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# **Income Inequality in New Zealand, 1935-2014**

John Creedy, Norman Gemmell and Loc Nguyen\*

## **Abstract**

Trends in income inequality are increasingly being examined and discussed by economists and policy makers both in New Zealand and globally. In the case of New Zealand, it is known that income inequality indices, such as the Gini index, increased during the late 1980s and early 1990s, with limited change thereafter. But with most data series beginning in the early 1980s, little is known about the levels and changes of such indices over prior decades. Based on previously unexplored data from Statistics New Zealand Official Yearbooks and Inland Revenue, this paper reports estimates for the Gini index of income inequality for New Zealand from the mid-1930s to the present. They are then compared with similar Gini estimates for Australia for 1942-2001 where some remarkable commonalities are found. The paper describes the methodology used to calculate the index and reports Gini indices for incomes for individuals before tax and, where available, after tax, and separately for male and female incomes from 1981.

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# 1 Introduction

This paper examines long-period changes in annual income inequality of individuals in New Zealand. The aim is to provide descriptive measures over the period 1935 to 2013 using a range of data sources. No detailed attempt is made to disentangle the relative contributions of a number of possible causes of changes. Rather it is hoped that information about orders of magnitude over a long period can contribute to the wider debate about inequality. As in Australia and many other major industrialised countries, this subject is currently receiving more media attention than for many years.

One of the paradoxes of recent years is that the huge increase in media interest in income inequality in New Zealand follows a period, since the early to mid-1990s, during which there has in fact been no trend increase in standard annual income inequality measures.<sup>1</sup> Many commentators simply refer to ‘increasing inequality’ without making any reference to empirical studies. Information is nevertheless readily available using data on household income from the early 1980s to 2013, including work within the Ministry of Social Development reported by Perry (2014), and research within the Treasury, by Creedy and Eedrah (2016) and Ball and Creedy (2016).<sup>2</sup> The latter reported Gini inequality measures of annual income per adult equivalent person and showed that inequality rose during the late 1980s until the early 1990s, after which it remained steady.<sup>3</sup> For individuals, Easton (2013, 2014) reports estimate of Gini coefficients for the New Zealand adult population using census data at 5-10 yearly intervals from 1926 to 2016.

It is possible that many references to increasing inequality have in mind increasing shares of top individual incomes, which was the focus of studies for Australia and New Zealand by Atkinson and Leigh (2007, 2008). However, more recently Wilkinson and Jeram (2016) examine top income shares, suggesting that they have become more stable, unlike for example the US where they have continued to grow. The existence of different views about how inequality is perceived raises the important question of how it can be measured. This paper

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<sup>1</sup> Indeed, the term ‘paradox’ was used by Wilkinson and Jeram (2016) in the title of their wide-ranging discussion of inequality and associated policy issues in New Zealand.

<sup>2</sup> See also various publications by Statistics New Zealand, such as (1999). On the period 1987 to 1998, see Crawford and Johnston (2004). Summary results for disposable incomes selected years (1981/82, 1985/86 and 1989/90) are reported in Saunders (1994). Decompositions by income source for 1983/84, 1991/92 and 1995/95, using gross (pre-tax) incomes are reported by Podder and Chatterjee (2002), using household income per person as the income measure, with individual as unit of analysis: however, the selection of years gives a misleading picture of the inequality changes over the 1980s. On the period 1981 to 1996, see also O’Dea (2000), Easton (2013, 2014). Easton (2015a,b) studies the share of top incomes from the 1930s, but mainly from the 1970s. Studies considering macroeconomic influences on the income distribution in New Zealand include Bakker and Creedy (1999) and Martin (2002). On gender differences over the decade, 1998 to 2008, see Papps (2010). On wage inequalities from 1984 to 1998, see Dixon (1999).

<sup>3</sup> For many years the stability of the personal income distribution, along with that of labour’s share in total income, was regarded as a ‘stylised fact’. Indeed Pareto (1909) went so far as to regard the distribution as incapable of change.

concentrates on the Gini measure, as discussed in Section 2, which clarifies the nature of the value judgements implicit in using this overall measure, and explains its calculation when faced with grouped income distribution data.

Before computing summary measures, any study of inequality must first make decisions regarding three ‘Ws’ of inequality: ‘what’, ‘when’ and ‘whose’. The first (what) concerns what is usually referred to as the ‘welfare metric’ and involves a decision of whether, for example, to consider earned gross income, or total net of tax and transfer income, or consumption (and the form of any adult equivalence scale, if any, to use). The second (when) involves the accounting period over which the metric is measured. In the case of, say, disposable income, interest may be on a short period, such as a week, or at the other extreme, the lifetime of members of a cohort. The choice of a longer period introduces complexities arising from relative income mobility within the cohort.<sup>4</sup> The third (whose) concerns the population group and the income unit: the latter may be the individual, household or ‘equivalent adult’.<sup>5</sup> Although these choices all involve value-judgements, in practice the choice is often strongly influenced by data availability. However, it is important to recognise that the alternatives can produce results suggesting inequality changes in opposite directions or quite different orders of magnitude. Data limitations mean that the concentration here is on incomes of individuals, rather than households.<sup>6</sup>

These issues are compounded when attempting to take a longer-term perspective, as here. For example, if it is desired to measure the annual taxable income of individuals, changes in the tax structure over time, influencing the components that are included in ‘taxable income’ (such as certain benefit payments, ‘fringe benefits’ or other components of ‘comprehensive income’) can have a substantial effect on measured income and even on the timing of income receipts, and thus on comparisons. The measurement of changes in inequality over a long period must therefore necessarily be accompanied by the important caveat that many other changes are taking place which may affect results but which may not be regarding as fundamentally reflecting inequality changes. An obvious qualification is that cross-sectional annual inequality is influenced by changes in the age composition of the population group considered, in view of the fact that there are systematic variations in income over the life cycle.

After discussing the Gini measure in Section 2, Section 3 describes the sources of income data and the definition of each series. Section 4 reports Gini inequality measures for individual

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<sup>4</sup> In New Zealand, much emphasis was placed on the role of mobility, and a longer accounting period, by Barker (1996). The relationships between income mobility characteristics, annual inequality, and inequality using a longer accounting period are far from straightforward: see Creedy (1997).

<sup>5</sup> For example, using annual household income per adult equivalent person as accounting period and welfare metric, the choice of unit of analysis is not straightforward: see Creedy and Eedrah (2016) for further discussion and comparisons for New Zealand.

<sup>6</sup> The Household Economic Survey goes back only to 1973, and the income concept used in surveys before 1983 makes it difficult to produce a consistent series over the life of the survey.

before-tax incomes from 1935-2014, and compares those with similar estimates for Australia over 1942-2001 by Leigh (2005).<sup>7</sup> Consistent data on before-tax *and* after-tax incomes from 1981 allow inequality indices to be calculated for 1981-2014 for all individuals and separately for male and female groups. A particularly important income measurement issue arises with the introduction in the tax year 1957-58 of the Pay as You Earn (PAYE) system of tax withholding. This significantly affected the coverage of income data. This is discussed in Section 4 which describes the resulting adjustment made to the Gini index for the period 1935-1957 associated with missing data on low income earners (tax non-filers) before the introduction of PAYE. Brief conclusions are in Section 5.

## 2 The Measure of Inequality Used

The highly influential paper by Atkinson (1971) stressed that value judgements are inevitably involved in constructing inequality measures. There is thus a need for an inequality measure to be linked explicitly to value judgements, which are summarised in a ‘social welfare function’: this is essentially a formulae which shows how an income distribution is evaluated. He showed that, where the income distribution is evaluated using an additive and individualistic social welfare function (where the weight attached to each individual’s income is a concave function of income, thereby satisfying the ‘principle of transfers’<sup>8</sup>), it is possible to define an inequality measure based on the proportional difference between arithmetic mean income and an ‘equally distributed equivalent’ income, defined as the value which, if obtained by everyone, produces the same ‘social welfare’ as the actual distribution.<sup>9</sup> The use of an explicit evaluation function not only links inequality to value judgements, but also implies a clear trade-off between total income and its inequality (often referred to as a trade-off between ‘equity and efficiency’).

Subsequent research showed that the Gini inequality measure – previously rationalised in terms of areas in the famous Lorenz curve diagram – can also be derived in the same way but with a different form of social evaluation function, in which the rank order of each individual plays an important role. The income of the richest person is given the lowest weight while the poorest person is given the highest weight.<sup>10</sup> The welfare function, for income  $x_i$  for  $i = 1, \dots, n$ , and income ranked in ascending (strictly, non-decreasing) order, is written as:

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<sup>7</sup> The characteristics of Australian inequality are also examined by Gaston and Rajaguru (2009) and Saunders (1994).

<sup>8</sup> This is a basic value judgement which takes the view that a transfer from a richer to a poorer person, which leaves their relative rankings in the distribution unchanged, represents an improvement.

<sup>9</sup> The degree of concavity of the weighting function measures the extent of ‘relative inequality aversion’ of the judge whose value judgements are represented by the social welfare function. The equally distributed equivalent income is a ‘power mean’ in this case.

<sup>10</sup> In the Gini case, as shown below, the equally distributed income is a reverse-rank-order weighted mean of incomes, rather than the ‘power mean’ of Atkinson’s measure.

$$W = \sum_{i=1}^n (n+1-i)x_i \quad (1)$$

It can be shown that the equally distributed equivalent income is given by the reverse-rank weighted mean:

$$x_E = \frac{2}{n(n+1)} \sum_{i=1}^n (n+1-i)x_i \quad (2)$$

Therefore giving the Gini measure as:

$$G = 1 - \frac{x_E}{\bar{x}} \quad (3)$$

where  $\bar{x}$  is arithmetic mean income. Those whose value judgements do not agree with the expression in (1) are not likely to be comfortable with the use of the Gini as a summary measure. Its use in popular debates is often ‘justified’ merely on the vague grounds that it is ‘well known’, but it is important that the associated value judgements are clear.

Both Gini and Atkinson measures, by giving relatively little weight to the highest incomes in the overall evaluation, are not very sensitive to changes in top incomes. Stability shown by overall inequality measures may therefore be quite consistent with higher top income shares.<sup>11</sup> However, evaluations based on top incomes, by ignoring the form of much of the distribution, have considerably less clear-cut rationales in terms of the implicit value judgements involved.

The present study is restricted to using the standard Gini inequality measure.<sup>12</sup> However, the computation is less straightforward than suggested above because grouped data, rather than individual observations, must be used. First, while there are many alternative ways of expressing the Gini measure for individual data, the following covariance form is very useful.

This is given by:

$$G = \frac{2}{x} Cov(x, F(x)) \quad (4)$$

where  $F(x)$  is the cumulative distribution function, and  $Cov(x, F(x))$  is the covariance between  $x$  and  $F(x)$ . In samples with individual observations,  $F(x_i)$  is calculated simply as  $i/n$ .

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<sup>11</sup> Furthermore, standard inequality measures such as the Atkinson and Gini measures can take unchanged values for what may otherwise be judged to be widely different income distributions: for further details, see Creedy (2017).

<sup>12</sup> Ball and Creedy (2016) examined a range of Atkinson measures (for different degrees of inequality aversion) as well as Gini measures, and found that they produced similar variations over time for household income per adult equivalent.

## 2.1 Computing the Gini with grouped Data

This subsection describes two methods to calculate Gini with grouped data. Results from the two methods are the same. Where grouped data are available, the term  $x_i$  is now the arithmetic mean income in group  $i$ , where there are now  $n$  groups rather than individuals.<sup>13</sup> The number of observations in group  $i$  is  $f(x_i)$  and thus the ‘weight’ attached to each mean is

$$w_i = f(x_i) / \sum_{i=1}^n f(x_i) = f(x_i) / N.$$

### 2.1.1 Method 1

If each observation has a weight,  $w_i$ , with  $\sum_{i=1}^n w_i = 1$ , The cumulative proportion,  $F(x_i)$ , is obtained, where  $w_0 = 0$ , as:

$$\hat{F}(x_i) = \frac{w_i}{2} + \sum_{j=0}^{i-1} w_j \quad (5)$$

The Gini coefficient is thus:

$$G = \frac{2}{\bar{x}} \sum_{i=1}^n w_i (x_i - \bar{x}) (\hat{F}(x_i) - \bar{F}) \quad (6)$$

Here  $\bar{x}$  and  $\bar{F}$  are the weighted means of  $x_i$  and  $\hat{F}(x_i)$  respectively, so that  $\bar{x} = \sum_{i=1}^n w_i x_i$  and  $\bar{F} = \sum_{i=1}^n w_i \hat{F}(x_i)$ .

### 2.1.2 Method 2

This method uses the (integer) frequencies,  $f(x_i)$ , defined above. Define  $D_{i,j}$  as follows. For  $i = 1$ , and  $j = 1, \dots, w_1$ :

$$D_{1,j} = N + 1 - j \quad (7)$$

and for  $i = 2, \dots, n$ , and  $j = 1, \dots, f(x_i)$ :

$$D_{i,j} = N + 1 - \sum_{k=1}^{i-1} f(x_k) - j \quad (8)$$

Then:

$$G = 1 + \frac{1}{N} - \frac{2}{N^2 \bar{x}} \sum_{i=1}^n x_i \left( \sum_{j=1}^{f(x_i)} D_{i,j} \right) \quad (9)$$

It is also possible to obtain a convenient expression for the standard error of the Gini measure, when using grouped data. These were computed in all cases, but when reporting results below,

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<sup>13</sup> The data used here allow means to be calculated, although often it is necessary to use, for example, class midpoints.



the standard errors are not included because they are so small. This is because the results are dominated by the very large number of observations involved.

### 3 The Data

Statistics New Zealand Official Yearbooks (NZOYB) are available in digitised form for 1893 to 2013 from the Statistics New Zealand website.<sup>14</sup> Inevitably the type of information provided, and definitions of reported items, vary over that period. Of particular interest are Inland – Revenue based data on incomes for individual taxpayers available annually (with a few exceptions). Prior to the 1930s, NZOYB income data are recorded for individuals and companies combined and hence are unsuitable for income inequality measurement. Thereafter, reports for various years provide data for ‘total income’ (and other income categories) and the number of ‘returns’ (taxpayers) across income bands.

Subject to some changes in definition, described below, this source provides suitable data from 1935 to 1983. Income data by income band using more consistent definitions are available from the Inland Revenue Department (IRD) for 1981-2014. These two series, supplemented by income data sourced from the separate Statistics New Zealand (SNZ) *Report on Incomes and Income Tax* for some missing years in the 1970s, form the basis for the Gini indices reported below.<sup>15</sup>

#### 3.1 Types of income

Statistics New Zealand have collected income data over many decades, for a variety of definitions. The main income types reported in the NZOYB are: ‘returnable income’, ‘total income’, ‘assessable income’, and ‘analysis total income’. These are defined in Table 1 and the Appendix below. The primary purpose of the data collection was tax assessment, and for this reason definitions often relate to tax properties such as income required to be included in a tax return (‘returnable’) even if not liable to tax, or income that is liable (‘assessable’) or non-liable (non-assessable) for income tax.

In addition, the complete collection of income from tax records can take some years. This means that NZOYBs for year  $t$  typically report incomes for a number of previous years up to  $t-2$  or earlier. For several years in the 1970s and early-1980s, provisional estimates obtained before complete income records were available were reported in the relevant NZOYB, but subsequent ‘final’ records appear not to have been published. For those years, equivalent data were obtained from the SNZ *Report on Incomes and Income Tax*.<sup>16</sup> ‘Proprietary income’ in Table 1 refers to

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<sup>14</sup> See [http://www.stats.govt.nz/browse\\_for\\_stats/snapshots-of-nz/digital-yearbook-collection.aspx](http://www.stats.govt.nz/browse_for_stats/snapshots-of-nz/digital-yearbook-collection.aspx).

<sup>15</sup> An important difference, discussed further below, between these data and data analysed by Easton (2013, 2014), is that Easton’s data refer to all adults rather than taxpayers or tax filers, but Easton’s inequality estimates are only available for census years.

<sup>16</sup> As far as can be ascertained these reports used identical income definitions to those in the NZOYB.

income from ownership of assets (such as interest and dividends arising from company share ownership) that are allocable to individuals.

**Table 1: NZOYB income definitions**

<b>NZOYB income</b>	<b>Definition</b>
Returnable income (to 1960)	Assessable income + proprietary income + non-assessable income
Total income (from 1961)	Returnable income*
Analysis total income	Provisional estimate of total income

\* “The term ‘total’ income corresponds in concept with the “returnable” income which was used in previous *Yearbooks*. Total income ... does not include income which is exempt from income tax such as social security benefits (except for universal superannuation), the first £12 of income from interest, war pensions, workers' compensation payments, and certain other types of income.” NZOYB (1961).

For years after 1980, the income data used for Gini calculation are based on an IRD definition of ‘taxable income’. That is, income and tax information derived from IR3 tax returns, personal tax summaries and employer PAYE information.<sup>17</sup> Taxable income for individuals is income on which their personal income tax is assessed for the March year.<sup>18</sup> It is shown below that the Gini estimates based on data from both NZOYB and IRD sources for the overlapping years 1981-83 show that ‘taxable’ and ‘total’ income data yield almost identical Gini values.

### **3.2 Data sources used in calculations**

Two further major data consistency issues must be dealt with prior to Gini calculations. First, a decision is required regarding the treatment of negative and zero incomes. Second, there is a problem of how to compare Ginis, obtained from data covering almost all taxpayers after PAYE was introduced in 1957-58, with measures based on pre-1957 income data which were collected only for tax filers.

For Gini calculations, only individuals with positive income are considered, thereby ignoring individuals with zero or negative incomes (losses).<sup>19</sup> Also some yearbooks record the lowest income categories as ‘losses’ ‘nil’ and ‘\$1-199’, while others record only ‘losses’ and ‘\$1-199’, or simply ‘under \$300’. For estimation purposes, data from NZOYB grouping incomes as \$0-\$199 are treated as equivalent to \$1-\$199; see, for example NZOYB (1969) and NZOYB (1970).

<sup>17</sup> IR3 is the individual tax return used by IRD. Completion of this return is required if the individual has income other than salary, wage, interest or dividends.

<sup>18</sup> Source: <http://www.ird.govt.nz/aboutir/external-stats/revenue-refunds/income-distrib-individual-customers/income-distrib-individ-customers.html>; accessed on 18-01-17.

<sup>19</sup> The Gini measure is not defined for negative values. Some investigators reset negative values to zero. In the present context of individual incomes, there is no reason to include zeros.

Table 2 shows the data sources used in calculations. The total income data for the periods 1935 to 1941 and 1946 to 1972 are from NZOYB, and record before-tax incomes only. The data for the period 1942 to 1945 are unavailable due to difficulties collecting income data under war conditions. (Statistics New Zealand, 1947-1949).

**Table 2: Summary data used in Gini index calculations**

Period	Source	Type of income	Coverage	Tax
1935-1972 (excl. 1942-5)	NZOYB	Total income	All individuals	Before tax
1970-1977	NZOYB	Total income: provisional estimate*	All individuals	Before tax
1976, 1978-1983	SNZ Income Report	Total income	All individuals	Before tax
1981-2014	IRD	Taxable income	All individuals (male and female 1981-2013)	Before & after tax

\* Labelled ‘Analysis total income’ in NZOYBs; it is based on income estimates for a given year before more complete ‘final’ data are available for that year. For some years in the 1970s no subsequent updated ‘final’ incomes were reported.

As mentioned above, ‘final’ total incomes are not available for most years during 1970-77. For this reason, SNZ provisional estimates (‘analysis total income’) are used, and the relevant Gini series is separately identified. The taxable income data for the period 1981 to 2014, available from IRD, enable Gini indices to be estimated for both before-tax and after-tax income and for male and female groups separately.

Discussion of how Ginis based on tax-filer-only data prior to 1957, and PAYE data from 1958, may be compared is deferred until Section 4, following discussion of the results for each separate series.

#### **4. Empirical results**

This section presents the empirical results, beginning in subsection 4.1 which reports inequality measures of total income before tax over the period 1935 to 2014 for all individuals. Subsection 4.2 discusses the problem raised by the introduction of PAYE in 1958, and subsection 4.3 proposes an adjustment method to deal with this problem. Comparisons with earlier census-based measures are made in Subsection 4.4. Subsection 4.5 reports Gini inequality measures by gender for both before-tax and after-tax incomes over the period 1981 to 2013.

## 4.1 Gini indices: all individuals ‘total income’ before tax 1935 to 2014

The Gini indices for 1935 to 2014 are shown in Figure 1.<sup>20</sup> Inequality is seen to be relatively stable from the early 1960s to the late 1980s, after which it rose to 0.47 in 1994.<sup>21</sup> It is hard to escape the view that the increase was associated with the reforms which took place during the 1980s, discussed by, for example, Evans *et al.* (1996). Relevant changes included the gradual ‘flattening’ of the marginal income tax rate structure, with the top marginal rate falling from 66, to 48 and then to 33 per cent, along with benefit reductions and the end to centralised wage setting.<sup>22</sup> In addition, fringe benefits tax was introduced in 1985 such that, along with the major reductions in the top rate of income tax, the strong incentive to divert income into non-taxable forms prior to the reforms was substantially removed or reduced by those reforms. It might be expected therefore that from the mid-1980s, an increasing amount of income of top earners would be recorded in official data that may well have been ‘hidden’ before. This would very likely contribute to the observed increase in income inequality but how far this is genuine, as opposed to being due to data coverage limitation, is hard to judge without more information.

After 1994 the Gini is relatively constant again, except for a spike in the tax year 1999/2000. This spike is association with the major income tax change which raised the top marginal rate from 33 per cent to 39 per cent in 2000: this led to a certain amount of income shifting after the announcement of the change. Both periods of relative stability in the Gini measure nevertheless witnessed substantial changes, for example in the structure of industry, and in labour force participation (particularly of women) and participation in tertiary education.

Interpreting the Gini indices prior to 1981 requires some caution. Firstly, for the period 1981 to 1983, the IRD and NZOYB total income series reveal almost identical Ginis: they are indistinguishable in Figure 1. However, comparing ‘total income’ and ‘provisional total income’ series suggests that the latter may not be a good proxy for the former. For the four years of overlap, 1970 to 1972 and 1976, the provisional series *underestimates* the final series by around 3 to 4 per cent (or 1 to 1.5 percentage points) over the period 1970 to 1972, but appears to *overestimate* the final income-based Gini by around 3 per cent in 1976.

Considering only the NZOYB total income series, the first year of full PAYE implementation in 1959 is clearly a crucial year, indicating that the Gini peaks at 0.425. From 1959, the data suggest a steady decline in the Gini index to 0.387 in 1967, followed by a slight rise to 0.409

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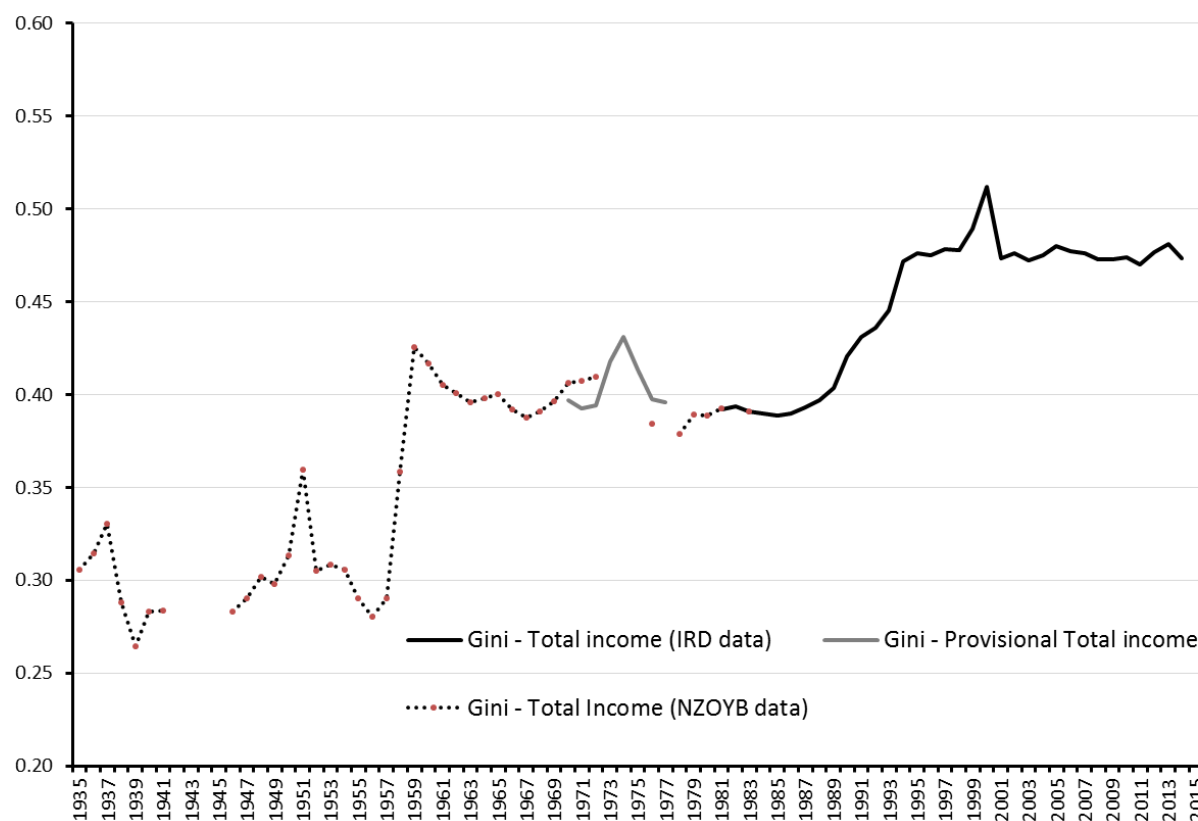
<sup>20</sup> As mentioned earlier, Figure 1 does not show confidence intervals around these Gini estimates because in all cases the standard errors are very small, at less than 1 per cent of the Gini measure for each year.

<sup>21</sup> The pattern from the early 1980s is similar to that found for household incomes per adult equivalent person, reported in Perry (2014) and Ball and Creedy (2016).

<sup>22</sup> The reforms were influenced by severe macroeconomic pressures as well as a need for structural/microeconomic reforms, and were followed by improved growth. The ‘trade-off’ between equity and efficiency implicit in the social welfare function generating the Gini measure suggests that the growth in average real incomes outweighed the increase in inequality: this is demonstrated for household incomes by Ball and Creedy (2016).

in 1972. Thereafter the observable pattern is generally one of decline again until 1978, although there are numerous gaps in the series. In addition, the provisional estimate-based series suggests a more volatile pattern with a strong spike in the Gini in 1974. This may reflect genuine inequality changes, since it coincides with the major global oil shock event that substantively affected the New Zealand economy in the early-to-mid 1970s.

**Figure 1: Gini Measures for all individuals: total income before tax 1935 to 2014**



The sudden large rise in the NZOYB total income Gini from 1957 to 1959 can be attributed to the move to PAYE-based data, which included almost all income taxpayers. This contrasts with the tax-filer-based data that excluded almost all of the lowest incomes in view of the tax-free threshold that existed. The pre-1959 Gini coefficients inevitably appear much lower because they capture inequality among tax *filers* not tax *payers*.<sup>23</sup> The following subsection explores a

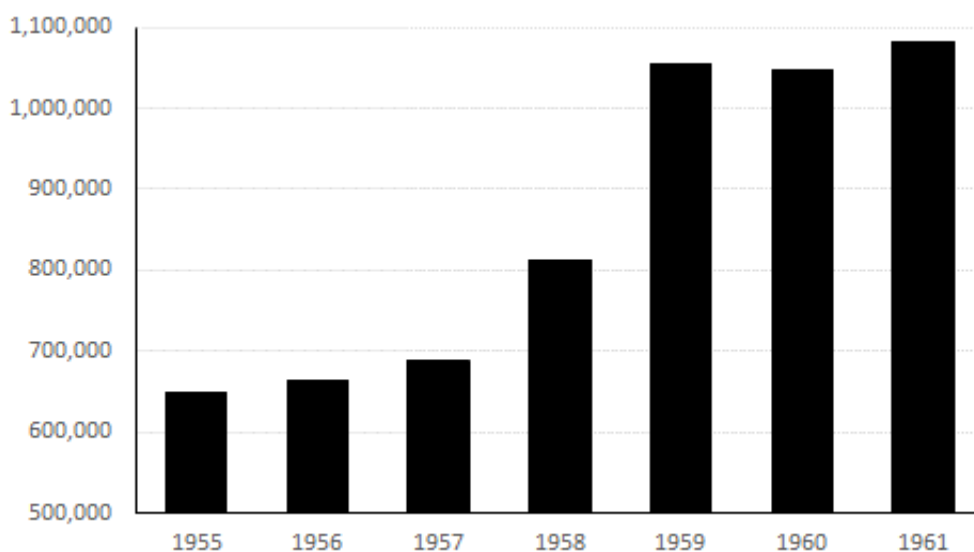
<sup>23</sup> Figure 1 shows a particularly large spike in the Gini coefficient in 1951, to around 0.36, from values around 0.3 in the years before and after. This appears to be associated with particularly rapid increases in national income associated with a huge temporary rise in wool prices in 1950-51, a point noted also for Australian inequality indices by Leigh (2005); see sub-section 4.4. According to SNZ yearbook data, wool prices between 1948/49 and 1951/52 were (in pence per pound of wool): 25.81, 37.98, 87.84, 40.19 respectively. Similarly gross national income over 1947/48 to 1951/52 was (£m): 410, 419, 481, 607, 617; that is, substantially higher growth from 1949/50 to 1950/51 and from 1950/51 to 1951/52. We are grateful to Brian Easton for pointing out this wool-related phenomenon. This spike in wool prices and farmers' incomes would undoubtedly have had a large and disproportionate impact on income levels within the income distribution in 1951, but especially generating temporarily high incomes for wool farmers and related activities.

method of adjusting the pre-1959 Gini indices to make them more consistent with the PAYE-based versions.

## 4.2 Income data before and after 1958

Prior to PAYE, taxpayers with incomes below £300 per year were generally exempt from income tax and not required to file a tax return. Figure 2, which shows the number of taxpayers from 1955 to 1961,<sup>24</sup> demonstrates that the number of taxpayers increased substantially following the introduction of PAYE.

**Figure 2: Number of taxpayers, 1955-1961**



It can be seen that before 1958 the number of taxpayers is between 600,000 and 700,000. Those numbers increased significantly to over 800,000 in 1958, when PAYE was introduced, and increased again to around 1,050,000 in 1959.

Importantly, the data show that the substantial increase in the number of taxpayers in 1958 and 1959 was *only* for taxpayers with income less than £400. This can be seen in Figure 3 which shows income data by income band (up to £3000) for 5 years from 1956 to 1960.<sup>25</sup> The number of taxpayers in income bands equal or greater than £400 are very similar in all 5 years. However, there was a large increase in the number of people with income less than £400, from around 15,000 in 1956 and 1957 to approximately 100,000 in 1958, and 300,000 in 1959. Hence the

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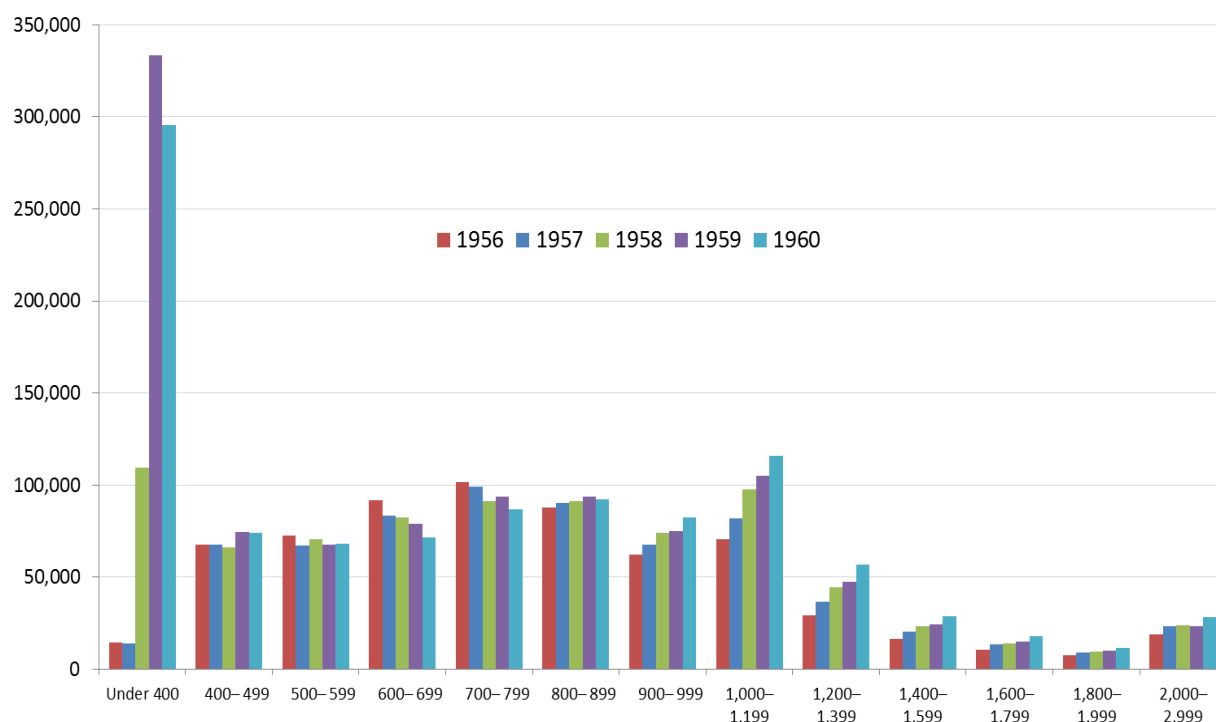
<sup>24</sup> NZOYB refer to these data as ‘numbers of returns’ both before and after 1958. These are treated here as numbers of taxpayers. The year numbers (for example, 1958) refer to the fiscal years (1957/58). PAYE was first introduced in 1957/58 but appears not to have been fully implemented until 1958/59; see Goldsmith (2008, pp. 229-230) and Vosslander (2012). In addition, various changes to tax settings including exemptions in the 1958 budget would have substantively affected the number of individuals liable to tax in 1958 and 1959.

<sup>25</sup> Higher income bands are not shown in the figure as their distributions are almost identical across years and they account for only around 1 to 2 per cent of the taxpayer population.

trend for *total* taxpayers is almost identical to the trend for taxpayers with income less than £400.

In short, the introduction of PAYE provided data on a large number of income earners not previously captured in income data because they did not need to file tax returns. The following subsection, based on these data, explores a method of adjusting the pre-1958 Gini indices (for filers) to make them more comparable to post-1958 indices (for PAYE taxpayers).

**Figure 3: Number of tax payers by income group, 1956-1960**



### 4.3 An adjustment for the introduction of PAYE

As discussed above, the full effect of PAYE (at least on recoded income taxpayers) appears to be from 1959, with data for the number of income earners with income less than £400 significantly underestimated by the filer-based data before 1959.

Two steps are pursued to adjust the Gini indices. Firstly, Ginis for 1957 and 1958 are adjusted, using the 1959 Gini index as benchmark. From Figure 3, the data for taxpayers (before and after 1958) with income greater than or equal to £400 is likely to be a better representation of income earners above or equal to £400 in those years. Thus, the Gini for the sample of taxpayers with income greater than or equal to £400 is calculated for 3 years: 1957, 1958 and 1959. It is assumed that the *rate of change* in Gini for the sample of taxpayers with income greater than or equal to £400 is the same as for the total population from 1957 to 1959. Using this assumption, the adjusted Gini for the year 1957 and 1958 can be estimated.

This can be stated more formally as follows. It is assumed that:

$$\frac{G_{1957}(All)}{G_{1957}(x \geq 400)} = \frac{G_{1958}(All)}{G_{1958}(x \geq 400)} = \frac{G_{1959}(All)}{G_{1959}(x \geq 400)} \quad (10)$$

Here  $G_i$  is the Gini index for year  $i$ , and  $G_i(All)$  represents the Gini for all incomes. From equation (10), the adjusted Gini index for 1958 is therefore:

$$G_{1958}(All) = \frac{G_{1958}(x \geq 400)}{G_{1959}(x \geq 400)} * G_{1959}(All) \quad (11)$$

and similarly for 1957.

Secondly, the adjusted Gini index calculated in the first step for 1957 is used as a benchmark to estimate the adjusted Gini indices for the years before 1957. For 1935 to 1957 it is assumed that the rate of change in the Gini index estimated from those submitting returns in (NZOYB data) is the same as rate of change in the Gini index for (unobserved) income earners equivalent to those captured later in PAYE-based data. That is:

$$\frac{G_i(All)}{G_{i-1}(All)} = \frac{G_i(NZOYB)}{G_{i-1}(NZOYB)} \quad (12)$$

Using the growth rates from (12), the adjusted Gini index for each year from 1935 to 1957 is then computed as:

$$G_i(All) = G_{1957}(All) * \frac{G_i(NZOYB)}{G_{1957}(NZOYB)} \quad (13)$$

Hence, re-arranging (11) as  $\frac{G_{1958}(All)}{G_{1958}(x \geq 400)} = \frac{G_{1959}(All)}{G_{1959}(x \geq 400)}$ , the 1959 data yield  $\frac{G_{1959}(All)}{G_{1959}(x \geq 400)} = 1.60$  which, together with an estimate of  $G_{1958}(x \geq 400) = 0.285$ , gives  $G_{1958}(All) = 0.455$ . That is, slightly higher than the value of  $G_{1959}(All) = 0.425$ . A similar process for 1957 yields  $G_{1957}(All) = 0.458$ . For years before 1957, values for  $G_{1957}(All)$  are obtained using (13). The results obtained after making these adjustments for all years 1935-58 are shown in Figure 4.<sup>26</sup>

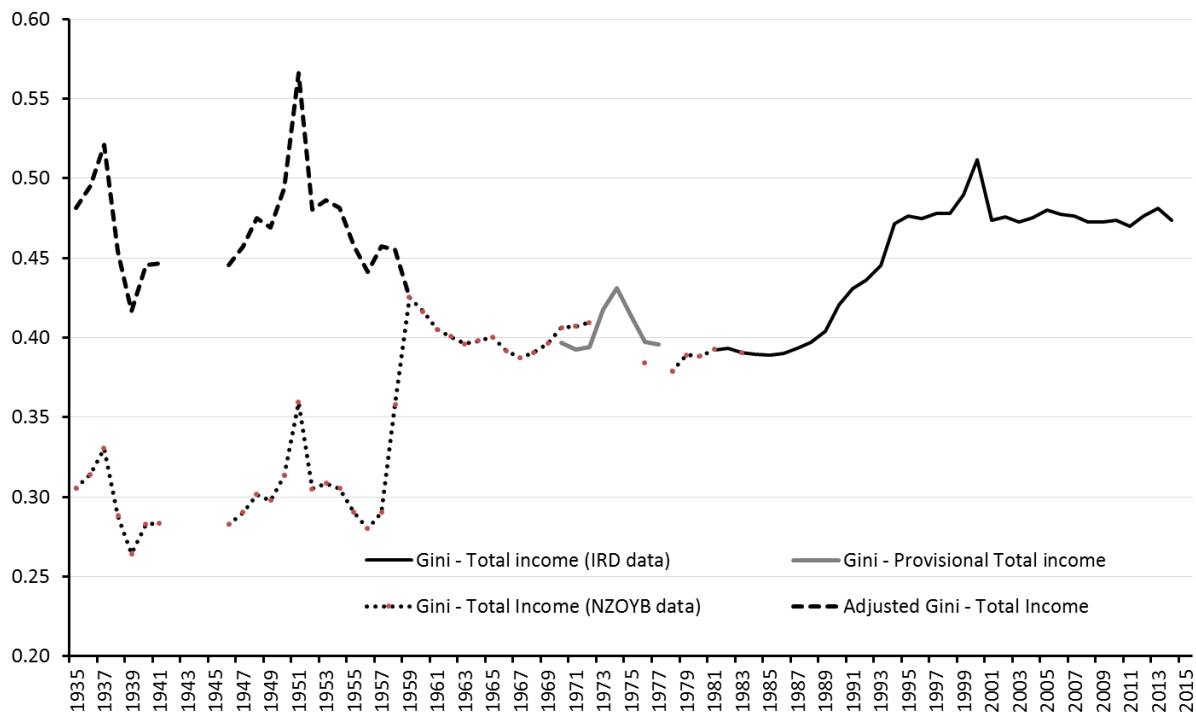
This adjusted series suggests a substantial fall in income inequality during the 1950s from a peak of around 0.566 in 1951, having risen after World War II (WW2) from 0.445 in 1947. It is likely that the peak in 1951 is associated with the Korean War. Clearly the further back in time the adjusted Gini series is extrapolated the more uncertain the accuracy of the method used here becomes – relying on the measured year-to-year *changes* in the Gini for tax filers being an accurate representation of the equivalent changes for non-filers. But, based on these adjustments, the Gini indices for the pre-WW2 years shown in Figure 4 suggest some variability in the index from 1935, around 0.45.

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<sup>26</sup> An alternative approach to the adjustment would be to apply the form in equation (11) to all years from 1935-1958. However, examination of the income distributions for early years reveals that the vast bulk of the distribution (around 50-75 per cent) of all income earners during the 1930s and 1940s had incomes below £400; with the percentage generally falling over this period as general income growth occurred. As a result, these early distributions generate unreliable Gini estimates for the sub-sample with  $x \geq £400$  in (11). By the 1950s this proportion had dropped to 30% in 1950 and to 12% in 1957; such that there can be more confidence in the annual  $G_i(x \geq 400)$  obtained from these larger sub-sample sizes.



**Figure 4: Adjusted Gini for all individual total income before tax, 1935-2014**



#### **4.4 Comparisons with Australian and other NZ estimates**

Having obtained an adjusted annual series of Gini coefficients for taxpayers for 1935-2014 in Figure 4, it is interesting to compare these with alternative New Zealand estimates based on census data, and also with comparable estimates for Australia. The former are reported in Easton (2013, 2014) for 1926-2014 using census data for all adults. The latter are reported by Leigh (2005) for Australia based on income tax returns adjusted to account for no-taxpayers in the population, and cover the period 1942-2001.

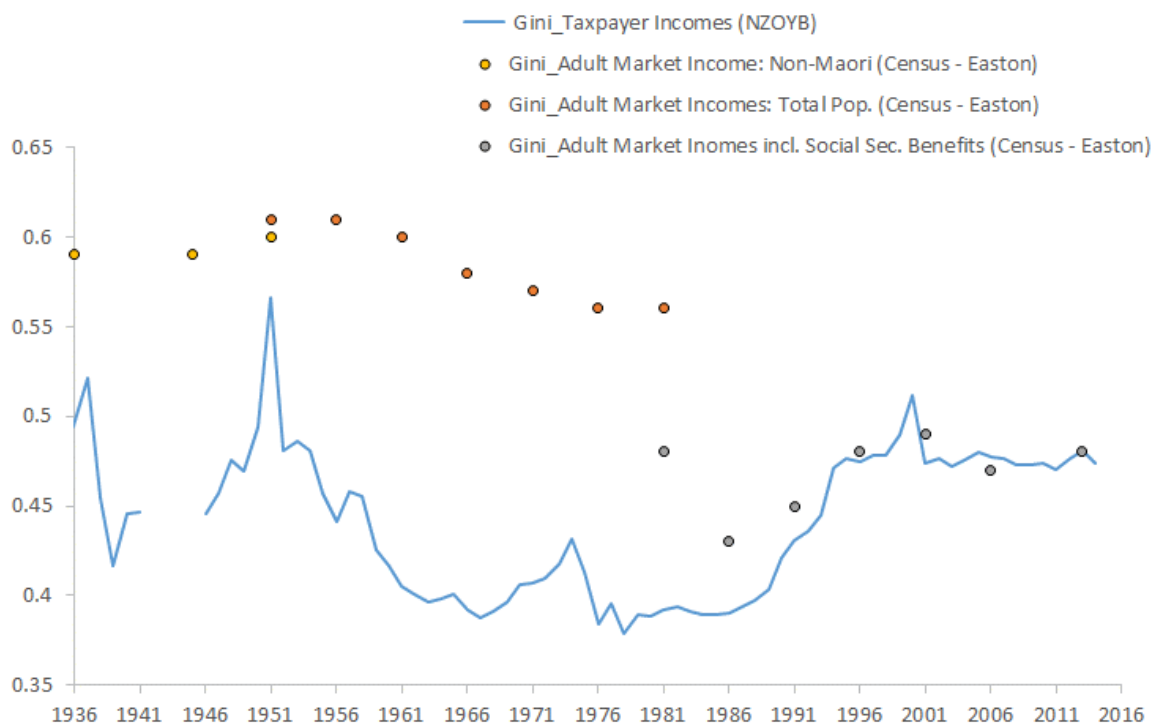
Before comparing the two New Zealand Gini estimates, a number of differences in data coverage between the NZ census and NZOYB/IRD data must first be mentioned. In addition to the difficulties discussed above, associated with estimating the numbers and incomes of taxpayers as opposed to tax filers before 1958, the data used in the present paper involve two substantive differences from census data.

Census data on adults include all those not in the labour force and hence include many individuals with zero or very low (non-wage) incomes. Where NZOYB taxpayer data report zero or negative incomes, as mentioned above, these were excluded from the Gini estimates

reported here.<sup>27</sup> It can be expected that both of these differences serve to increase Gini values obtained from census data relative to those calculated from taxpayer-based data.

Figure 5 compares the Gini estimates from Figure 4 with Easton’s census-based values for 1936 to 2014. These are, as expected, substantially higher for the census-based series, at least until the 1990s. There is also an important change in the income concept used. In particular, social security benefits were included in Easton’s ‘market income’ series from 1981. This inclusion substantially reduces the value of his Gini estimates from that date.

**Figure 5: Comparing adult-based and taxpayer-based Gini estimates**



Though the census-based series is noticeably higher than the taxpayer-based series, except for 1950/51 when the taxpayer-based series displays the unusual spike discussed earlier, the pattern of a decline in the Gini from the early 1950s is confirmed by both series. However, it is less dramatic in the census data, which is also affected much more strongly by the 1981 change of definition to include social security benefits.

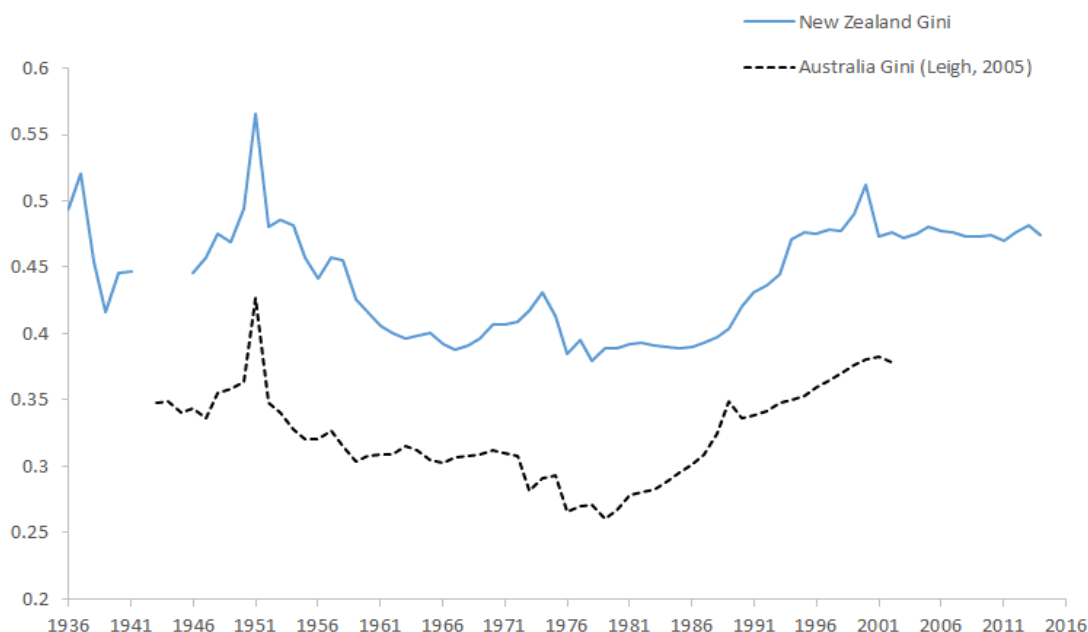
It is also of interest that the census-based series, while demonstrating the familiar increase in the Gini from the mid-1980s, suggests that Gini estimates for the mid-1990s to 2013 are not very different from the comparable estimate for 1981.

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<sup>27</sup> The issue is further complicated in recent censuses by the decision of Statistics New Zealand to change the way those on low incomes are reported in the 2013 census. Easton (2014, p.14), quoting SNZ, reports: ‘Non-response rates were lower in 2013 because we have allocated people who selected ‘no source of income’, but did not answer the total income question, to the ‘zero income’ category. This edit was not carried out in previous years’.

Figure 6 compares the annual NZ Gini series with Leigh’s (2005) series for Australia over 1942-2001. The Australian Ginis relate to pre-tax incomes for adult males based on data for male taxpayers, together with an adjustment for imputed incomes of non-taxpayers. As a result the absolute levels of the Gini coefficients are not comparable across the two countries but it is interesting to compare their trends over time.

**Figure 6: Comparison of Australia and New Zealand Gini estimates**



The similarity in the long-term pattern of the Gini coefficient over time in the two countries is quite remarkable, notwithstanding very different economic conditions and policies in the two countries over this extended period. Both countries display the same tendency for inequality to fall during the immediate post-World War II decades and both subsequently experience an increase in inequality from the 1980s. New Zealand’s upturn appears somewhat later than in Australia and is more rapid, taking less than a decade, compared with the more steady increase in Australia over two decades from the late 1970s.<sup>28</sup>

Interestingly a number of short-term movements in the Gini are also common to both countries, such as the sharp spike in 1950-51 associated with the wool price shock (as noted also by Leigh for Australia in 1950-51).<sup>29</sup> The greater volatility of the Gini estimates at the time of the global oil shocks in the early-to-middle 1970s is also reflected in the data for

<sup>28</sup> Some support for the trends, and shorter-term movements, in the Gini in Figure 6 are provided by estimates of top income shares in New Zealand by Atkinson and Leigh (2008) for 1921-2005. These reveal very similar patterns over the shared 1942-2005 period, including the spike in 1950-51, turbulence in the 1970s and the rapid upturn in the mid/late 1980s.

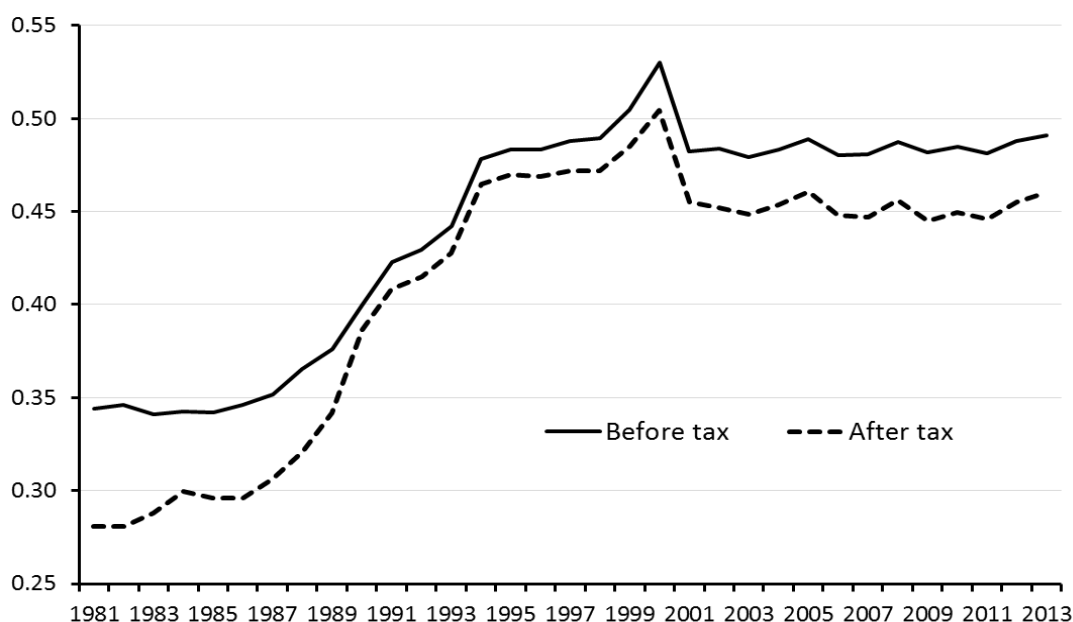
<sup>29</sup> See Leigh (2005, p.S64). The year labels used in Figure 5 for Australia are shifted by one year compared to the labels used by Leigh (1950) to account for the fact that Leigh used the label “1950” for 1950-51, whereas “1951” is used in this paper for 1950-51.

both countries. However, unlike New Zealand, Australian data do not reveal an obvious spike in 2000 when, as argued above, New Zealand incomes were probably subject to substantial responses to the 2000/01 tax reforms. Unfortunately, the end of the Australian series in 2001 means that it is not possible to confirm whether the rise in Australian inequality was largely halted by 2000, as in New Zealand.<sup>30</sup>

#### 4.5 Gini indices by gender and before/after ta/: 1981-2013

Inland Revenue income data available from 1981 allow decompositions of taxpayers' incomes by gender, and the calculation of Gini measures for after-tax incomes. Before-tax and after-tax Gini indices are shown in Figure 7 for males and in Figure 8 for females. Figure 9 then compares the before-tax Ginis for males and females with the equivalent for all individuals.

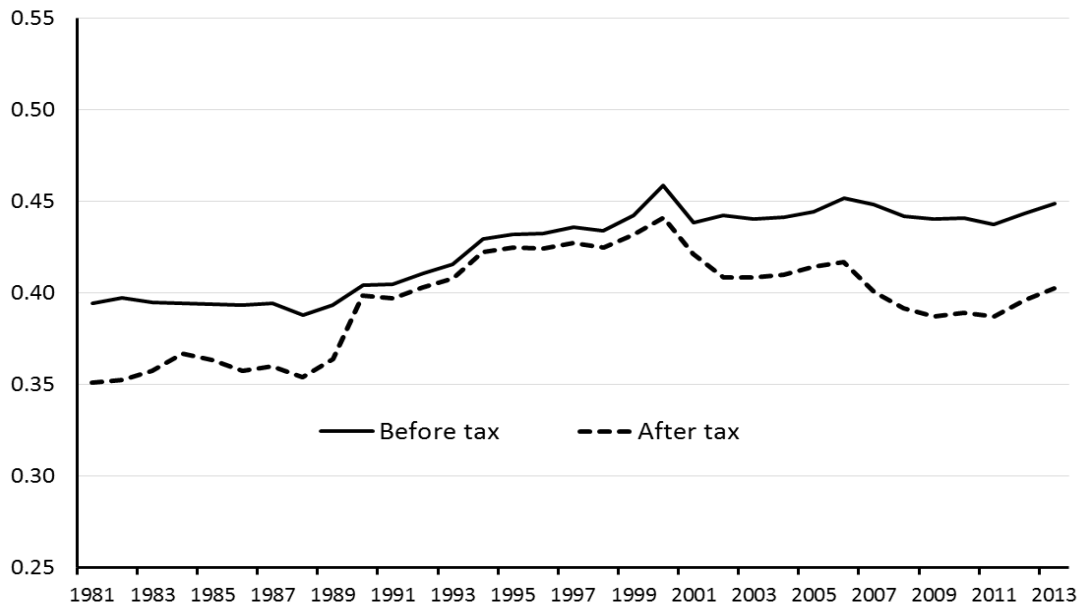
**Figure 7: Male Gini, total income, 1981-2013**



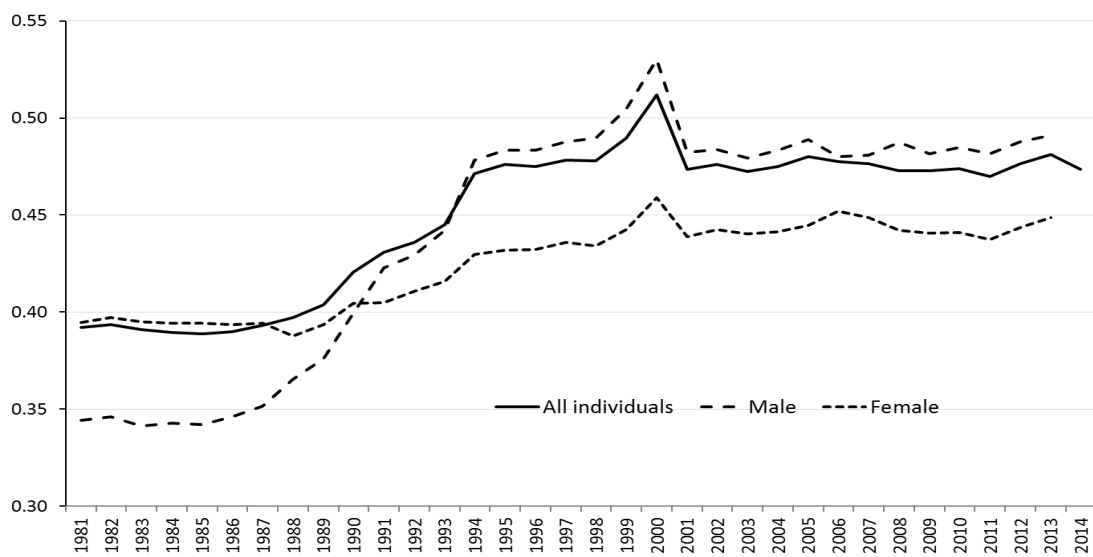
Figures 7 and 8 reveal some interesting differences. Regarding gender, it is clear that the substantial increase in inequality observed for all individuals combined in the 1990s was much more prevalent for males than for females. For example, the male before-tax Gini rises persistently from 0.34 in 1985 to 0.48 by 1995, but the female index rises only from 0.39 to 0.43 over the same period. Female inequality, having been higher than for males before the mid-1980s, became lower than for males from around 1991.

<sup>30</sup> Evidence for top income shares in Australia from Atkinson and Leigh (2008), however, suggests that the share of the top 5% and 10% remained fairly static from 2000 to 2005 (the final year of their series). Other inequality indices from Leigh (2005), such as the 90:50 and 75:25 ratios, also suggest some 'flattening' of inequality from the mid-to-late 1990s to 2001.

**Figure 8: Female Gini, total income, 1981-2013**



**Figure 9: Gini before tax, total income, 1981-2014**



However, much caution needs to be exercised in interpreting both the level of, and trends in, male and female Gini indices. In particular, the data in the figures cover a period of increasing female participation in formal income-earning employment. Furthermore, participation also involves greater use of *part-time* work by females, but less so over time.

Both Figures 7 and 8 also indicate that, for each gender, the before-tax and after-tax Gini indices become much more similar during the period approximately from the late 1980s to 2000. This reflects the reduced degree of rate progression of the income tax in the mid-to-late 1980s when the number of marginal tax rates (MTRs) was reduced to three in 1988, and the top marginal rate was reduced to 33 per cent by 1990. The subsequent increase in the top rate of income tax

in 2000 from 33 to 39 per cent, and reductions in some lower MTRs, resulted in a more progressive income tax from that year. This seems to be reflected in a widening of the gap between the pre- and post-tax Gini indices thereafter in Figures 7 and 8.

When the Gini for all individuals is included in Figure 9 it can be seen that this largely tracks the female Gini (and lies above *both* male and female Ginis) until the substantial late-1980s increase for males.<sup>31</sup> After a transition, the Gini for all individuals largely tracks the male Gini from around 1993 to the end of the period of available data in 2013.<sup>32</sup>

## 5 Conclusions

This paper has sought to extend previously available estimates of Gini income inequality indices for New Zealand individuals from the early 1980s to cover a much longer period. Based on income data collected from various sources such as *Statistics New Zealand* (SNZ) yearbooks and Inland Revenue, the paper reported Gini indices for various definitions of income earners or taxpayers' total income before tax for the years 1935 to 2014. For the more recent period, covering 1981 to 2014, separate male and female Gini indices were reported and also comparable indices based on both before-tax and after-tax incomes, revealing changes in the redistributive properties of the personal income tax.

The evidence suggests that the introduction of the PAYE system in 1958 led to substantial changes in the coverage of income data available to SNZ, and hence to estimates of Gini indices after 1958. However, examination of income data around 1958 suggests that the change in data coverage applied almost entirely to those with incomes previously below the tax filing threshold, who become recorded in the SNZ data only after 1958. The paper proposed a method of controlling for this change in coverage. This resulted in the Gini index showing substantial decline during the 1950s, rather than the apparent rapid rise from 1957 to 1959 suggested by indices based on the 'raw' original data.

It is worth repeating here that any empirical study of income inequality is severely constrained by available data, which are usually collected for tax administrative purposes. In the present case the analysis is necessarily restricted to individuals and annual incomes. Where the desired 'welfare metric' is a longer-period measure of income, the relationship between annual and longer measures of inequality are complicated by the possibility of changing patterns of relative income mobility. Furthermore, as in the case of the PAYE introduction considered here, variations in the nature of the population group considered mean that published distributions cannot necessarily be taken at face value.

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<sup>31</sup> Since the Gini for all individuals includes both within-gender and between-gender inequality dimensions it is possible for the latter to dominate such that the 'all individuals' Gini need not lie within the range of value for the two genders separately.

<sup>32</sup> For the period 1998 to 2008, Papps (2010) uses a decomposition of the variance of logarithms to examine within- and between-gender effects, and found evidence that male and female distributions are converging.

An important problem is that it is almost impossible to obtain a consistent measure of ‘income’. For example, the definition of what is included in ‘taxable income’ varies over time, involving, for example, variations in the administration of welfare benefits and whether they are included in taxable income. And, as mentioned above, measured income is substantially affected by regulations regarding the taxation of fringe benefits. The introduction of fringe benefits taxation in the mid-1980s is likely to have increased measured annual income inequality, without necessarily affecting the more fundamental dimensions of inequality.

One particular component of taxable income is also worth bearing in mind – the relatively generous taxable and ‘universal’ New Zealand Superannuation (NZS) introduced in 1977.<sup>33</sup> This means that there is a mode in the total annual income distribution corresponding to those in receipt of NZS. An increase in the extent of superannuation payments (also partly associated with an ageing population) may increase measured annual taxable income inequality, but lifetime inequality may move in a quite different manner.

When examining long period movements in an aggregative measure such as income inequality, there is always a danger of committing the ‘*post hoc ergo propter hoc*’ fallacy: attributing causality to changes purely because they precede the change. Any analysis of the underlying causes of changing inequality is severely handicapped by the fact that the generation of the income distribution is affected by so many complex interacting factors, many of which are central to the functioning of the economy. This paper has offered only an empirical description of income inequality changes over a long period, derived from available data and with some important caveats. However, hopefully this can contribute to more-informed public discussions of policy preferences and prescriptions on this important topic.

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<sup>33</sup> The age of eligibility for NZS has changed, for both males and females, over time.

## **Appendix A: Statistics New Zealand Income Definitions**

This appendix provides the Statistics New Zealand Yearbook definitions of income in Tables 1 and 2.

### *Returnable income*

Returnable income “comprises assessable income plus proprietary income and the classes of non-assessable income. In addition to the proprietary income which is included in returnable income, certain classes of non-assessable income are taken into account in determining the amount of tax payable on the balance of the assessable income. The classes concerned mainly comprise dividends from companies trading in New Zealand, interest on New Zealand Government securities issued free of tax, and interest on company debentures issued free of tax or with a floating rate of interest. Company dividends, or proprietary income in lieu of company dividends, are actually by far the largest source of non-assessable income.” (Statistics New Zealand, 1961).

### *Assessable income*

“The broad principle adopted in calculating the assessable income is that any expenditure or loss exclusively incurred in the production of assessable income for any year may be deducted from the total income from any assessable source for that year. Depreciation is allowed, varying rates for different classes of assets being fixed. The assessable income is approximately equivalent to the net profit as determined by the normal commercial accounting systems. It is, on the whole, rather higher than the commercial net profit, since certain types of expenditure which are regarded as a revenue charge in commercial accounts are not permissible deductions from income for income-tax purposes. Where the operations of a source of income which would be assessable for income tax have resulted in a loss for the year, the loss may be set off against assessable profits from other sources (if any) or, in default thereof, may be set off against assessable profits in the three following years. The Land and Income Tax Amendment Act 1953 extends this period to six years, but does not apply to losses incurred before the income year 1949–50. Capital profits are not assessable and capital losses are not deductible.” (Statistics New Zealand, 1954).

### *Non-assessable income*

“Certain types of non-assessable income, including war pensions and social security monetary benefits, are excluded from the returns, and are therefore completely omitted from these statistics. The social security universal superannuation benefit became part of the assessable income from 1 October 1951. The coverage of the returns is also incomplete in one other respect.” (Statistics New Zealand, 1954).

### *Total income*

Total income corresponds in concept with the returnable income which was used in NZOYB up to 1960 (Statistics New Zealand, 1961). “Total income is used in the sense that it is the total



of the various component items of income. It does not include income which is exempt from taxation, such as social security benefits (other than universal superannuation), the first \$24 of income from interest in 1959– 60 (raised to \$60 from 1960–61), war pensions, workers compensation payments, and certain other types of income.” (Statistics New Zealand, 1961). Because total income is returnable income and the term total income is used in later NZOYB, for convenience, the term total income is used in later sections instead of returnable income.

#### *Analysis total income*

Analysis total income is the estimation of total income. “The data required for statistical compilation of incomes do not become available for a lengthy period after the end of the income year. This, coupled with the necessary time taken by the statistical processing, means an unduly long time lag before results of the compilation are available. To meet this situation provisional estimates are made on a sample basis.” (Statistics New Zealand, 1976). Analysis total income is used for those years in the 1970s when the actual total income is not available.

## **APPENDIX B: Alternative Definitions of Income**

*From NZOYB 1950*

<https://www3.stats.govt.nz/New Zealand Official Yearbooks/1950/NZOYB 1950.html>

*Proprietary Income* - The income-tax year 1940–41 saw the introduction of this classification of income. There are two factors which must be present before the income of a company can be proprietary income in the hands of the shareholder. The first is that the control must be in the hands of not more than four persons. If this is the case, then the company is a proprietary company. The second factor is that a shareholder of a proprietary company is not a proprietary shareholder unless he is entitled to receive not less than one-fifth of the company's income. Only in the case of a proprietary shareholder in a proprietary company is the shareholder's proportion of the company's income transferred to the shareholder's assessment. A proprietary shareholder may be an estate or another company.

Where proprietary income is transferred to the shareholder's assessment, that income becomes assessable income in the hands of the shareholder. The tax is assessed on the taxable balance (including proprietary income), provision being made for a credit in respect of tax already paid on that income by the company. In the statistics such proprietary income is included only in the returnable income. It has been excluded from the assessable earned, the assessable, and the taxable incomes.

*Returnable Income* - In addition to the proprietary income which is included in returnable income, certain classes of non-assessable income are taken into account in determining the amount of tax, &c. Returnable income is obtained by adding to the assessable income the amount of any non-assessable income of the classes used for rate determination. The classes concerned mainly comprise dividends from companies trading in New Zealand, interest on New Zealand Government securities issued free of tax, and interest on company debentures issued free of tax or with a floating rate of interest.

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