$$

where π_i is the proportion of population income accruing to group i, and p_j the proportion of the population in group j. The term E'_{ij} is the difference, if positive, in mean incomes of groups j and i expressed as a proportion of the mean income of group i. Hence the first part of (4) above is that part of the Gini coefficient due to differences in group mean incomes and its calculation only requires knowledge of subgroup numbers and mean incomes. The term E^2_i is the Gini coefficient of inequality within group i. Thus the second part of (4) above is a weighted sum of within group inequality coefficients. Finally the term E^3_{ij} is defined as the minimum of the values of E_{ij} and E_{ji}, and the third part of (4) above may be interpreted as that part of the Gini coefficient due to the overlapping of incomes in groups.

Paglin [14] argues[4] that the conventional Gini coefficient which measures departures from an equiproportional income distribution is misleading. As an alternative he suggests that inequality be measured from an hypothetical distribution in which all individuals in specific subgroups receive identical incomes. It is readily shown that such a coefficient is given by the sum of the second and third terms in equation (4) above.[5] Paglin's discussion is confined to age-income profiles, and he calculates inequality coefficients for the departure of observed income distributions from those in which all individuals in specific age groups

[3]The reader is referred to Pyatt [17] for a detailed derivation of this decomposition, and for its interpretation.

[4]The initial paper [14] by Paglin aroused much comment; see [5], [8], [9], [10] and [13], together with Paglin's reply [15].

[5]The relation between the Pyatt decomposition and Paglin's procedure is shown in detail in the Appendix to this paper.

receive identical incomes, which are termed Paglin–Gini coefficients. In this paper variables other than age are used to classify the population. Inequality measures, equivalent to those used by Paglin, are obtained for the departure of the actual income distribution from hypothetical distributions in which all individuals in subgroups are assumed to receive identical incomes. These are the adjusted Gini coefficients which are presented below.[6]

Sample population surveys were undertaken by the Australian Bureau of Statistics in 1969 and 1974. As a part of these surveys information on the incomes of individuals and families was obtained. Estimates of the incomes of all Australian families and individuals were subsequently published. The results presented in this paper are derived from data in two of these publications, [2] and [3]. A detailed discussion of the data is contained in those documents.

The available data is generally in the form of closed income ranges with a terminal open ended group. To calculate the Theil and Gini coefficients, I and LG in the equations above, the following procedure has been adopted. Mean incomes have been taken as the midpoints of closed income ranges. The mean income in the terminal group has been estimated by fitting a Pareto tail to the top 20 percent of the population.[7] The estimates given here are subject to some error since first there are a finite number of income ranges (but at least 33 such ranges) and the income distribution within each income range is ignored, and secondly the mean income for the terminal group is an estimate (but the group contains less than 0.3 percent of the population). It is believed that the error is not large, and further since this paper is primarily concerned with values and changes over time in the values of the adjusted coefficients it is suggested that the possible error in the calculated Gini and Theil coefficients is not of major importance.

The adjusted Theil and Gini coefficients are obtained by calculating the first term on the right hand side of equations (2) and (4) and then subtracting these from I and LG respectively. These terms are calculated using data on the numbers and mean incomes in subgroups and do not require knowledge of the income distributions in the subgroups. It should be noted that the classifications used for age groups in particular are very broad. A finer classification of age groups would result in the mean difference terms being larger and the resulting adjusted Gini and Theil coefficients being smaller.

In some instances mean incomes are not available in the sources for all of the subgroups used in the three way classifications below. These are subgroups with very small numbers (less than 8,000 in 1968/69 and less than 4,000 in 1973/74) and the values for mean incomes have been estimated.[8]

[6]It should be noted that Paglin ([15], pp. 529–30) would apparently have doubts about the value of this approach using variables other than age.

[7]A detailed discussion of the accuracy of various methods of estimating Gini Coefficients is contained in Gastwirth [6]. Using income data from the United States, upper and lower bounds for the Gini coefficient are derived when mean incomes in all income ranges are known. It is then shown that the procedure used here—midpoint mean incomes in closed ranges and a Pareto tail—may give results which lie outside the bounds obtained earlier. The Australian data does not however specify mean incomes within income brackets—consequently we have been forced to adopt this relatively undesirable method of estimation. The fitting of a Pareto tail is described in the Appendix to Gastwirth [6].

[8] The author is willing to supply details of these estimates.

Table 1 shows the mean total income accruing to all income recipients classified by age and sex. The table brings out two features which will be of importance in the subsequent analysis. The first is the relationship between income and sex and age. In general males have higher incomes than females.

TABLE 1

ALL INCOME RECIPIENTS, MEAN TOTAL INCOME, AGE AND SEX, 1968–69 AND 1973–74 ($'000)

	Age								
Sex	15–19	20–24	25–29	35–44	45–54	55–59	60–64	65 & over	Total
				1968–69					
Male	1.1	2.7	3.8	4.3	4.2	3.9	3.4	2.0	3.4
Female	0.8	1.4	1.0	1.2	1.4	1.4	1.2	1.0	1.2
Persons	1.0	2.1	2.5	2.8	3.0	2.8	2.4	1.4	2.3
				1973–74					
Male	1.9	4.7	6.7	7.1	7.1	6.2	5.9	2.8	5.7
Female	1.5	2.6	2.1	2.4	2.5	2.4	1.9	1.6	2.2
Persons	1.7	3.7	4.4	4.8	5.1	4.5	4.0	2.1	4.0
				Increase (%)					
Male	74	73	76	68	68	60	74	41	68
Female	77	79	106	90	83	73	61	65	85
Persons	75	74	81	72	71	60	67	51	72

Sources: Australian Bureau of Statistics [2], Table 44, and [3], Table 13.

Income increases, and then decreases, with age. Secondly, we can note that income changes over the period have not been the same for all classes of persons. In particular female incomes have risen more rapidly than male incomes and younger persons have apparently had greater income increases than older persons.

The changes in incomes shown in Table 1 relate to total incomes—which accrue from a variety of different sources. Table 2 shows the changes in mean incomes accruing to persons who derive their incomes principally from different sources. There are a number of points to note from this table which will be of importance in the subsequent discussion. Firstly, the male/female income differential persists even when the population is divided into the separate categories shown. Secondly, it should be noted that of the 8.7 million income receivers approximately 60 percent derived their incomes principally from wages and salaries, while another 15 percent derived their incomes principally from other sources except government social service benefits. Thus these income sources cover approximately 75 percent of income receivers. The residual 25 percent of income receivers obtained their incomes principally from government social service benefits. It should also be noted that the mean incomes of these various groups are very different—in particular persons whose principal income sources

TABLE 2

MEAN TOTAL INCOMES BY SEX AND PRINCIPLE SOURCE OF INCOME, 1973–74, AND COMPARED TO 1968–69

	Principal Source of Income							
	Wages or Salary	Own Business Trade or Profession	Share in Partnership	Government Social Service Benefits	Superannuation or Annuity	Interest, Rent, Dividends, etc.	Other Income	Total
	Mean total incomes, 1973–74, ($'000)							
Male	6.1	7.9	6.5	1.4	4.3	4.1	4.1	5.7
Female	3.2	4.0	4.8	0.7	2.5	1.5	2.4	2.2
Persons	5.0	7.2	5.8	0.9	3.7	2.2	2.9	4.0
	Total number, 1973–74, ('000)							
Male	3,353	277	280	416	45	84	13	4,467
Female	1,968	59	204	1,748	23	226	37	4,266
Persons	5,322	336	484	2164	68	310	49	8,732
	Increase in incomes, 1968–69 to 1973–74, (%)							
Male	76	65	45	67	57	41	37	68
Female	89	93	55	85	51	33	34	85
Persons	76	67	48	85	59	41	44	72
	Increase in numbers, 1968–69 to 1973–74, (%)							
Male	8.7	9.1	3.6	40.7	−7.3	−3.2	54.3	9.4
Female	21.8	6.7	11.7	11.1	−28.0	−16.5	−16.3	13.0
Persons	13.2	8.7	6.8	15.8	−15.6	−13.0	−5.4	11.5

Sources: Australian Bureau of Statistics [2], Tables 41 and 43 and [3], Tables 10 and 12.

was wages and salaries had a mean income of approximately one and a quarter times the average of all income receivers, while persons who derived income principally from government social service benefits had a mean income of less than one quarter of that of all income receivers.

Over the period 1968–69 to 1973–74 there have been marked changes in relative mean incomes of the groups in the categories shown in Table 2, and also in the proportions of all income recipents in each category. There were above average increases in the mean incomes and number of persons who derived their income principally from wages and salaries or government social service benefits. By contrast, in all other groups there were less than average increases in both mean incomes and numbers in each category.

It is possible to examine these income differences and changes in relative incomes in greater detail for one major subgroup of the Australian population. Tables 3 and 4 show the salient features of income differences and changes over the five year period for one homogenous group of persons—full year, full time workers. In 1973–74 this group numbered 4.4 million—approximately half of the total number of income receivers. Table 3 brings out clearly the existence of a positive male/female income differential for all age/education groups, the existence of a positive relation between income and formal educational achievement for all sex/age groups and finally the existence of increasing then decreasing incomes with age for all sex/educational achievement groups.

TABLE 3

MEAN TOTAL INCOMES, 1973–74: FULL YEAR, FULL TIME WORKERS BY EDUCATIONAL ATTAINMENT, AGE AND SEX
($'000)

Sex and Educational Attainment	Age Group (Years)					
	15–24	25–34	35–44	45–55	55 and over	Total
Males						
Degree	6.8	10.9	13.2	14.6	14.0	12.1
Non-degree tertiary	5.9	8.7	10.3	9.9	9.9	9.5
Technician level	6.0	7.7	9.0	9.5	8.3	8.3
Trade level	5.8	6.8	6.9	6.8	6.1	6.6
Other	5.8	7.8	7.4	9.4	7.3	7.9
Matriculation, n.e.i.	5.0	7.7	8.5	9.5	7.8	7.4
Left school at						
17 or over	4.6	6.7	8.2	7.2	7.8	6.2
16	4.2	6.6	7.1	8.0	7.0	6.0
14 or 15	4.2	6.1	6.3	6.6	6.1	6.0
13 or under	4.9	5.6	5.8	6.0	5.8	5.8
Total:	4.7	7.0	7.5	7.5	6.7	6.8
Females						
Degree Non-degree tertiary	5.6	7.3	7.3	7.5	*	6.9
Technician level Trade level	3.9	5.9	5.8	*	*	5.1
Other	3.6	4.8	4.9	5.4	4.7	4.4
Matriculation, n.e.i.	4.2	5.2	5.2	4.5	*	4.5
Left school at						
17 or over	3.7	4.9	4.7	4.6	4.6	4.2
16	3.5	4.4	4.4	4.7	4.7	4.0
14 or 15	3.2	4.3	4.1	4.1	4.3	3.9
13 or under	*	3.9	3.9	4.0	3.7	3.9
Total:	3.6	5.0	4.7	4.7	4.8	4.4
Persons						
Degree	6.5	10.5	12.7	13.8	13.2	11.4
Non-degree tertiary	5.5	8.0	9.6	9.1	9.0	8.5
Technician level	4.8	7.3	8.4	8.7	7.3	7.4
Trade level	5.6	6.8	6.9	6.8	6.1	6.5
Other	4.0	6.4	6.4	8.0	6.6	6.2
Matriculation, n.e.i.	4.7	7.4	8.0	8.3	7.4	6.7
Left school at						
17 or over	4.3	6.4	7.1	6.6	6.9	5.7
16	3.9	5.9	6.2	7.1	6.5	5.4
14 or 15	3.8	5.7	5.8	5.9	5.8	5.4
13 or under	4.5	5.1	5.3	5.5	5.6	5.4
Total:	4.3	6.6	6.9	6.9	6.4	6.2

Source: Australian Bureau of Statistics, [3], Tables 24, 27 and 30.
Note: *denotes not available in source.

Table 4 shows the percentage changes in mean incomes over the period 1968–69 to 1973–74 for the groups identified in Table 3. Three features of this table stand out and are worthy of comment. First, it is apparent that the male/female differential has declined and that the percentage increases in female incomes have almost all been greater than the percentage increases in male incomes. Secondly, it appears that mean incomes increased by relatively greater amounts as we move down the educational achievement scale. Thirdly, we may note that in general income increases were relatively greater for the younger and the older age groups than for the age groups in the middle. In total these three observations can be summarized by saying that in general increases in mean income during the five year period have been inversely related to levels of income. The poor apparently have not become poorer—certainly when we confine our attention to full year full time workers.

The conclusion above cannot be stated with the same force for the total population, Tables 1 and 2. But the information given in those tables is certainly consistent with the conclusion. For all income receivers the relative gains of female and younger (but not older) income receivers can be seen from Table 1. From Table 2 it can be seen that persons who derived their income principally from government social service benefits were in receipt of very low mean incomes, and experienced the higher percentage increase in mean incomes.

These changes are partly due to government policies during the period and the state of the economy at the two points in time, particularly some increase in unemployment over the period. The proportion of the labour force receiving unemployment benefits increased from 0.31 percent to 0.55 percent between June 30th, 1969 and June 30th, 1974. This increase was most marked amongst young persons (under 25 years of age)—between the two dates they increased from 44 to 52 percent of the receivers of unemployment benefits. Since 1974 both unemployment and the proportion of young persons amongst the unemployed have increased substantially. Social security benefits increased very markedly during the period—the maximum weekly benefit to an unemployed adult with a dependent spouse was $14.25 in 1969 and in 1974 was $45.50. The conditions relating to the granting of age pensions were relaxed during the period—in 1969 55 percent of persons in the age groups (60 and over for females, 65 and over for males) eligible for age pensions received them; by 1974 this has increased to 73 percent. The weekly married rate of the age pension increased from $12.50 in 1969 to $22.75 in 1974.[9] While the increase in the number of unemployed persons woud tend to increase inequality receivers of social security benefits generally have low incomes and the large increases in the rates of benefits would have acted to reduce inequality.

A second set of factors which operated during the period and which almost certainly resulted in a reduction in inequality was the (partial) implementation of policies of equal pay for equal work, whether performed by males or females, and the adoption of anti-discrimination legislation. Although there had been some moves towards the equal pay for equal work objective prior to 1969 the main implementation of this policy occurred subsequent to 1969 and prior to 1974,

[9]This information is extracted from Australian Department of Social Security [4], Tables 1 and 7, and Appendix 1.

TABLE 4

INCREASE (%) IN MEAN INCOMES, 1968–69 TO 1973–74: FULL YEAR, FULL TIME WORKERS BY EDUCATIONAL ATTAINMENT, AGE AND SEX

Sex and Educational Attainment	Age Groups (Years)					
	15–24	25–34	35–44	45–54	55 and over	Total
Males						
Degree	*	57	49	42	57	48
Non-degree tertiary	73	67	57	56	39	60
Technician level	87	72	66	69	63	67
Trade level	76	68	62	66	70	68
Other†	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Matriculation	77	73	73	86	37	70
Left school at						
17 or over	74	69	81	65	56	66
16	82	75	63	72	67	72
14 or 15	83	78	66	75	69	75
13 or under	83	82	74	69	85	78
Total:	83	77	70	72	66	74
Females						
Degree Non-degree tertiary	103	110	81	95	*	106
Technician level Trade level	89	123	69	*	*	87
Other†	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Matriculation	112	*	*	*	*	78
Left school at						
17 or over	88	110	80	60	*	83
16	99	79	54	89	87	93
14 or 15	103	82	84	81	99	96
13 or under	*	116	72	88	97	94
Total:	104	102	84	88	84	99
Persons						
Degree	83	58	49	43	62	49
Non-degree tertiary	86	73	57	55	43	68
Technician level	86	82	70	79	47	71
Trade level	76	69	60	65	70	67
Other†	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Matriculation	84	77	76	81	37	72
Left school at						
17 or over	80	76	78	67	52	70
16	92	72	54	80	72	78
14 or 15	92	77	68	72	70	79
13 or under	97	84	73	67	89	80
Total:	90	79	70	72	67	77

Sources: Australian Bureau of Statistics, [2], Tables 56, 59 and 63, and [3], Tables 24, 27 and 30.
Note: *denotes not available from sources.
†not specified separately in 1968–69.

with its effectively being fully implemented by 1975.[10] Further, in June 1973, Australia ratified the International Labour Organisation Convention No. 111, which proscribes employment discrimination on various grounds, and this was followed by the establishment of a National Committee on Discrimination in Employment and Occupation and six State Employment Discrimination Committees.[11]

Finally it should be noted that there is some evidence of a reduction in wage differentials over the period, both between juniors and adults and between skilled and unskilled workers.[12] This would be expected to reduce income differentials for wage earners and hence reduce income inequality.

Statistical Results

(a) *All Income Receivers*

Estimates of the inequality of income[13] amongst all income receivers have been made and are shown in Table 5. The Gini coefficient shows a small decline over the period. The decrease in the Theil coefficient is more marked. Using these two coefficients of inequality it is fair to suggest that there has been a decline in income inequality for this group over the five year period 1968–69 to 1973–74.

Income receivers can be classified by sex, age and source of income. Both inequality coefficients can be decomposed to eliminate the inequality-creating effects of differences in mean incomes between the subgroups when classified by age, sex, and income source, singly and jointly. The adjusted Gini and Theil coefficients are also shown in Table 5. The adjusted Gini coefficients do not differ very much in the two periods, particularly when the classification uses two or more variables. The adjusted Theil coefficients show some decline over the period but the decline is not as large as that of the unadjusted coefficient. These results will be discussed after the presentation of the statistical results for full year, full time workers.

(b) *Full Year, Full Time Workers*

Detailed information is available on the incomes of full year, full time workers and it is possible to classify this group by age, sex and educational qualification. This group is relatively (to all income receivers) homogeneous but not entirely so. In 1973–74 these persons represented 50 percent of all income receivers; in 1968–69 they represented 53 percent of all income receivers. Information on total and earned incomes for this group is available. The subsequent analysis uses the less desirable total income figures since the detailed classification of this group by age, sex and educational qualification is available

[10] An informative discussion of the progressive implementation of this policy, and an analysis of its impact, is given in Gregory and Duncan [7].

[11] A discussion of the working of these committees is contained in National Committee on Discrimination in Employment and Occupation [12].

[12] The evidence on this point is discussed, *inter alia*, in Stricker and Sheehan [18], particularly pp. 23–25.

[13] A detailed discussion of the sources of household income inequality in Australia is given by Podder [16]. An evaluation of the sources of individual income inequality in Australia in 1968–69 is given in [11].

TABLE 5

INEQUALITY OF INCOME DISTRIBUTION. TOTAL INCOME, ALL INCOME RECEIVERS

Coefficient	Period	Unadjusted coefficients	Adjusted Coefficients, classified by:						
			Age	Sex	Principal Source of Income	Age and Sex	Age and Principal Source of Income	Sex and Principal Source of Income	Age, Sex and Principal Source of Income
Gini	1968–69	0.487	0.342	0.248	0.241	0.175	0.170	0.165	0.118
	1973–74	0.474	0.327	0.251	0.237	0.175	0.170	0.162	0.114
Theil	1968–69	0.427	0.386	0.307	0.275	0.265	0.229	0.230	0.190
	1973–74	0.398	0.353	0.294	0.249	0.248	0.205	0.210	0.168

Sources: Original data obtained from Australian Bureau of Statistics, [2], Tables 34, 41 and 43, [3], Tables 1, 10 and 12.

TABLE 6

INEQUALITY OF INCOME DISTRIBUTION. TOTAL INCOME, FULL YEAR, FULL TIME WORKERS

Coefficient	Period	Unadjusted coefficients	Adjusted coefficients, classified by:						
			Age	Sex	Education	Age and Sex	Age and Education	Sex and Education	Age, Sex and Education
Gini	1968–69	0.308	0.205	0.219	0.201	0.157	0.140	0.149	0.113
	1973–74	0.276	0.198	0.204	0.180	0.153	0.137	0.139	0.111
Theil	1968–69	0.180	0.152	0.156	0.150	0.136	0.128	0.130	0.114
	1973–74	0.141	0.123	0.126	0.120	0.112	0.106	0.105	0.095

Sources: Original data obtained from Australian Bureau of Statistics [2], Tables 55, 59, 60 and 61 and [3], Tables 23, 27, 28 and 29.

only for this measure of income. In practice the similarity of earned and total incomes is such as to suggest that the discussion below applies to earned incomes.

The Gini and Theil coefficients and the adjusted coefficients for this group in the two years are shown in Table 6. The unadjusted coefficients suggest that there was a fairly marked reduction in inequality over the period; the Gini coefficient declined from 0.31 to 0.28, the Theil coefficient from 0.18 to 0.14.

The adjusted coefficients present a different pattern. Initially we may look at the adjusted Gini and Theil coefficients for the single variable classification (age, sex and education). In each case the 1973–74 values are smaller than the 1968–69 values. The same comment applies when we look at the two way classifications, i.e., age and sex, sex and education and age and education. The adjusted coefficients for the three way classification are also shown in Table 6 but in 1968–69 the adjusted Gini coefficient had a value of 0.113 and the value in 1973–74 had apparently declined, but only marginally, to 0.111. By contrast the adjusted Theil coefficient did decline over the period. The decline is however smaller (absolutely and proportionately) than the decline in the unadjusted coefficient.

Evaluation and Interpretation of the Results

The narrowing of differences in mean incomes of subgroups in the Australian population and the declines in the Gini and Theil coefficients for all income receivers and full year full time workers suggest a fairly radical reduction in the inequality of income distribution. Adjusted inequality coefficients do not show the same declines, which suggests that the decline in inequality was due to a narrowing of income differences between persons with different attributes, rather than a narrowing of differences between persons with the same attributes.

The decline in the adjusted coefficients in each period as additional attributes are used to classify the population suggests that age, education and sex income differences all explain some part of total inequality even when the effects of the other variables has been allowed for. In particular we might note that this implies income differences between males and females which arise for reasons other than differences in education or age distribution. The adjusted coefficients also suggest that a large part of income inequality in Australia arises from differentials between persons with different attributes. For all income receivers approximately 75 percent of the Gini coefficient and 55 percent of the Theil coefficient can be explained by these differentials. For full year, full time workers the figures are 65 percent and 35 percent respectively. An understanding of the reasons behind these differentials would explain a substantial part of the observed inequality of income distribution in Australia.

Finally we may use the statistical results obtained to comment briefly on acceptable and unacceptable income inequality in the Australian economy. The adjusted coefficients obtained here are derived using the existing differentials in the two periods. It can plausibly be argued that the decline in differentials was either desirable or undesirable. More importantly we can note that the decline in inequality appears to have been primarily due to the reduction in these differentials, and not due to a reduction in income differences between persons with the

same attributes. Using the terminology developed earlier in this paper we would suggest that the latter may be regarded as unacceptable differences, and consequently can conclude that there was not a decline in unacceptable inequality in the Australian economy over the five year period examined. It must however be stressed that the decline in inequality due to narrowing differentials between persons with different attributes might be regarded as desirable by some persons—it is almost certainly a more debatable issue than the lack of a decline in inequality between persons with the same attributes.

Summary and Conclusion

This paper has discussed the interpretation of decomposed inequality coefficients. It is argued that the decomposed inequality coefficients are useful in three ways. First the decomposition provides an indication of the extent to which inequality arises because of income differentials between persons with different attributes. Secondly it permits us to identify the source of changes in income inequality over time. Thirdly, most contentiously, it provides the basis for distinguishing between inequality due to income differentials between individuals with different attributes and that due to income differences between individuals with the same attributes.

These three interpretations of the decomposed coefficients are used to provide an interpretation of the reduction in income inequality which occurred in Australia over the five year period 1968–69 to 1973–74. It is suggested that the decomposition of the inequality coefficients provides additional insight into the nature of these changes.

Appendix

The Relation between the Paglin Procedure and Pyatt's Decomposition of the Gini Coefficient

Following Yule and Kendall ([20], p. 146) the Lorenz–Gini coefficient of income inequality, LG, for a population with M members, mean income $\bar{X}$, divided into C classes with m_i members in group i each having income x_i is given by

$$\mathrm{LG} = \frac{1}{2M^2\bar{X}} \sum_{i=1}^{C} \sum_{j=1}^{C} |x_i - x_j| m_i m_j \tag{A1}$$

Paglin ([14], particularly pp. 599–601 and footnote 3) uses reference lines which are obtained by assuming that all individuals in particular groups (e.g. age groups) receive identical incomes. Associated with the reference line is a Gini coefficient, to be termed RLG. If there are G such groups with mean incomes $\bar{y}_i$ and numbers n_i, total number N and mean income of the whole population $\bar{Y}$ then

$$\mathrm{RLG} = \frac{1}{2N^2\bar{Y}} \sum_{i=1}^{G} \sum_{j=1}^{G} |\bar{y}_i - \bar{y}_j| n_i n_j \tag{A2}$$

The Paglin–Gini, PLG, is then defined as the difference between LG and RLG, so that

$$\text{LG} = \text{RLG} + \text{PLG} \tag{A3}$$

Pyatt [17] shows that the Lorenz–Gini coefficient for the population can be expressed as the sum of three components—as shown in equation (4) in the text above. The decomposition of the coefficient for a population with N members, mean income $\bar{Y}$, is based on G groups, with p_i being the proportion of the population in group i, π_i the proportion of total income accruing to group i. If there are n_i individuals in group i, which has mean income $\bar{y}_i$; then it follows that $p_i = n_i/N$ and $\pi_i = n_i\bar{y}_i/N\bar{Y}$. E'_{ij} is the difference, if positive, between $\bar{y}_j$ and $\bar{y}_i$ expressed as a proportion of $\bar{y}_i$ so that

$$\begin{aligned} \bar{y}_i E'_{ij} &= 0 & \bar{y}_j &\leq \bar{y}_i \\ \bar{y}_i E'_{ij} &= \bar{y}_j - \bar{y}_i > 0 & \bar{y}_j &> \bar{y}_i \end{aligned} \tag{A4}$$

and therefore irrespective of the relation between $\bar{y}_i$ and $\bar{y}_j$

$$\bar{y}_i E'_{ij} + \bar{y}_j E'_{ji} = |\bar{y}_i - \bar{y}_j| \tag{A5}$$

We wish to show that the Paglin–Gini coefficient, PLG, is given by the sum of the second and third terms on the right hand side of equation (4) in the text. We do this by showing that the first term on the right hand side is equal to the Gini coefficient of the Paglin reference line, that is RLG as defined in (A2). Substituting in we note

$$\begin{aligned} \sum_i^G \sum_j^G \pi_i E'_{ij} p_j &= \sum_i \sum_j (n_i\bar{y}_i/N\bar{Y}) E'_{ij}(n_j/N) \\ &= \frac{1}{N^2\bar{Y}} \sum_i \sum_j (\bar{y}_i E'_{ij}) n_i n_j \\ &= \frac{1}{2N^2\bar{Y}} \sum_{i=1}^G \sum_{j=1}^G |\bar{y}_i - \bar{y}_j| n_i n_j \\ &= \text{RLG} \end{aligned} \tag{A6}$$

The implication of the foregoing is that the Paglin–Gini is given by the sum of the second and third terms on the right hand side of (4). Paglin's graphical breakdown of the Gini coefficient into two areas—that between the 45° line and the reference line and that between the reference line and the population line is seen to be equivalent to the Pyatt decomposition. The Paglin–Gini is therefore a measure of inequality which excludes the inequality-creating effects of existing differences in the mean incomes of the subgroups.

References

[1] Atkinson, A. B., "On the Measurement of Inequality," *Journal of Economic Theory*, Vol. 2, 1970, pp. 244–63.

[2] Australian Bureau of Statistics, *Income Distribution, 1968–69, Consolidated and Revised Edition*, Canberra, 1975.

[3] Australian Bureau of Statistics, *Income Distribution, 1973–74, Part I*, Canberra, 1976.
[4] Australian Department of Social Security, *Statistical Summary 1967 to 1976*, Undated, Canberra.
[5] Danziger, S., Haveman, R., and Smolensky, E., "The Measurement and Trend of Inequality: Comment," *American Economic Review*, Vol. 67, 1977, pp. 505–12.
[6] Gastwirth, Joseph L., "The Estimation of the Lorenz Curve and the Gini Index," *Review of Economics and Statistics*, Vol. 54, 1972, pp. 306–316.
[7] Gregory, R. G. and Duncan, R. C., "The Relevance of Segmented Labour Market Theories: The Australian Experience of the Achievement of Equal Pay for Women," Paper presented at the Seventh Conference of Economists, Macquarie University, Sydney, August/September 1978.
[8] Johnson, W. R., "The Measurement and Trend of Inequality: Comment," *American Economic Review*, Vol. 67, 1977, pp. 502–3.
[9] Kurien, C. J., "The Measurement and Trend of Inequality: Comment," *American Economic Review*, Vol. 67, 1977, pp. 517–9.
[10] Minarik, J. J., "The Measurement and Trend of Inequality: Comment," *American Economic Review*, Vol. 67, 1977, pp. 513–6.
[11] Murray, D. H., "Sources of Income Inequality in Australia, 1968–9," *Economic Record*, Vol. 54, 1978, pp. 159–69.
[12] National Committee on Discrimination in Employment and Occupation, *Annual Report, 1976–77*, 1978, Canberra, Australian Government Publishing Service.
[13] Nelson, E. R., "The Measurement and Trend of Inequality: Comment," *American Economic Review*, Vol. 67, 1977, pp. 497–501.
[14] Paglin, M., "The Measurement and Trend of Inequality: A Basic Revision," *American Economic Review*, Vol. 65, 1975, pp. 598–609.
[15] Paglin, M., "The Measurement and Trend of Inequality: Reply," *American Economic Review*, Vol. 67, 1977, pp. 520–31.
[16] Podder, N., "Distribution of Household Income in Australia," *Economic Record*, Vol. 48, 1972, pp. 181–200.
[17] Pyatt, G., "On the interpretation and disaggregation of Gini coefficients," *Economic Journal*, Vol. 86, 1976, pp. 243–55.
[18] Stricker, P. and Sheehan, P., "Youth Unemployment in Australia: A Survey," *The Australian Economic Review*, No. 41, 1st Quarter, 1978, pp. 12–27.
[19] Theil, H., *Economics and Information Theory*, 1967, Amsterdam, North-Holland.
[20] Yule, G. U. and Kendall, M. G., *An Introduction to the Theory of Statistics*, (Fourteenth Edition), 1950, London, Charles Griffin.