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Income Inequality and the Accounting Period in New Zealand: Evidence from Administrative Data*

Nazila Alinaghi, John Creedy and Norman Gemmell

Abstract

This paper examines the effect on taxable income inequality among New Zealand individuals of extending the accounting period beyond a single year. Typically, inequality comparisons are based on a single-year accounting period and involve cross-sectional measures, ignoring the role of income dynamics. The paper uses a specially constructed dataset of the New Zealand taxpayer population since 2000. Results are reported for the population as a whole and for groups distinguished by age, gender, ethnicity and educational qualifications.

JEL Classification: D31; I30: D6.

Keywords: Income inequality, accounting period, Gini coefficient, Atkinson Index.

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Disclaimer

Results reported below are based in part on tax data supplied by Inland Revenue to Statistics New Zealand (SNZ) under the Tax Administration Act 1994 for statistical purposes. Any discussion of data limitations or weakness is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements. Access to the data used in this study was provided by SNZ under conditions designed to give effect for the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the authors, not SNZ or individual data suppliers. These results are not official statistics. They have been created for research purpose from the Integrated Data Infrastructure and/or Longitudinal Business Database which are carefully managed by SNZ. More information about these databases can be obtained at: *https://www.stats.govt.nz/integrated-data/*.

1 Introduction

This paper uses a new and unique dataset of the New Zealand taxpayer population since 2000 to examine the inequality of individual taxable income. Results are reported for the population as a whole and for groups distinguished by age, gender, ethnicity and educational qualifications. The special feature of the analysis is that the effect on inequality of extending the accounting period beyond a single year is investigated. Typically, inequality comparisons are based on a single-year accounting period and involve cross-sectional, or 'static', measures and ignore income dynamics. In view of the scarcity of longitudinal data in New Zealand, this paper undertakes a descriptive review of the evidence available from the new dataset.

In addition to the choice of accounting period, any study of income distribution must make crucial choices regarding the income concept and the unit of analysis. Here, the income concept used is necessarily that of taxable income, which includes wage and salary earnings, self-employment income (shareholder salaries, partnership income), dividends, interests, and rental income. In addition, pensions (including NZ superannuation payments) and other government transfer payments are typically taxable and are therefore included. Regarding the unit of analysis, this paper is based on individuals rather than families or households. Hence, the data cannot capture any form of income sharing among individuals, and are therefore not suited to the study of poverty.

The length of time over which income is measured is irrelevant only in the unrealistic case where all incomes remain constant over time, or all grow at a constant rate (where the inequality measure is based on relative, rather than absolute, incomes). Individual incomes are subject to fluctuations over time, which typically produce changes in individuals' relative incomes, and may also involve changes in the rank order of individuals in the distribution. Relative income changes can in principle be consistent either with increasing or decreasing annual income inequality. Similarly, incomes measures over more than one year may display more or less inequality than incomes in any single year, although longer-period measures cannot be more unequal than

in the year having the highest measured inequality.

Furthermore, in comparative static terms, it is possible for increased mobility to produce both an increase in annual income inequality, and a reduction in longer-period inequality. Since no *a priori* strong tendency exists, it is important to have longitudinal data so that the empirical characteristics can be measured.[1] A longer-period measure may be said to subsume the complex changes in relative incomes – the mobility process – and reflect the net effect of equalising and disequalising changes. It is also important to know if extending the accounting period beyond a certain length of time continues to have an effect on longer-period inequality. If inequality were found to stabilize beyond some point, generalisations about longer-period inequality would not need data extending over, say, the complete lifetime of individuals.

Longitudinal information in New Zealand has previously been scarce because of the absence of suitable survey data, and the extremely limited access to register microdata. An early study, using linked Inland Revenue data, is Creedy (1996), who used three years of tax return data to estimate a cohort income model and examine the dynamic of earnings over the life cycle for males and females in New Zealand.[2] More recently, the increasing availability of longitudinal data has resulted in substantial progress. For example, using three five-year longitudinal samples of around 35,000 New Zealand taxpayers, Creedy and Gemmell (2018, 2019, 2019a) and Creedy *et al.* (2021) examine some income mobility properties, highlighting important differences in interpreting inequality outcomes compared to outcomes obtained from cross-sectional inequality analysis.[3]

In New Zealand, microdata can now be made available to authorised researches working in specially created Statistics New Zealand (SNZ) datal-

[1] Despite the wide range of possibilities, previous studies have broadly found that mobility in individual incomes over time leads to estimates of longer-term inequality being lower than shorter-term inequality. This finding, in an early study of mobility, led Shorrocks (1978) to propose a mobility measure based on the extent of the reduction as the accounting period is extended.

[2] This approach was recently replicated and extended, using more recent data, by Creedy *et al.* (2021); see also Le *et al.* (2006).

[3] This anonymised dataset was specially constructed within the Inland Revenue department, and made available under a special agreement.

abs. The availability in these datalabs of administrative register data, such as from individuals' tax records, makes the construction of longitudinal data possible through the matching of income records for individuals over time. These data sources provide several advantages compared with sample surveys. Administrative data have very large sample sizes, improved coverage of top incomes, avoidance of survey respondent dropout or attrition, and fewer measurement errors. However, since the data are often originally collected for tax purposes, they contain limited demographic information. Obviously, they cannot capture those who do not interact with the income tax system.

The register-based data on taxable incomes in SNZ's large confidential research database, the Integrated Data Infrastructure (IDI), can be matched with other sources of information on individual and family characteristics. This provides a rich source of longitudinal information on the New Zealand taxpaying population. While recognising the limitations of such data, for example the absence of information on non-taxable income, the dataset used in this paper provides the most comprehensive information to date on NZ taxpayers' incomes, suitable for inequality and mobility analysis.

The data used here include the full NZ population of taxpayers from 2000, and were extracted from the IDI. A number of administrative datasets, including the Income Tax Register, were merged to form the final dataset. The primary database, covering the Inland Revenue individual taxpayer population, contains detailed tax return information such as wage and salary earnings, self-employment income, pensions, and capital income. Socioeconomic variables such as gender, age, ethnicity and highest educational qualification were then added to the primary dataset.

The construction of the dataset is described in detail in Alinaghi *et al.* (2020); for convenience this is referred to below as the ACG dataset. From a population of 5,393,874 taxpayer observations for whom there is taxable income information in the IDI for at least one year of data, over the 18 years 2000 to 2017, a sub-sample of 1,605,192 individuals is available with income data for all 18 years. This forms the 'base' dataset used in this study. When considering demographic decompositions, the total number of observations is further reduced due to missing observations for some demographic variables.

This means that, for example, the dataset used to construct single and multi-period inequality measures contains 1,447,755 individuals; see Table 1.

Section 2 reports annual measures of Atkinson and Gini indices for the period 2000 to 2017. Measures based on extending the accounting period by accumulating incomes from one year to up to 18 years are presented in Section 3. In each case aggregate results are followed by results for various demographic groups. Section 4 provides brief concluding remarks.

2 Annual Measures of Inequality

This section reports results for two summary measures of inequality, the standard Gini and Atkinson indices, over the period 2000 to 2017. Comparisons are made with results obtained by previous studies of NZ incomes. Among alternative indices, the Gini coefficient is most frequently quoted, perhaps due to its apparent ease of interpretation in terms of the famous Lorenz Curve diagram. However, since the computation of the Atkinson index requires explicit value judgements concerning the degree of aversion to inequality (unlike the Gini where these judgements are implicit), it provides a more transparent measure. Both indices have the convenient property that values range from zero (complete equality) to one (complete inequality).

Comparisons with other data sources are difficult, because studies differ in the income measure (or 'welfare metric') used, and the unit of analysis.[4] For example, using Household Economic Survey (HES) data, Ball and Creedy (2016) examine the inequality of household income per adult equivalent person, using the individual as the basic unit: that is, each value of income per adult equivalent person is weighted by the number of people in the household. They provide Gini inequality measures over the period, 1984 to 2013. Comparisons are also made here with Ministry of Social Development (MSD,

[4] A complication when comparing alternative household based Gini estimates is that studies vary in the ways in which household incomes are adjusted to achieve 'adult equivalent' incomes within each household, and whether, after equivalence adjustments, the unit of analysis is the individual, adult-equivalent individual or household. See Creedy (2017) for discussion and Creedy and Gemmell (2019) for a comparison of Lorenz curves for cross-sectional and logitudinal samples.

2019), the latest update in a series of MSD income reports. This reports a variety of annual income inequality measures from 1982 to 2018, none of which includes the Atkinson index.[5] Furthermore, a study by Laws (2014) uses a sample of taxable income data for individual taxpayers over the period 1994 to 2012. The Laws dataset is based on a 2 per cent sample of Inland Revenue income taxpayers, while the present paper uses the larger IDI dataset drawn from the total taxpayer population. Unlike Laws (2014), the ACG dataset excludes taxpayers with zero or negative taxable incomes.[6]

In an earlier review of the New Zealand experience of income inequality, Barker (1996) identified four distinct periods: declining inequality between approximately 1951 and 1977, followed by a tendency to rise between 1977 and 1987. A more rapid rise over 1987-1991 was then followed by stability. This stability was subsequently estimated to have continued during the 2000s and 2010s. For example, Ball and Creedy (2016) report Gini inequality measures of annual income per adult equivalent person, showing that inequality remained steady following increases during the late 1980s and early 1990s.

2.1 All Individuals

Using the ACG dataset, annual cross-sectional results for the Gini and Atkinson indices for taxable incomes over the period 2000 to 2017 are shown in Figure 1. The Atkinson measure is reported for two values of relative inequality aversion, ε, of 0.2 and 0.9.[7] These reveal relatively constant values for each index, apart from higher values around 2000 (associated with tax reform in 2000-2001 as discussed below), and a slight rise in 2017. The absence of sizeable annual fluctuations, that are sometimes observed in survey-based

[5] An earlier study by Creedy and Sleeman (2005) examined New Zealand household income inequality using the Atkinson index.

[6] In general, Inland Revenue practice with their taxable income data is to transform all the negative taxable incomes to zero. Laws (2014) notes that some zero taxable incomes are omitted from the IR 2 per cent sample that she uses. However, where a tax return has been submitted and this shows zero or negative taxable income (such as with business income losses) the IR sample, but not the IDI data used here, treats all such incomes as zero; see further discussion below.

[7] For details on the Atkinson inequality measure and its interpretation, see Creedy (2016, 2019).

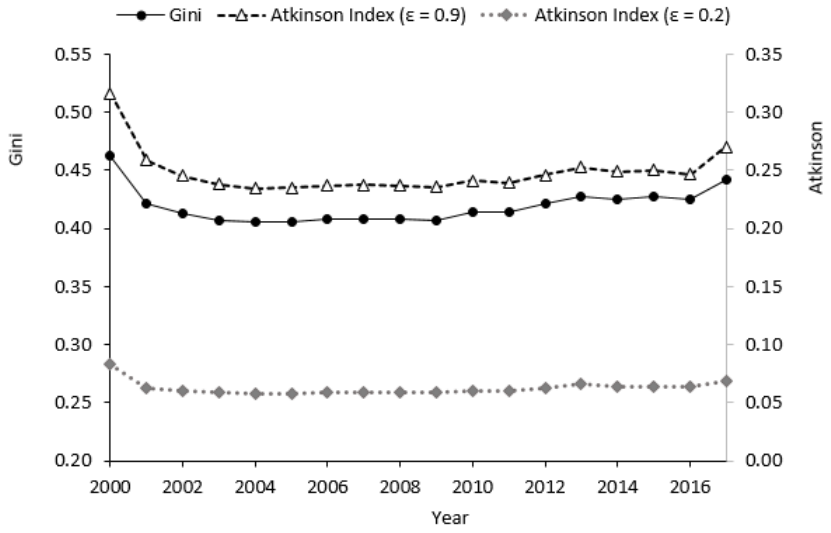

Figure 1: Annual Inequality: Gini and Atkinson Indices

and small-sample series (see below), most likely arises from the large, constant taxpayer population on which the present estimates are based.

Comparing the two Atkinson indices, the lower aversion to inequality series ($\varepsilon = 0.2$) reveals less variability than the higher aversion to inequality series ($\varepsilon = 0.9$), suggesting that the noticeably higher values of the latter index in 2000 and 2017 are especially associated with changes in higher incomes in those years, either in the form of tax rate increases as seen in 2000-2001 tax reform or the anticipation of tax rate increases in 2017. This is because higher aversion attaches less weight to high incomes.

The Gini and Atkinson series shown in Figure 1 can be compared with previous estimates from Ball and Creedy (2016) and MSD (2019) for households, and with Laws (2014) for individuals. Figure 2 compares Gini coefficients. This shows Ginis for household market income and disposable income, and for individual taxable income based on the Inland Revenue's 2 per cent sample (Laws, 2014).[8] As expected, the inequality of household disposable

[8]For details of the construction of the IR sample, see https://www.ird.govt.nz/about-us/tax-statistics/revenue-refunds/income-distribution.

incomes is lower than for market incomes, reflecting the equalising effects of income taxes, tax credits and social welfare benefits. The extent of inequality of individual taxable incomes varies somewhat between the Laws sample, labelled AL 2014, and the population-based estimates here. In particular the ACG estimates appear to lie between the two household income series though these are not directly comparable since household incomes (and the assumed household sharing and unit of analysis used to construct them) are very different from individuals' taxable incomes.

The Laws (2014) sample suggests slightly higher inequality of taxable incomes than the ACG data; this is discussed further below. In addition, where data extend back further than 2000, it can be seen that these confirm a spike in the inequality indices in 2000 or 2001.[9] Both this spike, and the spike observed in 2011, coincide with the change in the top personal income tax rate applicable to high incomes. This encouraged a backward shift in declared taxable income to 2000 from 2001, when the top tax rate rose, and a forward shift from 2010 to 2011, when the top tax rate fell. By increasing the amount of top incomes declared for tax in the relevant (lower tax rate) years, these two shifts tend temporarily to increase measured inequality in those years, and reduce it in the adjacent (higher tax rate) years.

Figure 3 focuses on individual incomes, and compares Gini and Atkinson indices from ACG's IDI data and the Laws (2014) IR sample data. The Ginis in the top panel of the figure include Ginis for 'working age' individuals from Laws (2014) and defined as those between age 25 and 64. Again, all three indices suggest similar patterns, but with less fluctuation in the ACG series except for the larger fall in 2001. The ACG Ginis appear to be systematically lower than those calculated by Laws (2014): around 0.4 rather than around 0.5, with the Laws working age series somewhat lower at around 0.47.

The Atkinson series, A, in the lower panel of the figure indicates a rela-

[9] The household series reported here are obtained from HES data. This survey collects income data in four quarters throughout the year (July to June), with participants reporting their income over the previous year. The taxable income data on the other hand refers to income within the relevant tax year (April to March). Hence HES income data reported as '2001' will overlap considerably with Inland Revenue taxable income data for '2000'.

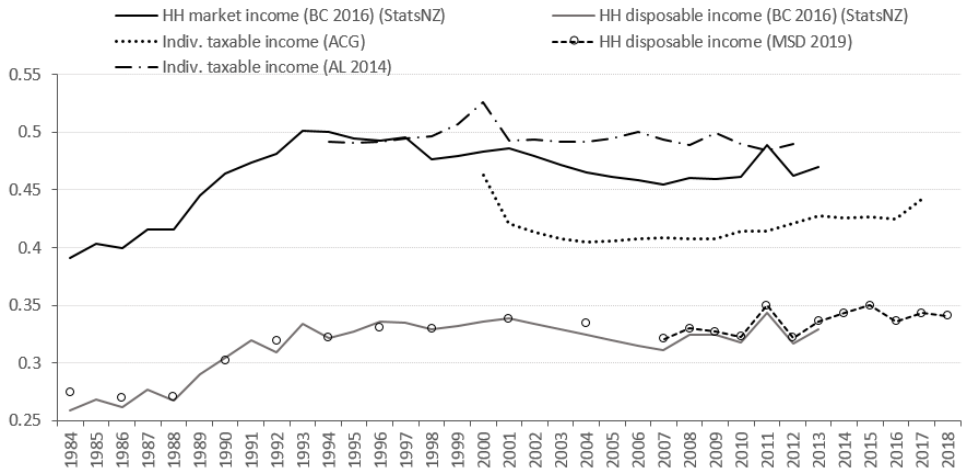

Figure 2: Gini Coefficients: Households and Individuals

tively small difference between the ACG and Laws estimates for $\varepsilon = 0.2$ with both series relatively flat around $A_{\varepsilon=0.2} = 0.06$ to 0.08 (right-hand axis). However for $A_{\varepsilon=0.9}$, the Laws (2014) estimates are around 0.50 to 0.55, while ACG estimates are noticeably lower at 0.25 to 0.30 (left-hand axis). This higher value for $A_{\varepsilon=0.9}$ would appear to arise from the presence of individuals recorded as having zero taxable income in Laws's 2 per cent IR sample, whereas the ACG dataset excludes such zero incomes.[10]

[10] Consistently, when individuals recorded with zero taxable income are retained in the larger ACG dataset, values of $A_{\varepsilon=0.9}$ around 0.5 are obtained. Such a large difference between the ACG and IR sample results for $A_{\varepsilon=0.9}$ when zeros are excluded in the former would not be expected for $A_{\varepsilon=0.2}$ because the $\varepsilon = 0.2$ case involves much less aversion to inequality, and hence attributes much less weight to zero incomes when these are present in the dataset.

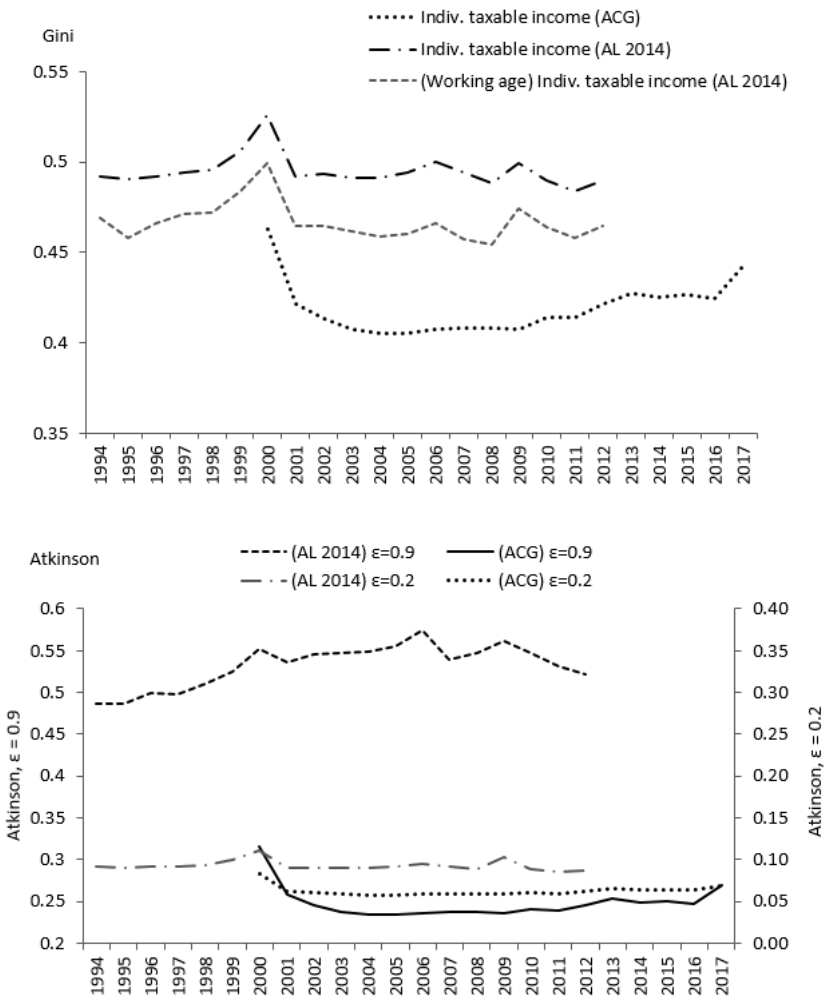

Figure 3: Gini and Atkinson Indices: Individuals

2.2 Demographic Groups

Decompositions of the total taxpayer population, with annual data over the 2000 to 2017 period (around 1.447 million), are shown in Table 1, for gender, age, ethnicity and highest educational qualification.[11] This indicates that the gender composition is close to 50:50 between males and females; the working-age group is 85 per cent of the total (1.234 million); while Māori and Pasifika represent 14 per cent and 4 per cent respectively of all individuals. 'Other' ethnicities recorded in the dataset include European, Asian, Middle Eastern/Latin American/African and 'Other'.[12]

Data on highest educational qualifications are constructed such that an individual is assigned to a category according to their highest qualification obtained in any year during the 2000 to 2017 period of interest. For example, an individual obtaining a university degree in 2005 is allocated to this category throughout the period for which data are available. This avoids changes in sub-sample sizes for each qualification category during the period, and reflects the interest here in an income decomposition based on an individual's educational capability or potential (as demonstrated by their highest qualification) rather than distinguishing incomes pre- and post-qualification.

Table 1 shows that the highest educational qualification is 'none' for around 20 per cent of individuals, close to those with university degrees (18 per cent). Individuals with 'school' and 'post-school' qualifications represent 36 and 26 per cent of the total respectively. 'Post-school' qualifications include diplomas and other non-degree qualifications from higher education institutions such as technical colleges and Wānanga.

[11] Working age, 20-64, is defined for each year in the dataset. The numbers shown here relate to 2002.

[12] In the 2018 New Zealand census, out of a total population of 4,699,755 individuals, ethnicity percentages were as follows: European (70), Māori (17), Pasifika (8), Asian (15), MELAA (Middle Eastern, Latin American, and African) (1), and Others (1). These percentages add to more than 100 percent because individuals are able to register more then one ethnicity. In the dataset used here a single 'prioritised ethnicity variable' has been created by assigning ethnicity to each individual according to the following priority ordering: Māori, Pasifika, Asian, European, MELAA, and Other. For example, an individual is classified as Māori, if their ethnic code in one of the data sources where this information is recorded is Māori. This process is repeated for other ethnic groups in order; see Alinaghi *et al.* (2020, p.11-12) for further details.

Table 1: Sample Sizes by Decomposition

Gender:		Ethnicity:	
Male	736,371	Māori	200,451
Female	711,384	Pasifika	64,692
		Non-Māori, non-Pas.	1,182,612
Age:		Highest educational qualification:**	
Working*	1,233,516	None	250,140
Non-working	214,239	School	457,917
		Post-school	325,521
		University	222,543
Total	1,447,755	Total	1,256,121

* Ages 20-64. ** Educational sub-totals sum to a smaller total due to missing qualifications data for some individuals.

Following the same procedure as in Section 2, three annual inequality indices were obtained: the Atkinson Index, A, for two inequality aversion parameters, $\varepsilon = 0.2$ and $\varepsilon = 0.9$, and the Gini Index, G.[13] As expected, the levels of the two Atkinson indices were different, but the patterns displayed over time and across sub-samples are almost identical. To save space, only A ($\varepsilon = 0.9$) values are therefore reported in this subsection. Figure 4 shows profiles of values for A ($\varepsilon = 0.9$) and G for 2000 to 2017 for all individuals and for working age individuals, and separately for males and females.

Both A and G reveal similar patterns over time. Following a decline in inequality from 2000 to 2001, associated with the temporary effects of the 2001 tax reform, as discussed above, inequality levels remain fairly constant throughout the period, at around $A = 0.25$ and $G = 0.42$. There is some suggestion of a small increase in both measures at the end of the period, in 2017. This effect is observed across all decompositions (see below) and, unlike in 2000, is not readily explained by any major policy changes or economy-wide events. However, it is possible that there was an 'election effect', involving the anticipation of tax rate increases, on the timing of declared income flows.

[13] All data in this subsection exclude individuals with zero or negative income as the Atkinson index is not defined for those values.

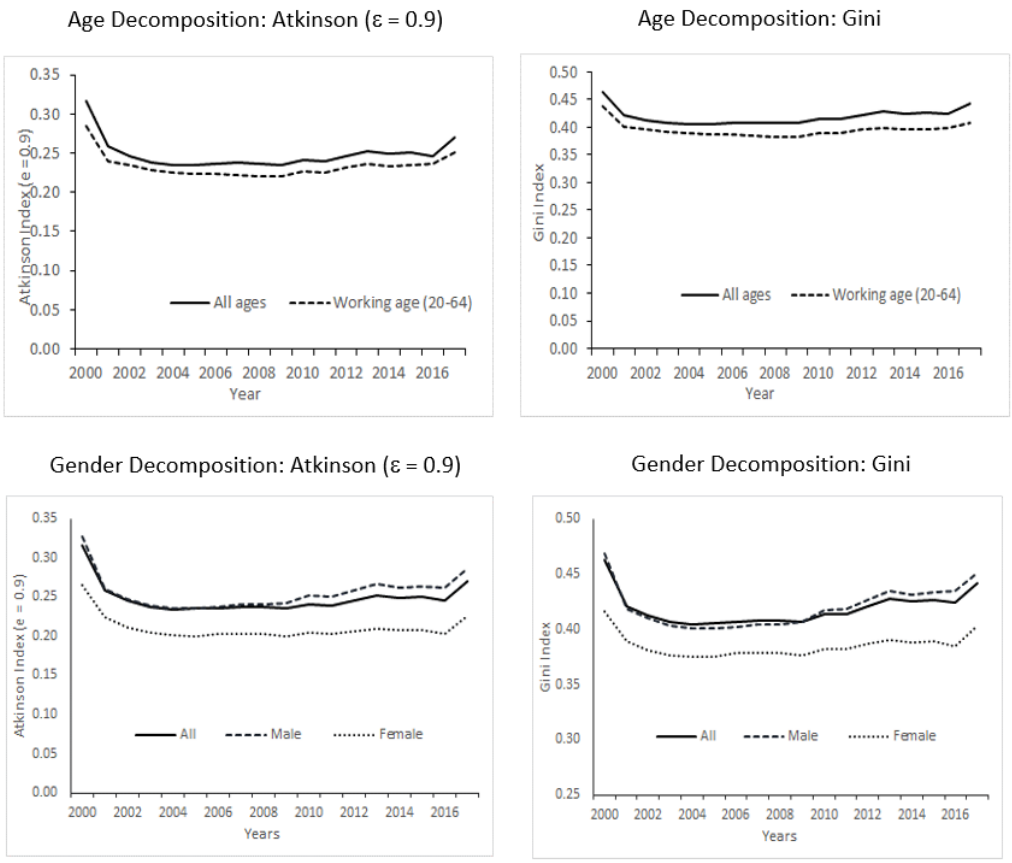

Figure 4: Annual Inequality: Age and Gender

Inequality measures in Figure 4 indicate that inequality levels for working age individuals are similar to, but slightly lower than, those for all individuals. This is not surprising since inequality between retirees and working age individuals can be expected to be greater, thus tending to raise inequality measures for all individuals compared to those of working age, even if within-retiree inequality is lower. Nevertheless, changes over time in the two age profiles are similar. This at least partly reflects the dominance, at 85 per cent, of working-age individuals in the total sample size.

Figure 4 also indicates that inequality among males is greater than inequality among females. For example, the Gini index is around 0.38 for females, and around 0.42 for males. These represent within-gender inequal-

ity. Following declines for both genders until about 2004, male inequality rose from $G = 0.40$ in 2004 to 0.44 in 2016, while female inequality remained relatively constant around $G = 0.38$. The profile for all individuals in Figure 4 captures both within- and between-gender inequality, and this generally mirrors intra-male inequality. This does not reflect a heavier weighting for males, since there are similar numbers of each in the dataset; see Table 1. Rather, it suggests that levels of between-gender inequality are similar to, or greater than, within-male inequality, thus counteracting the lower within-female inequality.

Figure 5 shows annual inequality for groups distinguished by ethnicity and highest educational qualification. For ethnic groups, similar patterns over time are observed to those for age and gender breakdowns. There are declining inequality values from 2000 to 2004, then slight rises to 2016 and a more noticeable rise in 2017. Separate profiles of A and G are shown for Māori, Māori and Pasifika, and all others combined (non-Māori, non-Pasifika). Both A and G measures suggest lower inequality within Māori or Māori and Pasifika ethnicities compared to others. This is perhaps not surprising given the more heterogenous nature of the other ethnicities (European, Asian, Middle Eastern and so on). Given the dominance of non-Māori, non-Pasifika enthicities, inequality levels for all individuals largely reflect those for that group.

For educational groups, Figure 5 reveals different inequality levels across educational categories, and over time. Inequality is generally lowest within the post-school qualification group, and highest among the university-degree group. Inequality within the 'no qualifications' and 'school qualifications' groups is generally similar to each other, and intermediate between post-school and university degree groups, which also demonstrate a general decline in inequality over the period. Inequality for the other two groups (with 'no qualifications' and 'school qualifications') remains steady, at least from 2002.

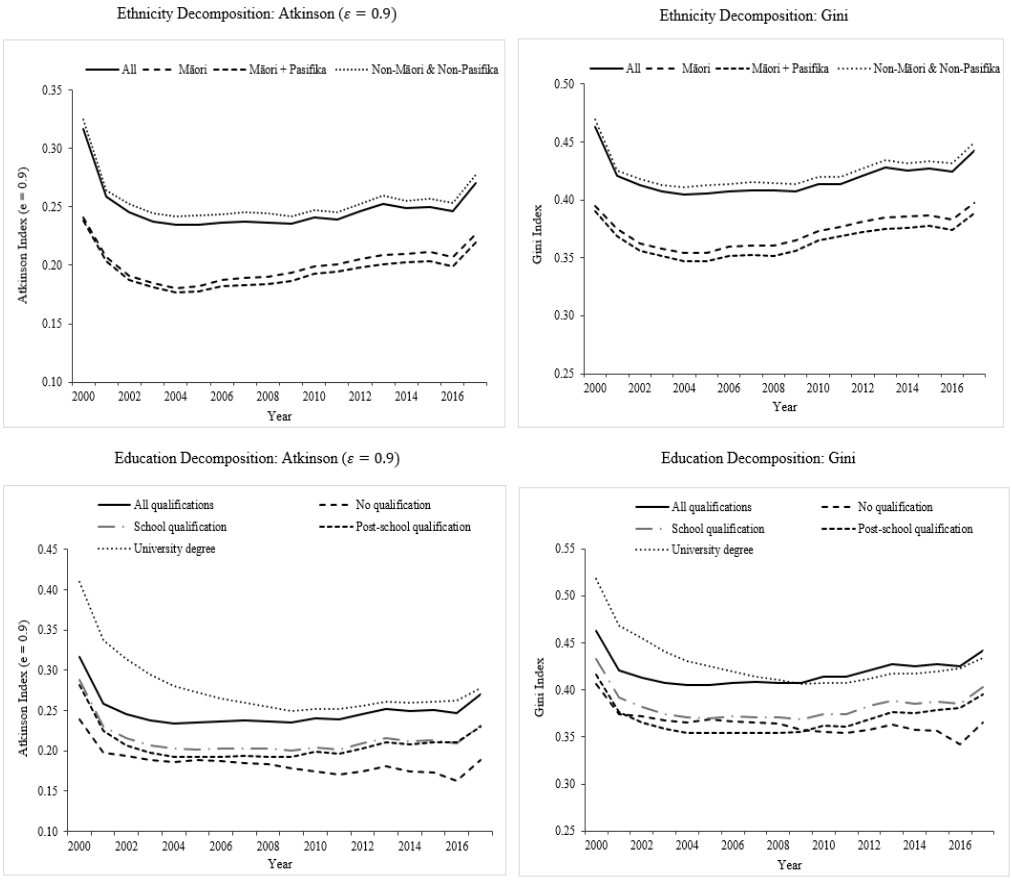

Figure 5: Annual Inequality: Ethnicity and Education

It is unclear what lies behind this 'compression' of incomes over time among those with university degrees or post-school diplomas. It cannot be due to changes in the sample composition with these longitudinal data, given the educational group definitions described above. However, for the same reason, each educational subsample, and the total, embody an ageing process such that all individuals in this dataset are 15 years older at the end of the period than at the beginning.

The declining inequality evidence for those two most-educated groups may represent a tendency for inequality to fall as individuals with those qualifications age. This can occur, for example, when the age-income profile rises from low levels initially at young ages but flattens in middle age and

beyond, as shown in Alinaghi *et al.* (2022). As a result, the ageing process tends to reduce the dispersion of a given longitudinal sample of such individuals. Conversely, for groups with little dispersion in wage levels by age, the ageing process will have a smaller effect on average inequality levels within the group over time.

3 Lengthening the Accounting Period

This section examines the effect on measured inequality of extending the accounting period. As explained above, a panel of the same individuals over time is used. The dataset is extracted from the full NZ population of taxpayers covering eighteen consecutive years of data from 2000 to 2017. The exercise involves calculating Atkinson inequality measures (again for two inequality aversion parameters, $\varepsilon = 0.2$ and $\varepsilon = 0.9$) and the Gini index covering the same individuals, for one year (2000), two years (2000 and 2001), three years (2000, 2001 and 2002), eventually reaching eighteen years (2000 to 2017) for the longer accounting period. This provides a 'forward looking' series. An equivalent 'backward looking' series, with a starting year of 2017, is also examined. This gives a population of 1,447,755 taxpayers with data in each of the eighteen years.[14]

3.1 All Individuals

Figures 6, 7 and 8 plot Atkinson and Gini inequality measures for various accounting period lengths. To highlight the significance of the accounting period, estimates of annual income inequality using the same longitudinal dataset are added to each plot. Three properties are evident. First, as expected, the annual income inequality is larger than the longer-period measures. Second, both forward and backward looking series indicate that increasing the length of time over which income is measured reduces observed

[14] In additional results available from the authors, (larger) longitudinal taxpayer samples covering 12 years (2000-2011) and 7 years (2000-2006) were also constructed. These confirmed that the patterns reported in this section for Gini and Atkinson indices as additional years are added, are not sensitive to sample selection. Other descriptive statistics are also similar to the 18 year, 2000-2017, sample.

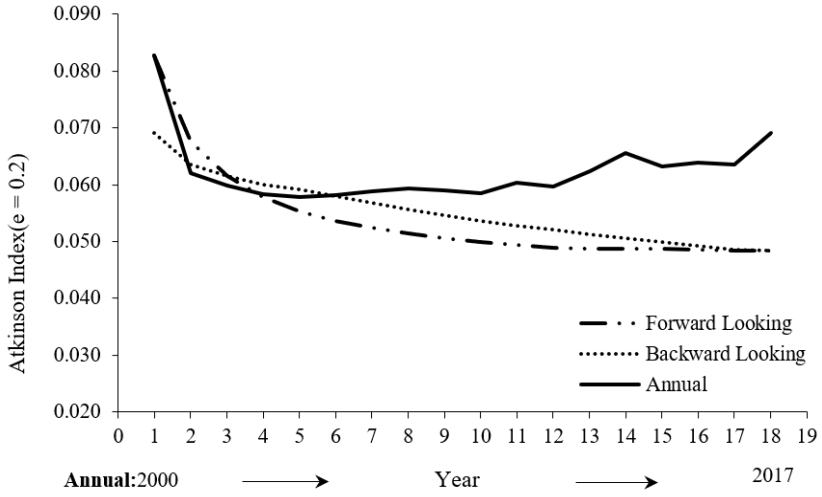

Figure 6: Atkinson Index ($\varepsilon = 0.2$) by Length of Accounting Period

income inequality. Third, as a result of the 2000-2001 tax reform, which mainly affected the top marginal income tax rate, income inequality dropped substantially. This '2001 effect' is relatively smaller for the higher inequality aversion parameter ($\varepsilon = 0.9$) where a lower weight is assigned to higher income individuals.

Figure 8 shows the equivalent profile for the Gini coefficient as the accounting period is extended in the same manner as in Figures 6 and 7. While the overall decline as the accounting period is extended is somewhat less than for each Atkinson measure, the patterns are similar. The Gini coefficient also displays the '2001 effect' associated with the tax reform.

To isolate the '2001 effect', the procedure was replicated, but starting in 2002, and hence generating sixteen years for the accounting period, covering 2002 to 2017. The results are shown in Figures 9, and 10 for the Atkinson measures.

3.2 Demographic Groups

As in the previous section, the effects of extending the accounting period are examined here for the working-age group, and by gender, ethnicity and

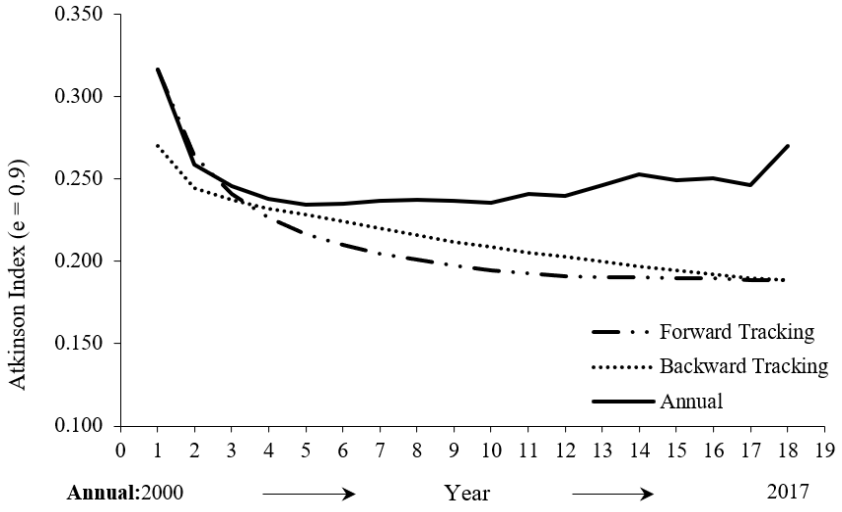

Figure 7: Atkinson Index ($\varepsilon = 0.9$) by Length of Accounting Period

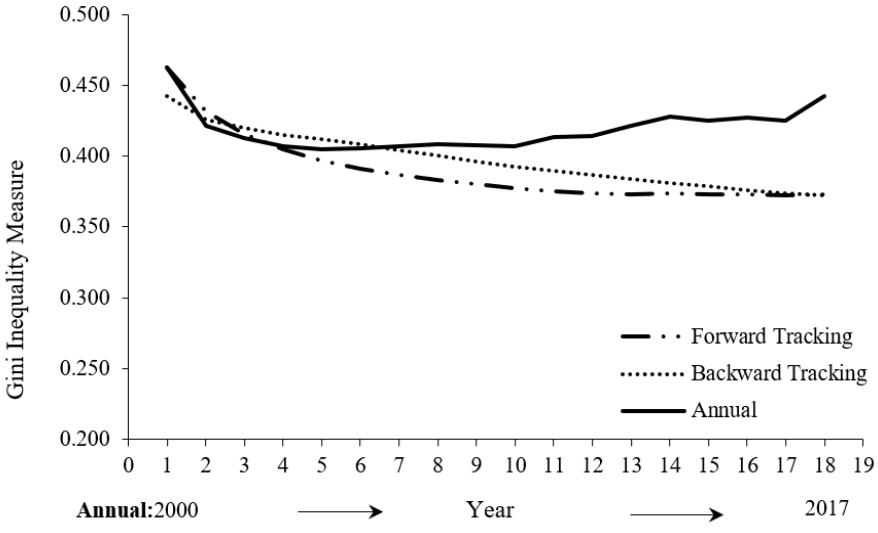

Figure 8: Gini Index by Length of Accounting Period

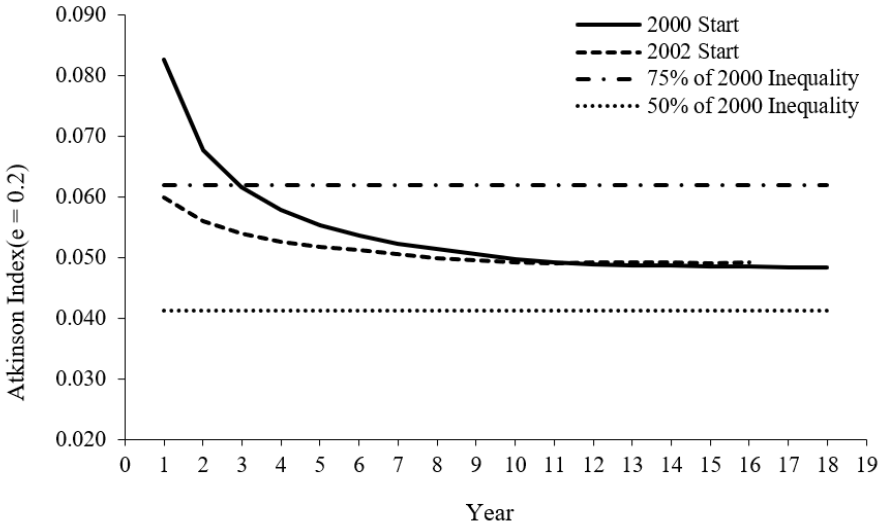

Figure 9: Atkinson Index ($\varepsilon = 0.2$) by Accounting Period (2000 versus 2002)

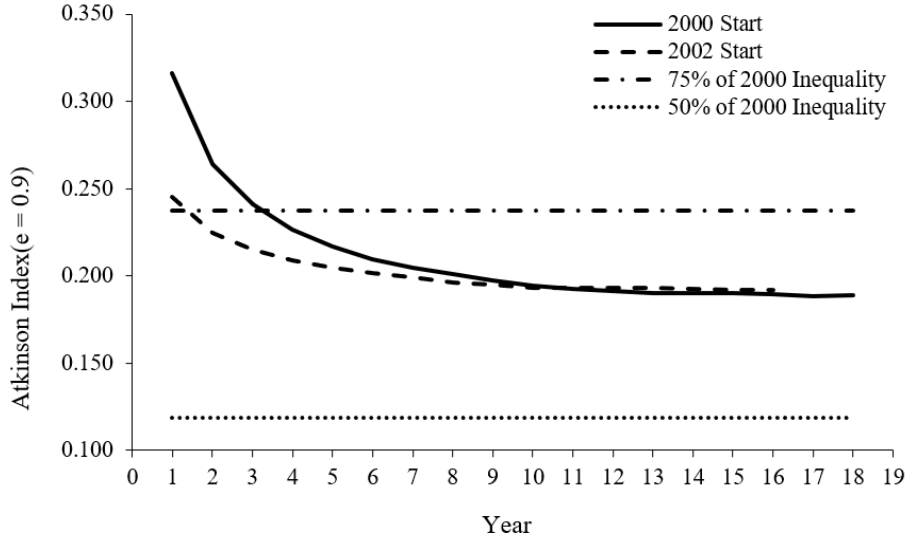

Figure 10: Atkinson Index ($\varepsilon = 0.9$) by Accounting Period (2000 vs. 2002)

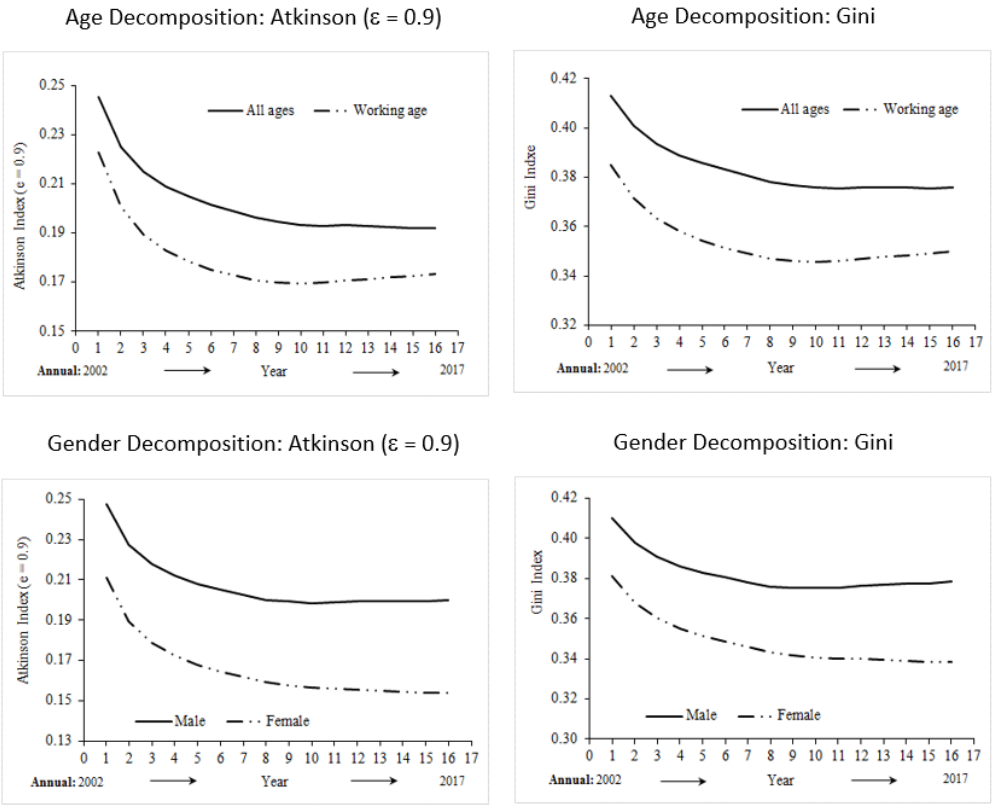

Figure 11: Extending the Accounting Period: Age and Gender

highest educational qualification.[15] Figure 11 reports the value of the Gini and Atkinson measures ($\varepsilon = 0.9$) as the accounting period over which income is measured increases from one to sixteen years. This exercise begins in 2002, rather than 2000, to avoid cumulative estimates being affected by the temporarily high values of those indices in 2000 and 2001 as discussed above. The chart shows Gini, G, and Atkinson, A, estimates by age and gender; Figure 12 records similar estimates by ethnicity and education. All estimates are based on a 'forward-looking' sample from 2002.

The top left-hand panel of Figure 11 indicates that, when based only on 2002 income data for all ages, $A_{\varepsilon=0.9} = 0.25$. This falls steadily, at a diminishing rate, as incomes in subsequent years are added, reaching $A_{\varepsilon=0.9} =$

[15] The samples used here are the same as those reported in Table 1.

0.19 in 2017. Indeed, by around year 11 onwards the profile is relatively flat, indicating that adding further years to the total incomes has a minimal effect on the level of inequality. A similar pattern holds for the Gini measure in the top right-hand panel of Figure 11. Equivalent profiles for the working-age group indicate both a lower overall level of inequality, as observed in Figure 4, and a similar pattern of decline as years are added. The profiles again flatten with around 10 years of cumulated data. For each of those measures, after reaching a 10-year accounting period, the level of the Atkinson measure of inequality for working age individuals is around 75 per cent of its single-year value in 2002, while the Gini index is around 90 per cent of its single-year value.

Figure 11 reveals the same patterns for males and females. The main difference (in addition to the lower inequality for females) is that, whereas male inequality measures appear to stabilise by around year 10, the female inequality measures continue to fall, if slowly, to the 16-year accounting period. However, they appear to be approximately constant by that point, suggesting that adding further years would have a limited effect.

Figure 12 reveals similar patterns for ethnic and education groups, whereby one-year differences in inequality for these groups tend to be preserved, as the inequality measure for each declines with added years of data. That is, profiles of A and G generally do not intersect as years are added, and initial differences are preserved even with 16 years of income data. For educational groups, the decline in the A and G measures for those with university degrees is most pronounced. For example, $A_{\varepsilon=0.9}$ falls from 0.31 with a single year period, to 0.197 with an accounting period of 16 years (while G falls from 0.46 to 0.38). Thus, the 16-year value is only 63 per cent of the single cross-section value for $A_{\varepsilon=0.9}$ in 2002, and 82 per cent in the case of G.

4 Conclusions

This paper has used a unique and extensive dataset of New Zealand individual taxpayer incomes, based on longitudinal data from tax records over an eighteen year period, to examine various measures of income inequality and

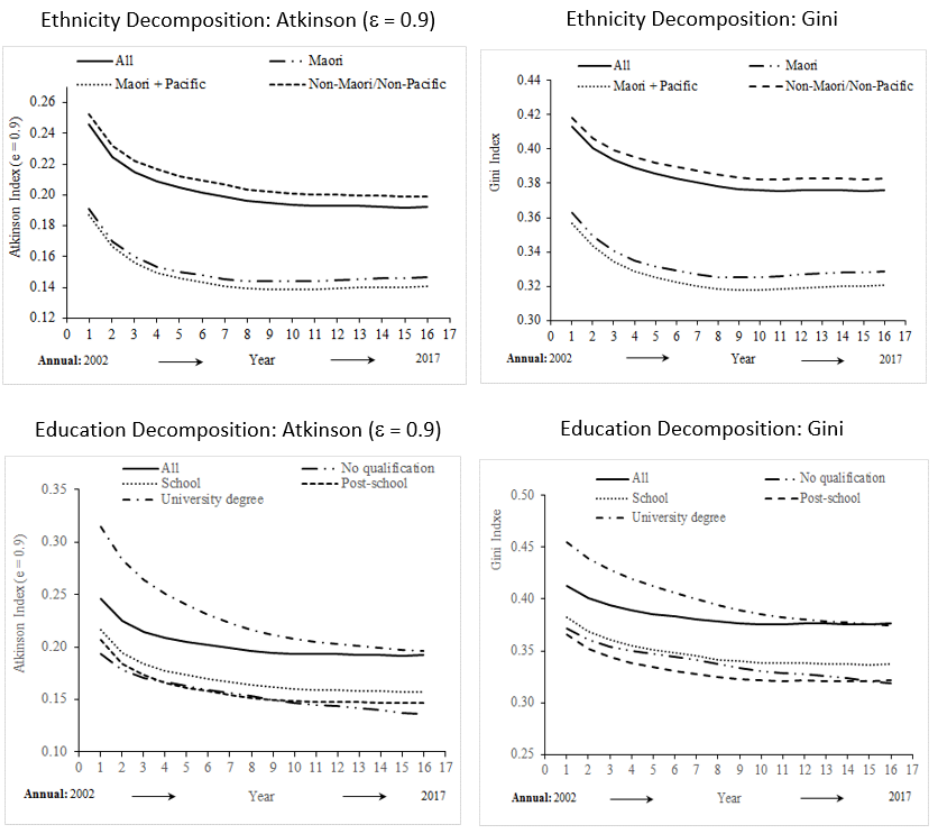

Figure 12: Extending the Accounting Period: Ethnicity and Education

their patterns of change over time. The longitudinal data for the full 18-year period, 2000 to 2017, include around 1.5 million taxpayers. Two commonly-used income inequality measures, the Gini and Atkinson indices, were used to examine annual cross-sectional inequality over the 18 years, and longitudinal equivalents. The paper also examined the extent to which extending the accounting period over which incomes are measured, from one year to multiple (up to 18) years affects measured inequality. For each of those exercises, results were obtained for a number of population decompositions, including by gender, working age status, ethnicity and highest educational qualification.

Overall inequality results suggest that, following a large drop in all annual inequality measures from 2000 to 2001, most likely due to an atypical rise in inequality in 2000 associated with tax reforms around that year, inequality generally remained flat or rose slightly over 2001 to 2016. A more pronounced rise in 2017 is harder to interpret and may also represent a short-term 'spike'.

These time-series patterns are generally repeated for each of the decompositions examined. *Within-group* inequality is generally lower for females than for males, and inequality is lower within Māori and Pasifika subgroups compared to non-Māori, non-Pasifika subgroups. Within educational subgroups inequality appears to be highest among those with university degrees but lowest for those with no educational qualifications. This latter result is not surprising, as those with few or no qualifications are likely to have a relatively common experience of low wages or (taxable) benefit levels. For those with university degrees, the result reflects substantial heterogeneity in the realised returns to higher education. This is to be expected given that the coverage of university qualifications in this category includes a wide range of bachelors, masters and PhD degrees across multiple disciplines.

Examining income inequality with longer accounting periods, results confirmed that measured inequality falls systematically as income is measured over longer periods. However, this decline tends to level out beyond about 10 years of data, at least for males. This suggests that ten years worth of income data may be sufficient to proxy for 'lifetime' income inequality. For females, inequality measures continue declining beyond a cumulative ten year horizon. Nevertheless, inequality profiles become relatively flat once twelve

or more years of data are included.

Based on an educational qualification decomposition, adding more years to the cumulative income measure suggested that, at least for those with university qualifications, beyond 15 years there was still some evidence of declining inequality, but with subsequent further declines likely to be small. For most other educational qualification categories, inequality profiles were found to be relatively flat after around ten years.

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