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WORKING PAPER 04/2022
March 2022

Working Papers in Public Finance

VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA

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Inter-Decile Income Movements of Individuals in New Zealand: Evidence from Administrative Data*

Nazila Alinaghi, John Creedy and Norman Gemmell

Abstract

This paper provides an empirical description of the income mobility of individual incomes in New Zealand over the period 2002 to 2017, using information from transition matrices. These capture movements of individual taxpayers between deciles of the income distribution over periods ranging from one to fifteen years. Transitions for sample decompositions by age, gender, ethnicity and education level are also expored. Though 1-year transitions indicate considerable inertia or stability, a relatively high degree of movement between deciles is observed across most of the distribution over longer periods. Different age, gender, ethnicity and educational qualification decompositions reveal remarkably similar patterns of inter-decile movement.

JEL Classification:

Keywords: Income mobility,

*This paper is part of a project on 'Measuring Income Inequality, Poverty, and Mobility in New Zealand', funded by an Endeavour Research Grant from the Ministry of Business, Innovation and Employment (MBIE) and awarded to the Chair in Public Finance at Victoria University of Wellington.

Disclaimer

Results reported below are based in part on tax data supplied by Inland Revenue to Statistics NZ (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

Although the distribution of income has received considerable attention in recent years, most discussions focus on 'static' measures in that they pay attention to cross-sectional comparisons of a short-term – usually annual – income measure. However, it has long been recognised that for many purposes, both positive and normative, income measured over a longer accounting period provides more valuable information. In such cases, the highly complex relative income dynamics and positional changes within the distribution are subsumed into the longer-period measure. When analysing the changing distribution of income over time, and the processes determining the evolution of the form of the distribution, it becomes important to understand the nature of those income changes. Some processes are equalising, for example where there is a systematic tendency for lower-income groups to experience relatively larger income growth compared with higher-income groups. Yet other processes, which generate apparently random income changes, are inequality-increasing.[1]

Furthermore, judgements about income mobility are not straightforward. Some aspects of change, from a 'social welfare' evaluation point of view, may be considered 'good' by an inequality-averse judge. A substantial amount of mobility may be viewed as being useful in generating desirable distributional changes. Yet, for individual income earners who are averse to risk, a highly variable income stream may not be welcomed *ex ante*, as well as *ex post*. Decreasing marginal utility ensures that an individual would prefer a steady income stream compared with a variable stream having the same total income. The dynamic process, and attitudes to it, are also complicated by the fact that income changes for some individuals may arise from exogenous factors (such as changes in health and market conditions), while other changes can arise from endogenous choices (for example, in response to income tax changes).

[1] In making cross-sectional comparisons, the inequality of annual income may change over time as a result of changes in the structure of the population being considered (through some kind of 'birth' and 'death' process). However, in making comparisons using longitudinal data for a fixed group of individuals, as in the present paper, this does not arise.

The present paper, rather than attempting to disentangle the various components of distributional change, or examine the implications of adopting different value judgements, provides an empirical description of the income mobility of individual incomes in New Zealand over the period 2002 to 2017. Such a descriptive analyses is warranted in view of the fact that the necessary longitudinal data have been extremely scarce in New Zealand.[2] This paper uses a unique dataset of the New Zealand taxpayer population to examine income transitions over different periods of time, for the population as a whole and for groups distinguished by age, gender, ethnicity and educational qualifications.

The income concept used is that of annual taxable income. This 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. The analysis reported in this paper is based on individuals rather than families or households.

The descriptive tool used here is the transition matrix, showing the movement of individuals among deciles between two years. Different time intervals are examined. For a transition matrix showing movements from rows (at time, t) to columns (at time $t+1$), each row essentially shows the conditional grouped frequency distribution of income in the second period, for those in a given decile in the first period. The 'margins' of the transition matrix, giving aggregates over row and column sums, show the unconditional frequency distributions in each period.

[2] One of the few studies to provide some information on the dynamics and inequality of taxpayers' lifetime incomes is Creedy (1996). He 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. This approach was recently replicated and extended, using more recent data, by Creedy *et al.* (2019); see also Le *et al.* (2006). The increasing availability of suitable longitudinal data has resulted in substantial progress in the analysis of income mobility in recent years. For example, using three longitudinal, five-year samples of around 35,000 New Zealand taxpayers, Creedy and Gemmell (2018, 2019, 2019a) examined some income mobility properties, highlighting important differences in interpreting inequality outcomes compared to outcomes obtained from cross-sectional inequality analysis.

The transition matrix provides a convenient non-parametric method of summarising a complex dynamic process. Information about the extent of relative income movements across the whole of the distribution is immediately clear. Questions naturally arise about the choice of income classes: some studies use classes of equal absolute size (after adjusting for inflation between the two relevant years), while others base class widths on logarithmic intervals.[3] The approach taken here is to show movements among deciles of the two distributions: the fact that the class widths necessarily vary needs to be kept in mind, although deciles are useful in immediately indicating the relative position in the distribution.

Furthermore, there may be substantial within-decile movements, particularly where the deciles are widely spaced. An obvious limitation of all discrete-time transition matrices is of course that they cannot provide information about the precise timing of movements during the relevant time interval, and where distributions are separated by a number of years, multiple movements among deciles may have taken place. Thus, an individual observed to be in a given decile in, say, years 1 and 5, may have experienced substantial income changes, rather than remaining in the same decile over the whole period. To mitigate this, the following analysis looks at changes over a range of time intervals.

Despite the ease of interpreting the information contained in transition matrices, they obviously do not provide a succinct summary measure of various mobility characteristics. Faced with this concern, Trede (1998) suggested the use of a diagram showing profiles of various quantiles of the conditional distributions, for given relative incomes in the initial year. The approach below instead makes use of a number of diagrams illustrating the extent of inter-decile movements.[4]

The remainder of the paper is organised as follows. Section 2 first introduces the dataset used. Section 3 examines transition matrices, for all

[3] On different definitions in the context of limiting forms of stochastic processes see Champernowne (1953), Aitchison and Brown (1957), and Shorrocks (1975).

[4] Several summary mobility measures and illustrative devices have recently been proposed including, for example, income growth curves (Jenkins and van Kerm, 2016) and TIM curves (Creedy and Gemmell, 2019a).

individuals combined, capturing movements of individuals across deciles of the income distribution over 1, 5, 10 and 15 years, from 2002. Section 4 then explores a number of separate demographic groups. Section 5 provides brief concluding remarks.

2 The Dataset

The construction of the dataset is described in detail in Alinaghi *et al.* (2020) and is summarised here. The dataset has been made possible due to the improved availability of anonymised administrative register data, such as from individuals' tax records, in Statistics New Zealand's Integrated Data Infrastructure (IDI). This has facilitated the construction of longitudinal data through the matching of income records for individuals over time. These data sources provide several advantages compared to surveys, such as very large sample sizes, improved coverage of top incomes, avoidance of survey respondent dropout or attrition, and less measurement errors.

Disadvantages include that since the data are often originally collected for tax purposes there can be limited demographic information available, and such data cannot capture those who do not interact with the income tax system. While recognising the limitations of such data, for example the absence of information on non-taxable income, the newly-constructed dataset used in this paper nevertheless provides the most comprehensive information to date on NZ taxpayers' incomes, suitable for inequality and mobility analysis.

In constructing the final dataset employed in this study, a number of administrative datasets within the IDI, including the Income Tax Register, have been merged. The primary database covers the Inland Revenue individual taxpayer population, containing 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. 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 the mobility analysis.

Each matrix calculation starts with the income distribution in 2002 and covers up to 15 years. This reduces the sample size slightly, but avoids the 2000-2001 years when reforms to the top personal income tax rate caused annual taxpayer incomes, especially towards the top of the income distribution, to fluctuate temporarily; see Creedy *et al.* (2021) for discussion. Therefore, for transition matrix analyses a total sample of around 1.6 million observations is available, as shown in Table 1. The table shows numbers of individuals used in four transition matrices covering 1, 5, 10 and 15 years. The total number of individuals generally rises slightly as the time period increases from 2002–2003 to 2002–2017, reflecting the growth in the taxpayer population.

Table 1 includes sample decompositions for working age individuals (defined as those aged 20 to 64 in each transition's start and end years respectively), and by gender, ethnicity and highest educational qualification.[5] It can be seen that the sample is split roughly 50:50 between males and females; Maori and Pasifika form approximately 14 per cent and 4 per cent respectively of each transition sample; while most individuals, unsurprisingly, have at least a school qualification (over 500,000), with decreasing numbers for post-school qualifications (around 360,000), no qualifications (around 270,000) and university qualifications (around 245,000).

3 Transition Matrices for All Individuals

This section presents transition matrices illustrating movements of individuals across deciles of the income distribution for the longitudinal sample, described in Section 2, of approximately 1.6 million income earners, covering the five years (2002, 2003, 2007, 2012 and 2017) respectively, capturing 1, 5,

[5] An individual is included in the relevant highest educational qualification category throughout the period under consideration, regardless of the year in which that qualification is obtained. For example, an individual obtaining a university degree in 2006 is asigned to this educational category in all 4 transition periods over 2002 to 2017.

Table 1: Transition Matrix Sample Sizes

Sub-samples:*	All ages**	Working age§	Male	Female
1-year	1,575,390	1,380,306	788,016	787,371
5-year	1,573,632	1,299,621	787,464	786,165
10-year	1,576,560	1,180,737	789,321	787,242
15-year	1,583,976	1,031,349	792,087	791,895
Ethnicity:	Maori	Maori & Pasifika	Others	
1-year	217,521	289,680	1,285,710	
5-year	217,155	289,257	1,284,366	
10-year	216,960	288,705	1,287,855	
15-year	217,350	289,104	1,294,863	
Educ. Quals:	None	School	Post-school	University
1-year	267,438	504,714	355,176	242,106
5-year	266,991	503,529	354,961	242,565
10-year	267,675	504,480	355,317	242,742
15-year	268,770	507,351	357,048	243,747

* Includes those entering and exiting between two years. 1-year = 2002-03; 5-years = 2002-07; 10-years = 2002-12; 15-years = 2002-17. § Aged 20-64 in relevant transition years. ** Male and female total do not add exactly to All ages totals because of SNZ confidentiality rules requiring random rounding to base 3.

10 and 15 year transitions. Before examining these transition matrices, it is useful to consider some descriptive statistics for these individuals.

The upper panel of Figure 1 shows incomes at the 10^{th}, 20^{th}, 30^{th} ... 90^{th} percentiles, and the lower panel displays the mean income levels within each decile, in 2002 and 2017. The upper panel also shows the annual gross-of-tax level of New Zealand Superannuation, NZS, in those years for a single person living alone, as a reference point for income levels in the lower income deciles: this is labelled 'NZS (single)'. These annual NZS incomes were approximately \$15,000 in 2002, rising to \$23,400 in 2017.[6] In 2002, percentile incomes range from \$9,000 at the 10^{th} percentile to \$59,500 at the 90^{th} percentile; equivalent values in 2017 are \$15,400 and \$99,200.[7] Figure 1 indicates that, in 2002, incomes up to around the 30^{th} percentile were below the NZS level. This probably includes many people working part-time, working part of the year overseas, or not working but earning modest amounts of other forms of taxable income such as rental income and interest. A similar situation applies in 2017 but where the NZS level (\$23,400) is close to the 40^{th} percentile income level of \$24,400.

The very low income levels in the lower deciles can be seen in the lower panel of Figure 1, which range from an arithmetic mean income of \$5,526 in decile 1 in 2002 (\$10,385 in 2017) to \$94,256 in the top decile in 2002 (\$167,645 in 2017). Care needs to be taken in interpreting changes in these decile means from 2002 to 2017. Since these deciles are based on annual cross-sections (albeit for individuals in a longitudinal sample) they do not represent the *same* people in a given decile in *both* years. Rather they capture those individuals observed in a given decile in a given year; the transition matrices discussed below enable the same individuals to be tracked within or across deciles. As discussed in Creedy and Gemmell (2019), previous commentators have sometimes misinterpreted differences in the growth of cross-sectional

[6] The NZS level is set each year such that the after-tax amount (for a taxpayer with no other taxable income) is 66 per cent of the 'average ordinary time wage' after tax. This is targeted at a level designed to ensure NZS recipients remain above recognised poverty levels, such as 50 per cent of median income.

[7] These percentile values have been rounded to the nearest \$100 to respect SNZ's data confidentiality requirements.

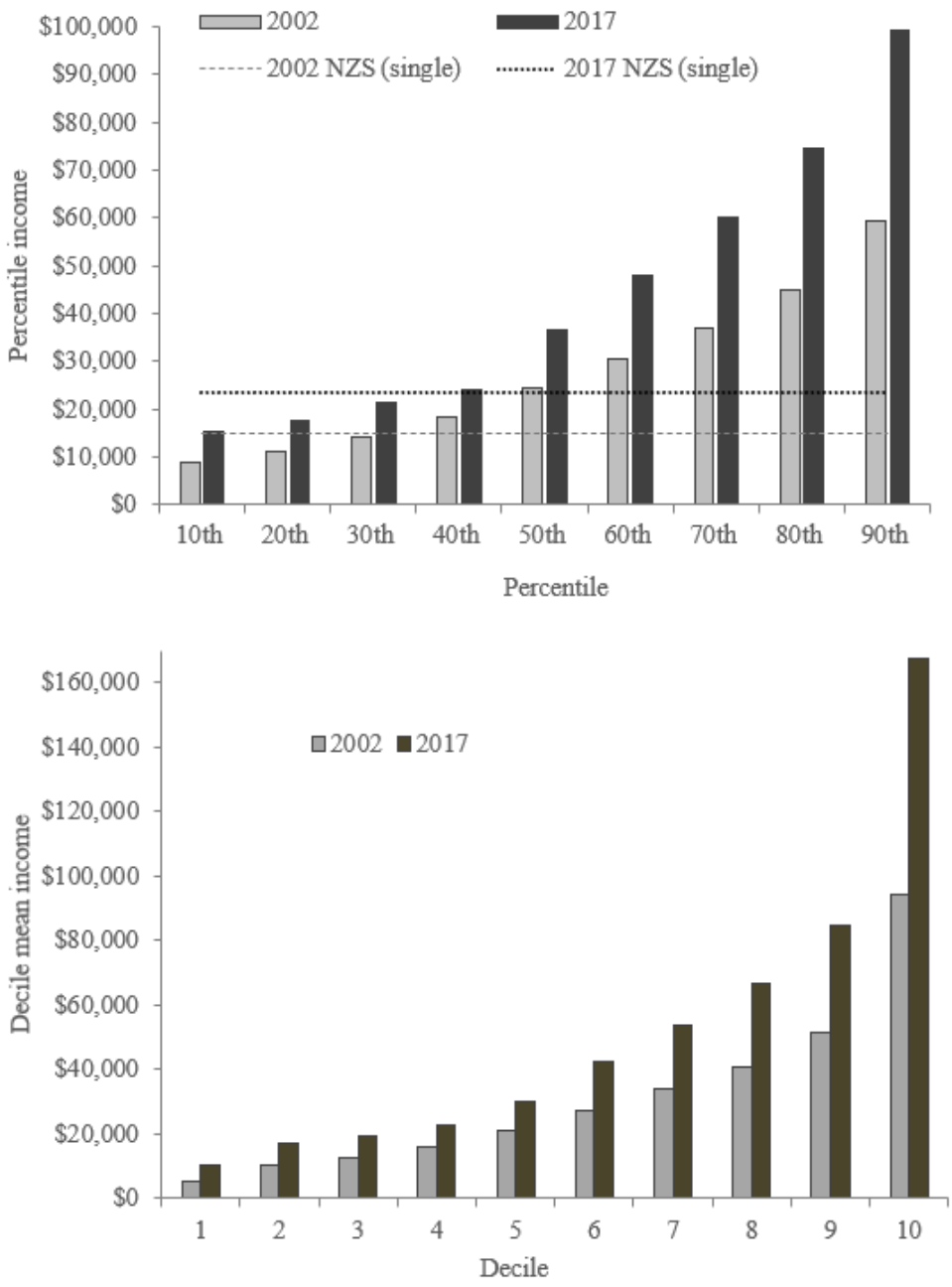

Figure 1: Percentile and Decile Incomes

decile mean incomes, such as those shown in the lower panel of Figure 1, as indicative of slower income growth among lower income deciles. However, for the relatively comprehensive dataset used here, such a cross-sectional phenomenon is not observed.

Figure 2 shows the ratio of decile arithmetic mean incomes in 2017 to their cross-sectional equivalents in three earlier years: 2002, 2007 and 2012. For example, in 2017, decile 1 mean income is almost 1.9 of its 2002 level while for decile 10 the ratio is around 1.8. More generally these ratios display a tendency to fall from the lower towards the middle (5^{th}) decile and rise again towards the 10^{th} decile. This pattern appears to become more prominent over time as the length of the period considered in extended from 5 years (2012 to 2017) to 15 years (2002 to 2017). Indeed, over five years, differences in the mean income ratio across deciles are modest, ranging from 1.12 in the 2^{nd} decile to 0.99 in the 5^{th} decile, and 1.17 in the 10^{th} decile. Equivalent values after fifteen years are 1.88 (1^{st} decile), 1.42 (5^{th}) and 1.78 (10^{th}). Again, it is worth stressing that these ratios do *not* indicate that those initially on lowest and highest incomes necessarily experienced faster income growth, since they do not track the incomes of those initially observed in these high or low deciles. Individuals observed in a given decile in an initial year may, or may not, be in the same decile in later years.

In presenting transition matrices here, the numerical flows have been converted to percentages, for ease of interpretation. Figure 3 shows transition percentages for 2002 to 2003 (1 year) and 2002 to 2007 (5 years). Figure 4 presents matrices for 2002 to 2012 (10 years) and 2002 to 2017 (15 years). In both figures, off-diagonal cells are shaded such that moving from darker to lighter shading indicates a smaller percentage in the cell, ranging from 30 to 40 per cent (darkest) to 0 to 5 per cent (lightest). The decile percentages indicate the percentage of taxpayers who are in the sample in both years (and the intervening period); thus across the ten deciles, each row sums to 100 per cent. Each figure also shows the percentage of new entrants to each decile between the two years (top row), and the percentage of exits between the two years (left column).[8]

[8]For each (initial year) decile, the percentage shown records exits as a percentage of

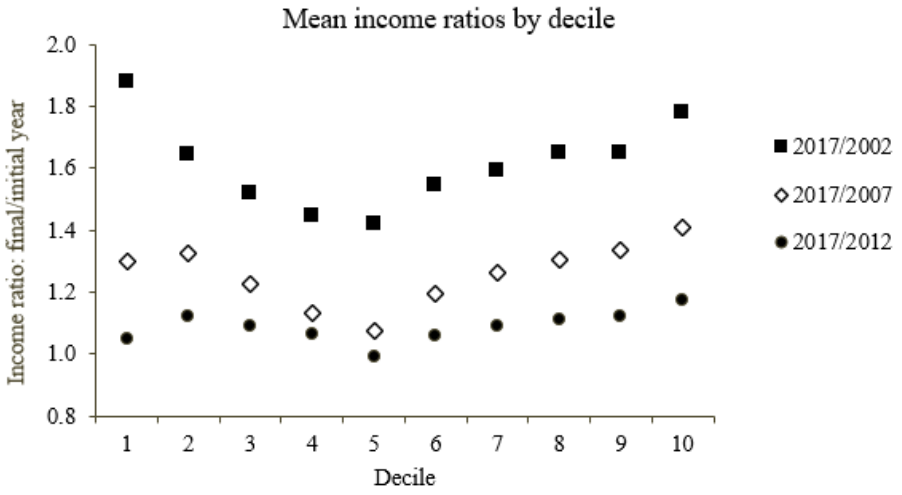

Figure 2: Decile Income Ratios, 2002 to 2017

Two points about Figures 3 and 4 should be mentioned. First, with around 1.57 million taxpayers across the 10 deciles in each matrix, each decile has around 157,000 individuals. Second, the presence of many individuals with the same income, straddling the 10^{th} and 30^{th} percentiles, results in somewhat unequal numbers of individuals in the bottom four deciles. This arises primarily due to retired taxpayers whose only income is New Zealand Superannuation (NZS) either as a single person or as a couple. For example, in the top panel of Figure 3, the bottom four deciles in 2003 contain respectively 150,264, 156,630, 156,567 and 156,720 individuals.[9] Thus, deciles 1 and 2, and deciles 3 and 4, average around 155,000 individuals.

The four sets of transitions in Figures 3 and 4 indicate, for example, that the percentage of individuals remaining in the same decile (on the diagonal)

individuals in the sample in *both* years (that is, the row sum of deciles 1 to 10). The top row of each matrix records how 100 per cent of entrants are allocated across (final year) deciles. For example, for 2002 to 2003, 60 percent of all entrants between 2002 and 2003 are observed in decile 1. This likely mainly reflects new, part-time entrants to the labour market. Similarly the highest percentage of exits leaving by 2003 is from decile 1.

[9]Standard gross-of-tax NZS payments in 2003 were around $15,400 for a single person living alone and $11,700 each for retired couples. Equivalent net-of-tax payments were around $12,800 and $9,800. Other NZS rates of payment applied to specific individuals such as single people sharing accommodation, rest home residents and military veterans.

				2003									
			Exits	1	2	3	4	5	6	7	8	9	10
		Entrants		60%	7%	8%	7%	6%	4%	3%	2%	2%	2%
		1	4%	**58%**	12%	11%	8%	6%	3%	2%	1%	1%	0%
		2	0%	14%	**62%**	12%	6%	3%	1%	1%	0%	0%	0%
Off-diagonal		3	1%	8%	16%	**49%**	15%	7%	3%	1%	1%	0%	0%
0-5%		4	0%	6%	4%	18%	**47%**	15%	5%	2%	1%	1%	0%
5-10%		5	1%	4%	3%	6%	15%	**43%**	19%	6%	3%	1%	1%
10-20%	2002	6	0%	2%	1%	2%	5%	16%	**46%**	19%	5%	2%	1%
20-30%		7	0%	2%	1%	1%	2%	5%	15%	**48%**	20%	4%	1%
30-40%		8	0%	1%	1%	1%	1%	3%	4%	15%	**53%**	18%	3%
		9	0%	1%	0%	1%	1%	2%	2%	4%	13%	**61%**	17%
		10	1%	1%	1%	0%	1%	1%	1%	2%	3%	12%	**78%**
				2007									
			Exits	1	2	3	4	5	6	7	8	9	10
		Entrants		30%	7%	10%	15%	11%	8%	7%	5%	5%	4%
		1	4%	**31%**	10%	11%	14%	11%	8%	6%	4%	3%	1%
		2	1%	19%	**42%**	15%	9%	6%	4%	3%	2%	1%	0%
Off-diagonal		3	1%	12%	25%	**25%**	15%	9%	6%	4%	3%	1%	1%
0-5%		4	2%	9%	6%	31%	**21%**	13%	8%	5%	4%	2%	1%
5-10%		5	2%	9%	5%	7%	17%	**23%**	16%	11%	7%	4%	1%
10-20%	2002	6	1%	6%	3%	4%	9%	18%	**24%**	18%	11%	5%	2%
20-30%		7	1%	4%	3%	3%	5%	9%	18%	**25%**	20%	10%	3%
30-40%		8	1%	3%	2%	2%	4%	6%	8%	17%	**29%**	21%	7%
		9	1%	3%	2%	1%	3%	4%	5%	7%	16%	**38%**	22%
		10	2%	2%	2%	1%	2%	2%	3%	4%	5%	16%	**62%**

Figure 3: Transition Matrices by Decile: 2002-03 and 2002-07

				2012									
			Exits	1	2	3	4	5	6	7	8	9	10
		Entrants		23%	7%	13%	10%	14%	9%	7%	6%	6%	4%
		1	3%	**23%**	11%	14%	9%	12%	9%	8%	6%	5%	3%
		2	1%	15%	**33%**	17%	17%	6%	4%	3%	2%	2%	1%
Off-diagonal		3	2%	13%	22%	**21%**	16%	10%	7%	5%	3%	3%	1%
0-5%		4	2%	11%	7%	17%	**26%**	13%	9%	7%	5%	3%	1%
5-10%		5	2%	11%	6%	10%	10%	**19%**	16%	12%	8%	5%	2%
10-20%	2002	6	1%	8%	5%	7%	7%	15%	**20%**	17%	12%	7%	3%
20-30%		7	1%	6%	4%	5%	5%	10%	16%	**20%**	18%	11%	5%
30-40%		8	1%	5%	4%	4%	4%	7%	10%	16%	**22%**	19%	9%
		9	1%	4%	4%	3%	3%	5%	6%	9%	16%	**30%**	22%
		10	1%	3%	4%	2%	2%	4%	4%	5%	7%	15%	**54%**
				2017									
			Exis	1	2	3	4	5	6	7	8	9	10
		Entrants		16%	11%	11%	7%	16%	12%	9%	8%	6%	5%
		1	3%	**17%**	13%	12%	8%	13%	11%	9%	7%	6%	5%
		2	1%	15%	**21%**	20%	23%	7%	5%	4%	3%	2%	1%
Off-diagonal		3	1%	18%	14%	**17%**	17%	11%	8%	6%	4%	3%	2%
0-5%		4	1%	14%	8%	14%	**21%**	13%	10%	8%	6%	4%	2%
5-10%		5	1%	10%	8%	9%	8%	**16%**	16%	13%	10%	7%	4%
10-20%	2002	6	1%	8%	7%	7%	7%	12%	**17%**	16%	13%	9%	4%
20-30%		7	1%	6%	7%	6%	5%	9%	13%	**18%**	17%	13%	6%
30-40%		8	1%	5%	7%	5%	5%	7%	9%	14%	**19%**	19%	10%
		9	1%	4%	6%	5%	4%	6%	6%	8%	14%	**25%**	21%
		10	1%	3%	7%	5%	3%	5%	5%	5%	8%	13%	**46%**

Figure 4: Transition Matrices by Decile: 2002-12 and 2002-17

after 1, 5, 10 and 15 years generally declines from around 43 to 61 per cent for 2002 to 2003 to as low as 16 to 25 per cent for 2002 to 2017. As might be expected, the wide top decile displays high (between-decile) immobility compared to other deciles, with the percentage remaining in the decile at 78 per cent (after 1 year) and declining to 46 per cent (after 15 years). The tendency towards greater upward or downward movement from a given decile over time is evident more generally in Figures 3 and 4, with darker shaded off-diagonal cells becoming more prevalent for longer transitions (notwithstanding the previously discussed issues around deciles 1 to 4).

Alternative illustrations of the inter-decile movements are shown in Figures 5 and 6. Figure 5 shows profiles for the percentage remaining within their initial (2002) deciles after 1, 5, 10 and 15 years. It shows that, apart from the previously mentioned specific issues with deciles 2 to 4, there is a consistent tendency for the proportion remaining in a decile to fall the longer the transition period considered. This effect appears to be strongest when moving from 1-year to 5-year transitions, but generally continues as the time period is extended, especially for deciles 1, 2 and 5 to 10. Figure 6 shows the percentage moving up or down at least one decile from their initial decile over the same time periods.

These profiles may be compared with the expected outcome if the probabilities of transitioning from any decile to any other decile were equal. In that case the probability or remaining in the same decile would be 10 per cent, giving a horizontal line (not shown) in Figure 5. Thus, the 15-year percentages shown in Figure 5, of around 15 to 25 per cent (except decile 10) suggest that after that length of time, this outcome is not far from what would be expected in the absence of forces against what might be termed 'equal likelihood' mobility, at least in terms of inter-decile movement.

As with individuals remaining in the same decile, a similar exercise can be conducted for individuals who move up or down from their initial 2002 decile. If all deciles were equally probable, the percentages in all cells in Figures 3 or 4 would be 10 per cent. However, the probability of moving up or down clearly differs according to the decile in which an individual is initially located. Thus, someone in the top decile has a 90 per cent probability

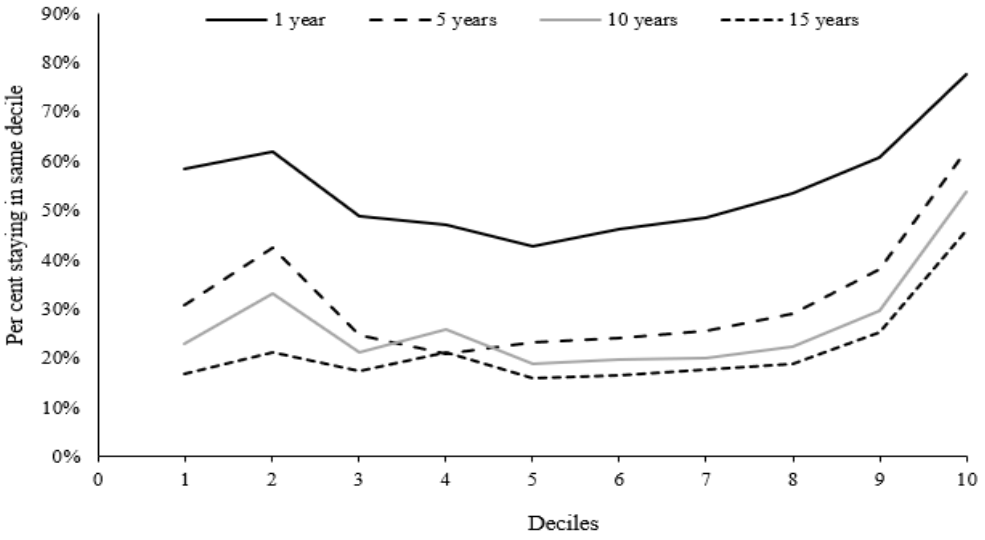

Figure 5: Taxpayers Remaining in Same Decile, 2002 to 2017

of moving down at least one decile (to deciles 1 to 9) and a zero probability of moving up, while the reverse holds for an individual in the bottom decile.

Figure 6 shows the percentage of individuals moving up at least one decile (upper panel), and moving down at least one decile (lower panel). The straight 'equal up' and 'equal down' (broken) lines indicate the two cases where there is an equal 10 per cent probability of moving to any other cell. This excludes the probability of no movement, and hence reaches a maximum probability at 90 per cent for individuals initially in decile 1 or decile 10.

Two phenomena in particular are evident from Figure 6. First, the upper panel suggests that there is a greater-than-equal probability of initially higher-decile individuals moving up, compared with lower-decile individuals. That is, each profile, for 1, 5, 10 and 15 years, lies above the 'equal probability' line at high deciles (except decile 10 where this is impossible *a priori*), while at lower deciles it lies below the 'equal probability' line. The reverse is true in the lower panel. Here the bottom deciles (except decile 1) have a greater-than-equal probability of moving down, while the higher deciles have a less-than-equal probability of moving down.

Second, these two phenomena become much less pronounced over time.

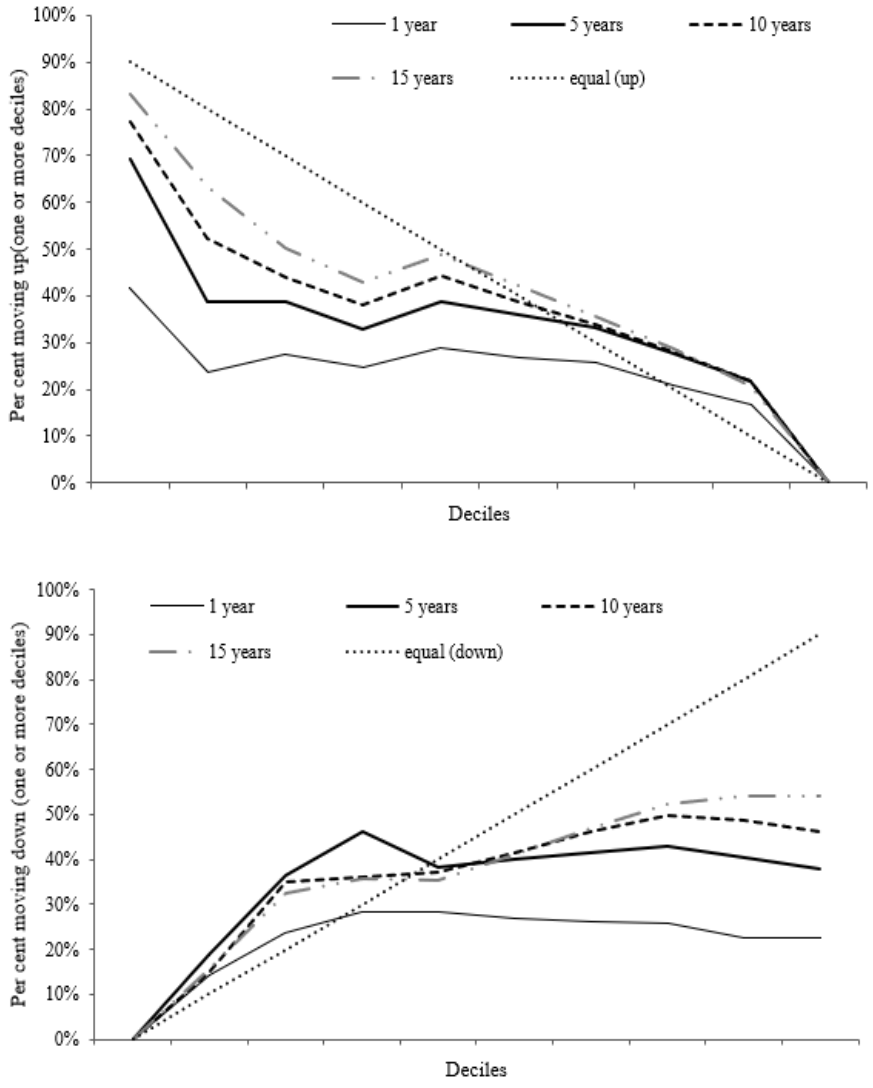

Figure 6: Taxpayers Moving Up or Down Deciles, 2002 to 2017

After 15 years, the two profiles (up and down) are much closer to the line of equality than the 1 year profile, especially for upward movement. Figure 6 simply displays movement up or down of *at least* one decile. Hence as the actual transition profiles approach the line of equal probability in Figure 6, this does not distinguish movement up or down of *only* one decile from movements across several deciles. This broader set of movements, and their deviation from a uniform 10 per cent, has to be gleaned from the percentages in Figures 3 or 4.

4 Demographic Groups

As argued above, transition matrices tracking individuals' movements across deciles over a series of years contain a great deal of mobility-related information that is not easily summarised. This is magnified when considering groups of individuals classified by age, gender, ethnicity, education, and so on. To summarise this information, this section focuses on two simplified representations of the transition matrix. First, transitions are illustrated for one, five, ten, and fifteen years, which might be characterised as capturing short, medium, and long-run mobility. This covers the years: 2002-2003, 2002-2007, 2002-2012, and 2002-2017.

Second, for each of these periods, two summary transition measures are illustrated. The first is the share of the sample observed in the same decile in both years, and hence the remaining share demonstrating movement across at least one decile between years. The second is the share of the sample observed to change deciles, in the range -1 to +1, from their decile position in the initial year. Both of these measures therefore capture relative *immobility* as represented by remaining in, or close to, an individual's initial decile position.

4.1 Some Descriptive Statistics by Decile

Before turning to mobility measures, Figures 7 and 8 show how the decompositions (gender, working/non-working age, ethnicity and educational qualification) vary across the deciles of the income distribution. These figures relate to 2017, but corresponding charts for 2002 show similar variations across

deciles. For example, in Figure 7, with an approximately 50:50 male/female composition of the sample as a whole, females are generally over-represented in the middle deciles and under-represented in the top three deciles.

When considering the working/non-working age decomposition, most deciles have similar shares of working age individuals, of around 80 to 90 per cent, except the 2^{nd} to 4^{th} deciles. This reflects the dominance in those deciles of Superannuitants with little or no other income beyond their state pension, either as a single or partnered recipient. This is an important characteristic to bear in mind when interpreting inter-decile differences in mobility, because some of the factors determining the extent and nature of mobility are likely to be quite different for retirees compared with working individuals.

Figure 8 shows the share of Maori and Pasifika within each decile ('other' ethnicities, mainly pakeha, make up the residual). With Maori and Pasifika making up 14 and 4 per cent respectively overall, Maori are also generally over-represented in the middle deciles and under-represented in the lower and higher deciles. (The high share in decile 1 should be interpreted with caution given the very low average income levels, noted earlier for this decile, suggesting it represents mainly part-time or part-year income data). A similar picture emerges for the Pasifika group though, with an overall average of only 4 per cent, there is less variation across deciles around that average.

Considering educational qualifications by decile, Figure 8 confirms the expected dominance of the lowest (four) deciles by those with no qualifications, and their shares also falling steadily towards the highest deciles. Those for whom a school qualification is their highest qualification are generally the largest group (typically over 30 per cent of the decile) and are also relatively similar across deciles – between 30 and 40 per cent; except at the highest income deciles where, unsurprisingly, those with university degrees dominate.

4.2 Decomposing Mobility Measures by Decile

Turning to comparisons of inter-decile mobility indicators across these various decompositions, Figure 9 shows profiles across deciles 1 to 10 for the two measures ('same decile' and '-1, 0, or +1 decile change') for the working

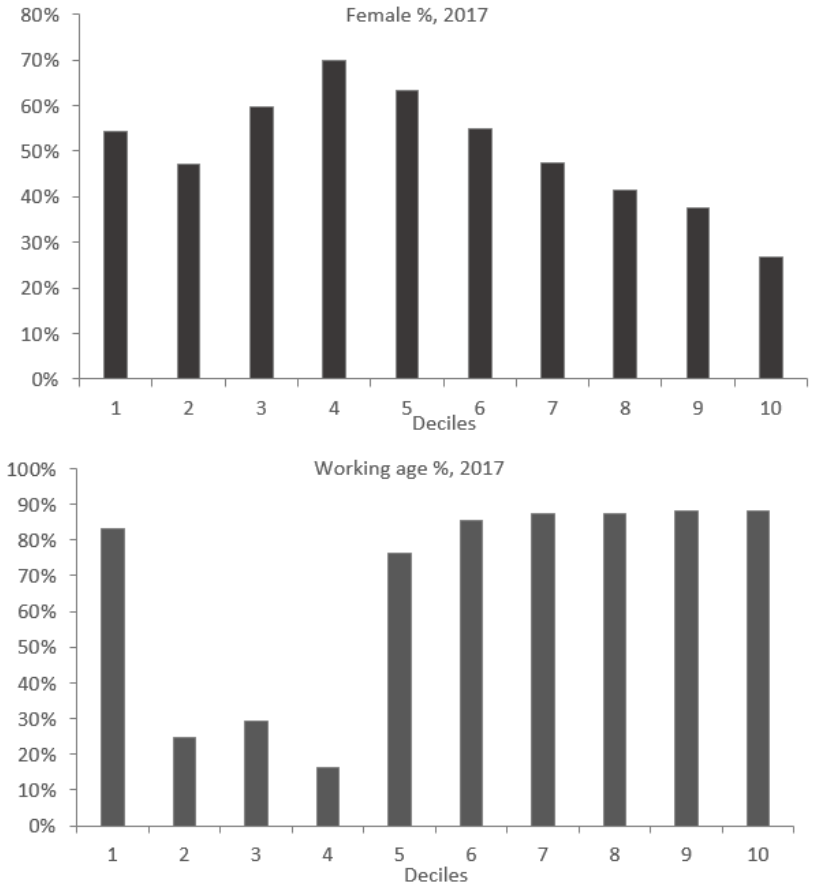

Figure 7: Gender and Age by Decile

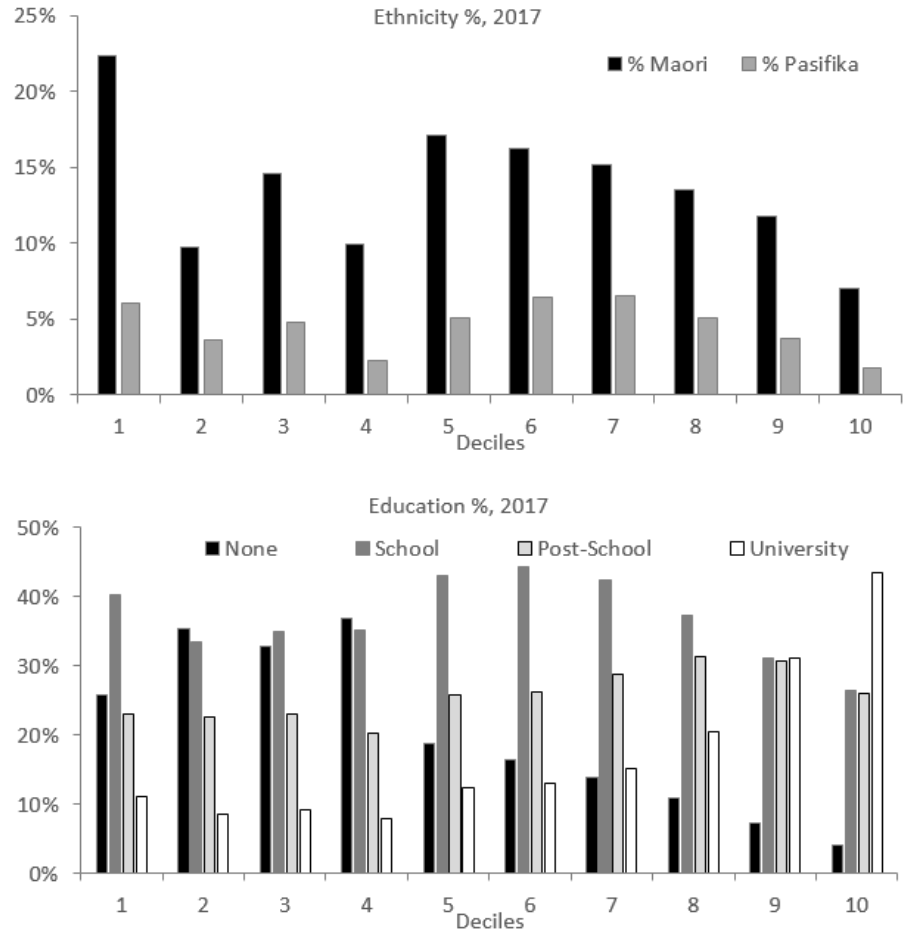

Figure 8: Ethnicity and Highest Educational Qualification by Decile

age population and for males and females. These profiles demonstrate three features that are largely repeated across decompositions by ethnicity and education.

First, for all deciles, the proportions that are relatively immobile consistently fall from 1-year to 5-year to 10-year transitions. Second, with the exception of the 10^{th} decile, which sometimes displays somewhat different behaviour, 1-year transitions typically reveal around 50-60 per cent of individuals remain in the same decile, falling to 20-30 per cent after 15 years. For the -1 to +1 decile changes, across deciles these typically record 80-90 per cent shares for 1-year transitions and 40-60 per cent for 15 year transitions. The equivalent shares for 5 year transitions always sit between these short- and long-run cases.

Third, some profiles show a tendency for a higher immobile share in the 2^{nd} and/or 4^{th} deciles. Since most Superannuitants without substantial non-pension income tend to be located in these deciles (or at the $2^{nd}/3^{nd}$ decile boundary), these individuals' incomes are largely determined by the NZ Superannuation (NZS) level; hence their relative income mobility reflects both the official level of NZS and their relatively limited opportunities to vary discretionary income.

Another way to express the extent of mobility is that these data indicate that, after 15 years, 70 to 80 per cent of individuals have moved at least one decile, and 40 to 60 per cent have moved two or more deciles. Of course, some individuals experiencing upward mobility necessarily implies that others experience downward mobility among decile groups. Normative interpretations of these movements should therefore be treated with extreme caution, especially in the case of short-run movements for which the implied income volatility is often regarded as less desirable than income stability.

For age and gender decompositions, the top decile sometimes displays greater immobility than lower deciles; see, for example, the 'same decile' shares in Figure 9. However, among the lower 9 deciles, there is no systematic tendency for lower or higher deciles to be more or less immobile. Indeed, to the extent that a general pattern emerges, it is that middle deciles (for working ages and both genders) tend to display the lowest immobile shares.

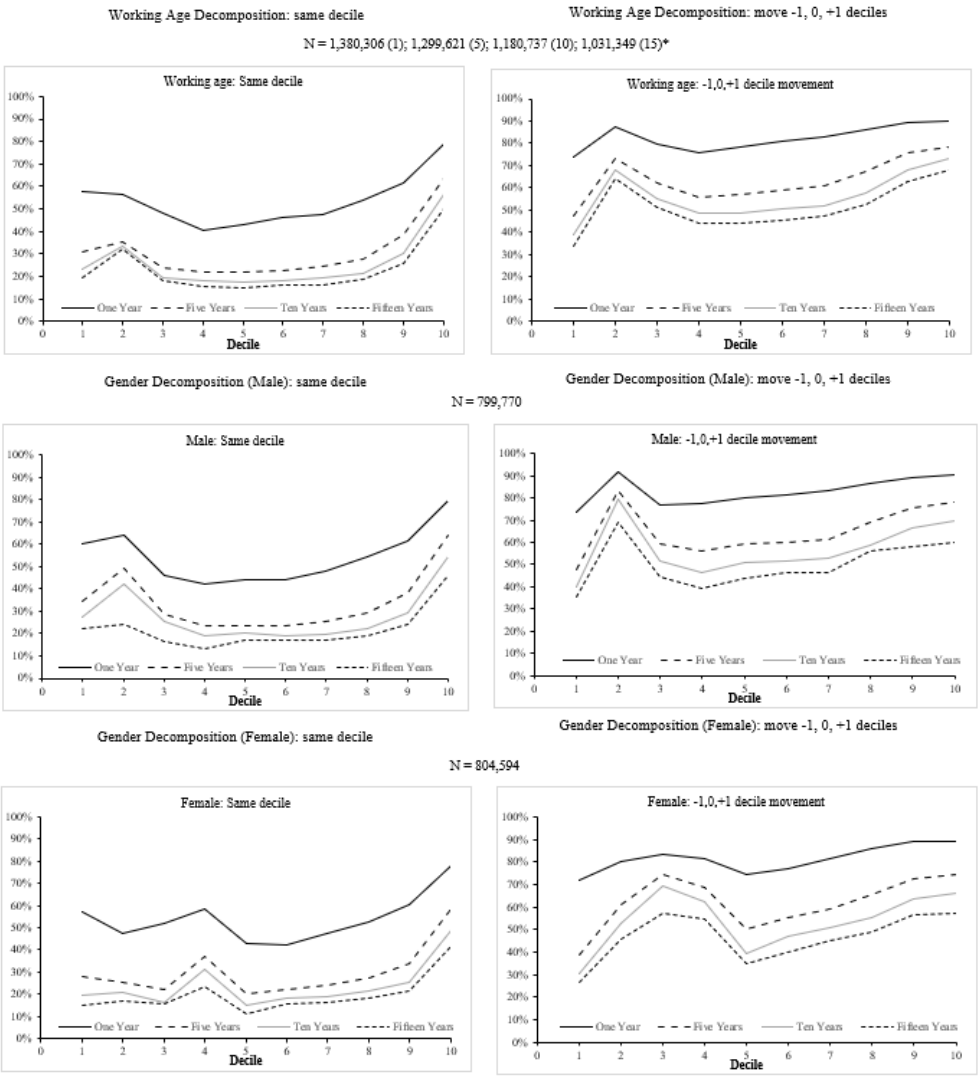

Figure 9: Cross-Decile Mobility by Age and Gender

Figure 10 shows ethnicity decompositions for the same two mobility measures. This again confirms a clear pattern of lower immobile shares for longer-period transitions, for both mobility measures. This applies to Maori, Maori and Pasifika, and 'other' ethnicities. The other cross-decile patterns, identified above for age and gender decompositions, also apply to ethnicity. All ethnicities reveal a tendency for 'same decile' shares to be around 20 to 30 per cent after 15 years, and 'change ranging from -1 to +1 decile' being around 40 to 60 per cent after 15 years. One difference from previous decompositions is that, for decile changes in the -1 to +1 range, all three ethnic groups (and most initial income deciles) reveal a tendency for over 40 per cent or more individuals to fall into this category after 15 years.

Finally, Figures 11 and 12 show mobility measures decomposed by four educational qualifications. These also suggest similar mobility levels and patterns across educational groups. For example, the 'same' decile' measure (left-hand panels of Figures 11 and 12) suggests that each qualification group has around 20 per cent of individuals remaining in the same decile after 15 years. This applies across most deciles, again with the exception of decile 10. Short-run transitions of 1-year also suggest that a similar 40 to 60 per cent remain in the same decile across the four qualification groups.

5 Conclusions

The distribution of income in New Zealand has received considerable attention in recent years, with most discussions focusing on 'static' measures that describe cross-sectional comparisons of a short-term – usually annual – income measure. In a series of papers on longitudinal aspects of income dynamics and mobility in New Zealand, Alinaghi *et al.* (2022a, b, c) use a variety of traditional, and more recently developed, measures to estimate the nature and extent of income mobility in New Zealand. These measures include standard summary income inequality indices measured over extended periods of time, income dynamic regressions capturing such systematic processes as regression to the mean, and the 'TIM curve' illustrative device.

The present paper has focused on an alternative, commonly used, mea-

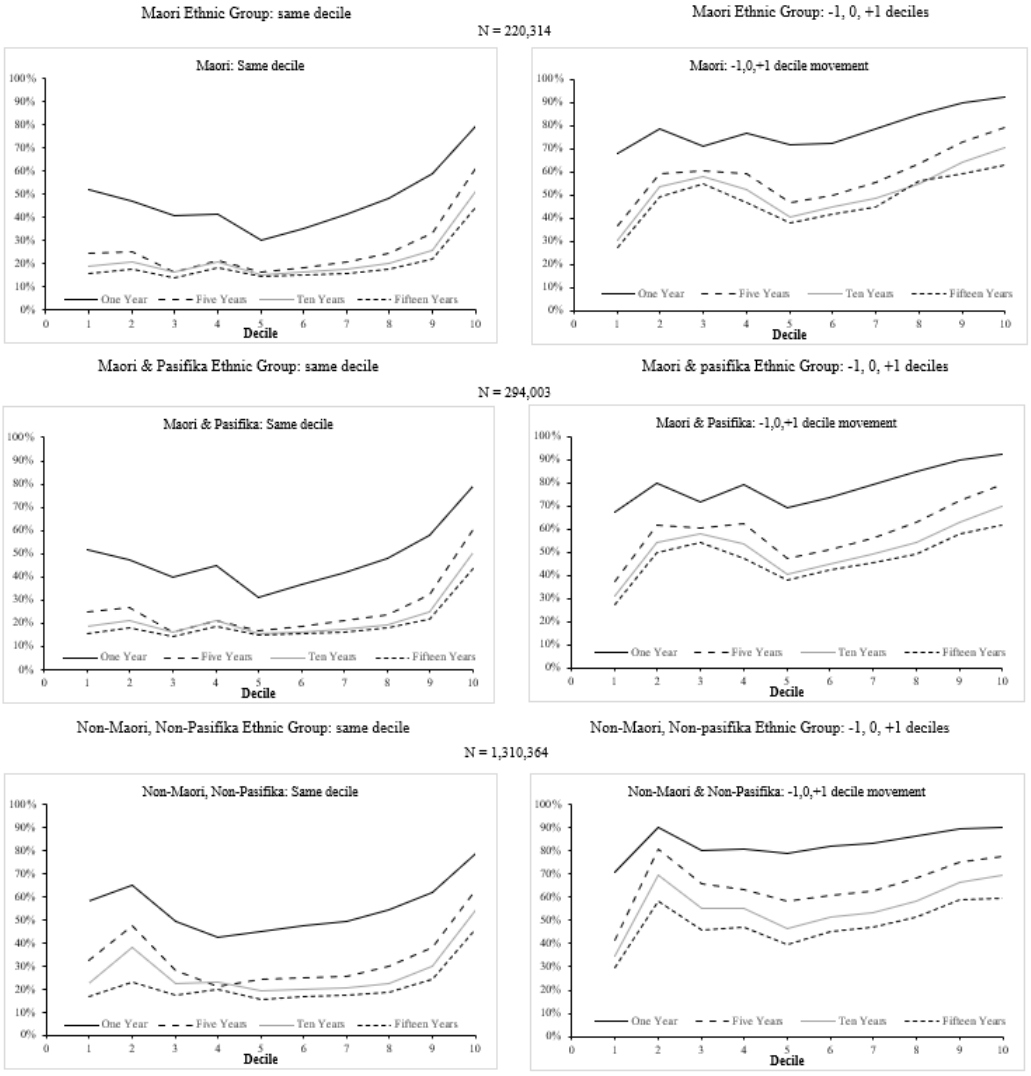

Figure 10: Cross-Decile Mobility by Ethnicity

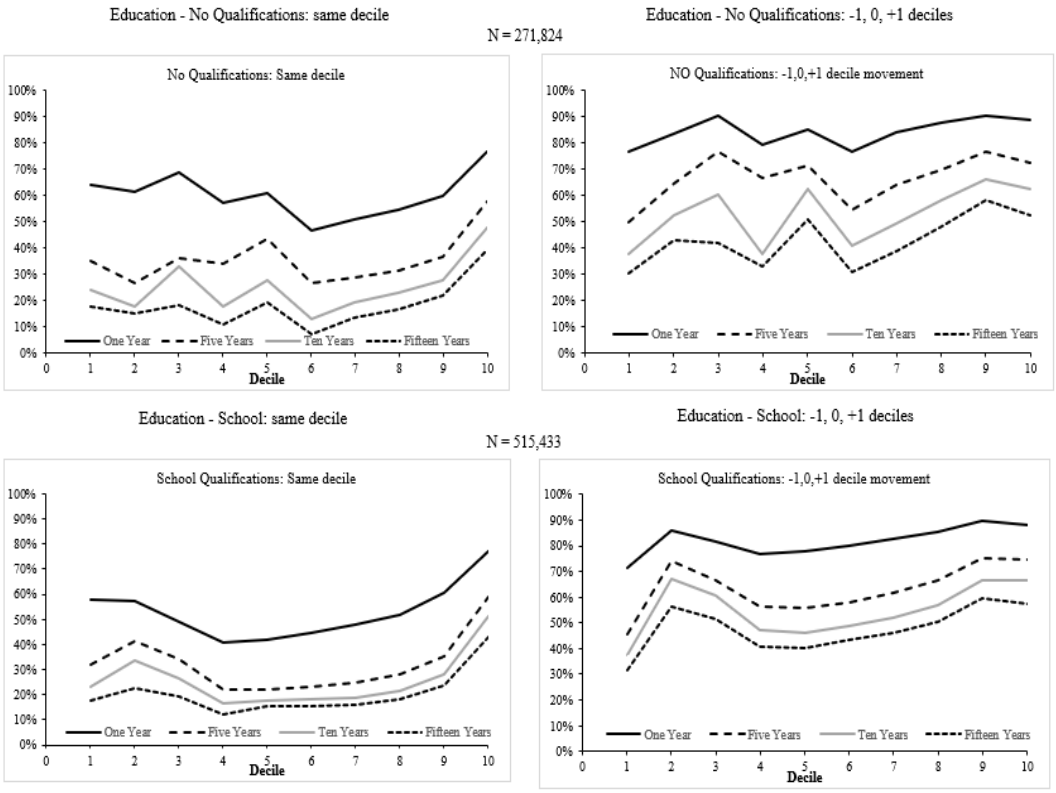

Figure 11: Cross-Decile Mobility by Educational Qualification (1)

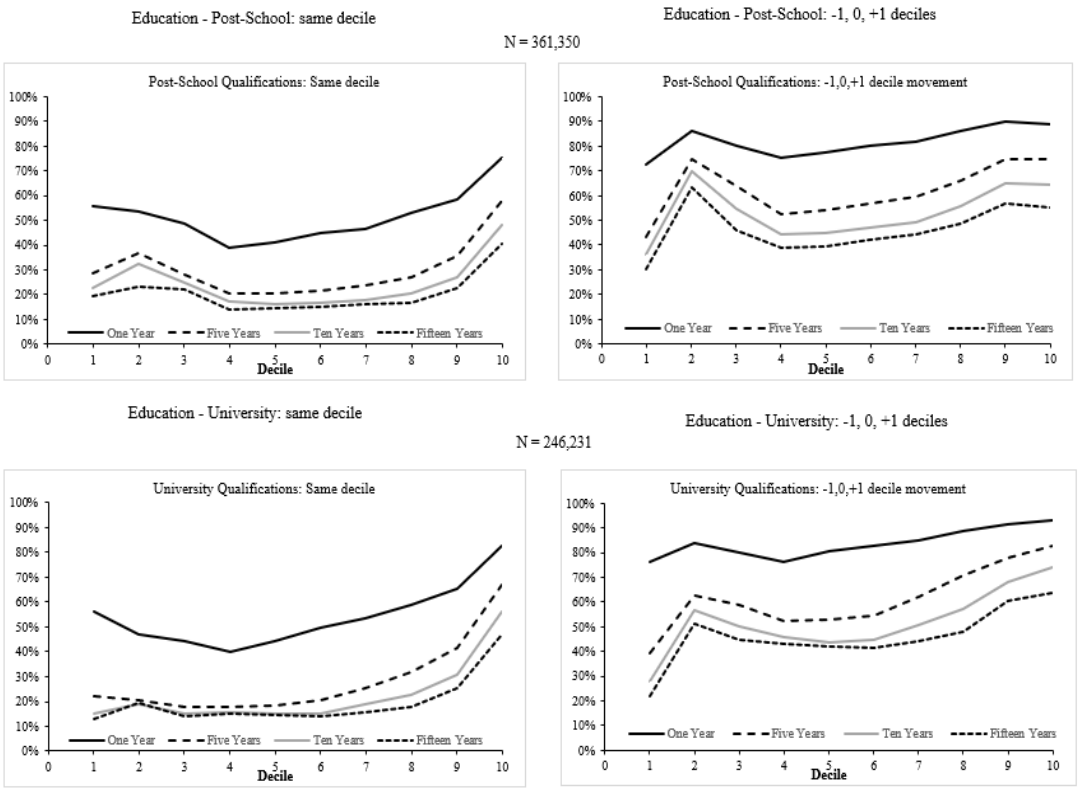

Figure 12: Cross-Decile Mobility by Educational Qualification (2)

sure – the transition matrix. This was used to capture inter-decile income movements measured over periods of 1, 5, 10 and 15 years. Income transitions were examined for individuals within the New Zealand taxpaying population as a whole, and for various population decompositions based on age, gender, ethnicity and educational qualifications. The analysis was based on longitudinal information for 2002 to 2017, from several matched datasets within Statistics New Zealand's Integrated Data Infrastructure.

For taxpayers as a whole, the analysis considered evidence on the extent of inter-decile movements in general. It also examined the extent to which the data reveal relative stability or immobility, as measured by the percentage of individuals remaining within the same decile across 1, 5, 10 or 15 years. Relative mobility was summarised by the percentage moving one or more deciles. This revealed that, while the percentage remaining within the same decile over 1 year was relatively high at 50 to 60 per cent, this fell substantially even after 5 years to around 40 to 50 per cent across most deciles, and to around 20 per cent after 15 years.

Measuring mobility by the percentage moving away from their initial decile by at least one decile over a given period of time, two phenomena stood out. First, there appears to be a greater-than-equal probability of initially higher-decile individuals moving up, compared with that for lower-decile individuals. The reverse appears to be the case for downward decile movements: the bottom deciles (except the 1^{st} decile) reveal a greater-than-equal probability of moving down, while the higher deciles have a less-than-equal probability of moving down. Second, these two phenomena become much less pronounced over time. After 15 years, observed decile movements (up and down) are much closer to that which an equal probability of decile movement (for any decile) would predict. This is especially strong for upward movement.

Considering sub-sets of taxpayers based on age and gender, measures of immobility (staying in the same decile or remaining within ± 1 decile) confirmed some of the patterns observed for the population as a whole. Across deciles, the proportions that are relatively immobile were found to consistently fall from 1-year to 10-year transitions: 1-year transitions typically

involved 50 to 60 per cent of individuals remaining in the same decile, and this figure falls to 20 to 30 per cent after 15 years.

For ± 1 decile changes, across deciles these fell from 80-90 per cent shares for 1-year transitions to 40 to 60 per cent for 15-year transitions. Alternatively, for both genders, after 15 years 70 to 80 per cent of males and females moved at least one decile, and 40 to 60 per cent moved two or more deciles. In general, middle deciles for working ages and both genders tend to display the lowest immobile shares.

Taxpayer decompositions, based on ethnicity and highest educational qualification, also revealed similar mobility and immobility patterns. All ethnicities reveal a tendency for 'same decile' shares to be around 20 to 30 per cent after 15 years, with '± 1 decile' shares of around 40 to 60 per cent after 15 years. Decomposing by educational qualifications, perhaps surprisingly the extent of inter-decile mobility also appears to be similar across taxpayers in the four qualification categories. Further, across deciles within educational categories, mobility levels again appear to be quite similar.

In some cases – for different educational categories and also for various other decompositions – the 1^{st} and 2^{nd} deciles display somewhat different patterns from the rest, such as apparently lower (higher) mobility among those initially in the 2^{nd} (1^{st}) decile. While it may be tempting to infer from these data that mobility experienced by 'the poor' is different, it should be recalled that average incomes in those deciles (and decile boundaries) are very low. Indeed incomes in those deciles are well below the state pension and welfare benefit levels, suggesting that they most likely represent incomes of part-time workers and/or those with relatively low unearned taxable incomes such as rental income, interest and dividends. In addition, since the data refer to individuals, many of those low-income individuals likely live within higher-income families.

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