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John Creedy, Jamas Enright,
Norman Gemmell & Angela
Mellish

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Department of Economics
The University of Melbourne
Parkville VIC 3010
www.economics.unimelb.edu.au

Population Ageing and Taxation in New Zealand

By

John Creedy, Jamas Enright, Norman Gemmell and Angela Mellish[12]

Abstract

This paper considers the implications for personal income tax and Goods and Services Tax (GST) revenues of population ageing in New Zealand. It considers 'pure' ageing effects; that is, population size is held constant but its age distribution changes over the next 40 years. It might be expected that an increase in the share of pensioners would reduce aggregate incomes while increasing the proportion consumed. However, with age-earnings profiles having a peak in the 45-54 age range, and the expected average age of the population over the next 40 years transiting this age range, younger individuals with increasing incomes are expected to approximately counteract the declining incomes of older individuals. But ageing is expected to increase the dependence of income tax and GST revenues on pension choices. Without changes in New Zealand Superannuation (NZS) settings, its cost is expected approximately to double over the next 40 years, with most of this occurring over the next 20 years. Changes to NZS rates have a non-trivial effect on the share of income tax and GST contributed from NZS incomes.

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[1] Creedy is in the Economics Department at the University of Melbourne. Enright, Gemmell and Mellish are in the New Zealand Treasury.

[2] In preparing this paper we have benefited from discussions with Matthew Bell, Bill Moran and Paul Rodway. The views, opinions, findings, and conclusions or recommendations expressed in this paper are strictly those of the authors. They do not necessarily reflect the views of the New Zealand Treasury.

1 Introduction

The New Zealand population, like that of all industrialised countries, is expected to age significantly over the next fifty years, accompanied by an 'ageing of the aged' whereby the proportion of people over 80 is expected to increase substantially. This ageing is likely to produce a reduction in the proportion of income obtained from earnings and a concomitant increase in the proportion of income in the form of social welfare payments, including superannuation. This structural change in income sources, combined with the existence of different spending patterns among individuals in different age groups, may perhaps be expected to give rise to a change in the composition of tax revenue. The possible effects of population ageing on tax revenue and its composition in New Zealand are therefore investigated here, with an emphasis on personal income taxation and GST.[3]

The prospect of population ageing has given rise to a wide range of studies. One group has examined the general equilibrium implications (at a very high level of aggregation) for savings, investment and growth, allowing for the endogenous responses of wages to the changing age distribution.[4] Other studies have concentrated on the possible implications for a range of categories of social expenditure, such as education, health, superannuation, unemployment and sickness benefits, using quite aggregative information about the age- and gender-specific propensities to receive such transfer payments. Even where no allowance is made for endogenous responses, for example to wages, labour force participation and unemployment rates, such projections of social expenditure are subject to a large degree of uncertainty.[5]

An alternative approach to the investigation of population ageing is to make use of cross-sectional household surveys, which provide information about the details

[3] Excise tax revenue is thus not considered here: the ratio of excise revenue to the sum of income tax and GST is approximately 0.057 currently and is projected to remain around this level with pure population ageing and under current policy settings.

[4] For a range of studies of the impacts of ageing, see Creedy (ed.) (1995) and Creedy and Guest (eds.) (2007). See also Miles (1999) and Disney (1996).

[5] Population and social expenditure projections for New Zealand were reported in Creedy and Scobie (2005), who also produced confidence intervals, following the approach set out in Alvarado and Creedy (1998).

of individuals' incomes from different sources and household expenditure patterns, thereby giving data on income and consumption taxes. Importantly, such surveys reflect the considerable heterogeneity found in populations. All individuals and households in sample surveys of this kind are given survey weights, which allow the sample values of incomes, taxes and so on to be 'grossed up' to population values. The weights reflect known differential responses and over-sampling of some groups. Allowance for population ageing can thus be made by reweighting a survey, using independent projections of the population age and gender structure for calibration purposes, as in Cai *et al*. (2006).

This latter approach is taken here to examine the potential implications for personal income taxes and GST in New Zealand of pure population ageing. That is, the possible effects of changes in aggregate population size are excluded by constructing new sample survey weights which generate different population age distributions having the same totals. The basic dataset used is the New Zealand Household Economic Survey for 2006/07, and all computations are made using the Treasury's (non-behavioural) microsimulation model, Taxwell. The simulations assume a tax and transfer system with tax rates and thresholds as they were in 2006/07.

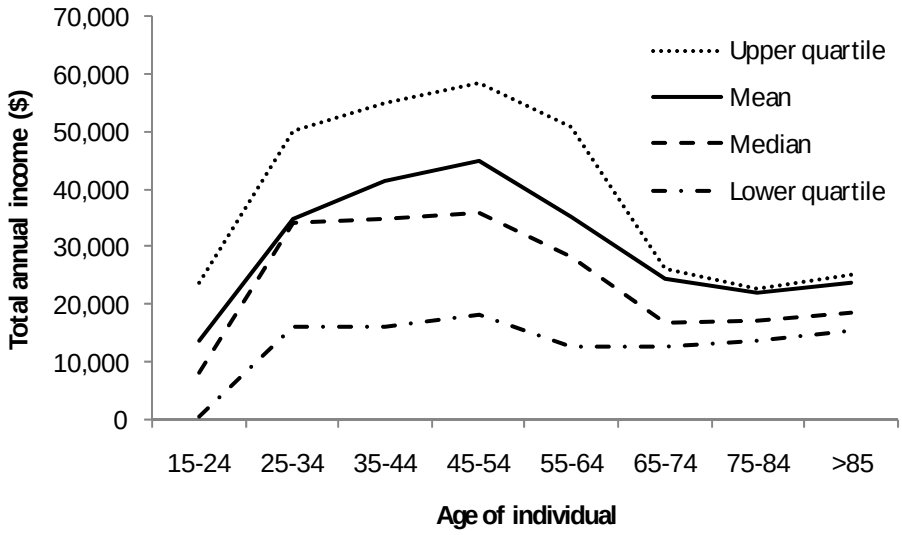
Before examining population ageing, Section 2 begins by examining some basic life-cycle patterns of income and consumption. On the assumption that such patterns remain relatively stable, they provide initial information about the effects of changing age distributions. Section 3 briefly describes the population projections and the sample reweighting approach. The implications of pure population ageing for tax revenue and its composition are then explored in Section 4. Conclusions are in Section 5.

2 Variations with Age

This section briefly describes a number of age-profiles which help to throw some light on the factors influencing the effects of pure population ageing. It is not intended to provide a detailed or comprehensive analysis of life cycle variations. Furthermore, all the results are cross-sectional profiles for 2006/07. The influences on the variation in, say, income over the life cycle can be decomposed into three factors: these are the effects of ageing itself; cohort effects which apply to each generation; and calendar

time effects. Even with extensive panel data, these effects are extremely difficult to isolate without making strong assumptions. An important time effect obviously relates to inflation and productivity changes, but in the following analysis all values are in real 2006/07 dollars. In comparing cohorts, earlier evidence suggests the existence of an 'overtaking' phenomenon whereby successive generations or cohorts experience higher earnings at comparable ages. However, there is no way to accommodate such variations here without imposing arbitrary assumptions. Thus in examining population ageing below, 2006/7 sample households and individuals are reweighted, with no adjustment made for cohort and time effects on earnings and other profiles.

Figure 1 Age and Individual Income



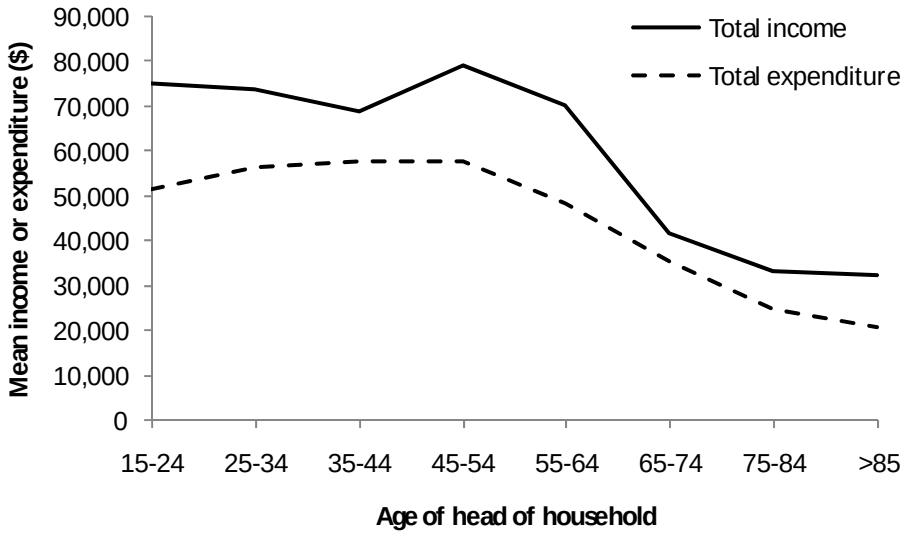
The cross-sectional variation in individuals' income with age is shown in Figure 1.[6] Here income is total income from all sources, including transfer payments. The arithmetic mean, along with the median and upper and lower quartiles, of the distribution in each age group is shown. This diagram displays the typical 'hump shaped' age profile, with the dispersion increasing with age until retirement. After a sharp decrease associated with retirement, the profiles rise slowly, reflecting the existence of savings among the aged: this phenomenon has been observed in studies

[6] For a detailed analysis of age-income profiles in New Zealand, see Creedy (1997).

of New Zealand saving behaviour.[7] Of course, even without cohort and time effects, individuals do not move systematically along the profiles over the life cycle, since there is substantial relative income mobility.

When considering expenditure patterns over the life cycle, data are not available at the individual level but at the household level. Hence it is necessary to examine household expenditure variations not in terms of the age of individuals but of the age of the 'household head'. In the case of the New Zealand Household Economic Survey, the head is considered to be the person who completes the questionnaire.[8] The variation in average household expenditure with age of household head is shown, along with that of household income, in Figure 2. The unit of analysis for income tax purposes is the individual, but these profiles are intended only to provide an indication of variations in income and expenditure, including both taxable and non-taxable, with age. In computing income tax revenues below, the correct income unit is of course used.

Figure 2 Household Income and Expenditure Variations with Age of Head



[7] The Household Economic Survey includes only those in private dwellings, and thus excludes student accommodation and retirement homes, who may differ systematically from those included.

[8] The effects of using alternative definitions of household age (such as average and maximum age) were also examined, but the head's age is preferred.

The 'humped' shape of the expenditure profile reflects, in part, the variation in household size with age of head. An indication of this variation is given in Figure 3, which shows, within each age group, the average number of people in the household, the average number of adults and adult-equivalents. The latter was obtained using parametric scales such that the adult-equivalent size of the household, m, is equal to $(n_a + \theta n_c)^{\alpha}$, where $\theta = 0.730$ is the weight attached to children and $\alpha = 0.621$ reflects the extent of economies of scale.[9] These different profiles clearly converge as household size shrinks to one adult in the high age groups and there are very few children in households where the head is retired.

Figure 3 Age and Household Size

In understanding the implications for income tax revenue of changes in the age structure, it is necessary to consider the contribution of different income components to total income, and the extent to which the different sources are taxable. A distinguishing feature of the New Zealand direct tax structure is that many transfer payments are included in taxable income: details of the tax treatment of different sources are given in Appendix B. The taxation of transfer payments does not simply represent 'giving with one hand and taking the same amount back with the other hand'. This is because, when taxable transfers are added to other sources of taxable

[9] These values replicate the Jensen scales often used in New Zealand.

income, individuals can move into higher tax brackets, with correspondingly higher marginal tax rates. The progressive nature of the income tax structure means that the average tax rate increases systematically over the whole range of incomes.

Figure 4 Mean Household Income Components and Age of Household Head

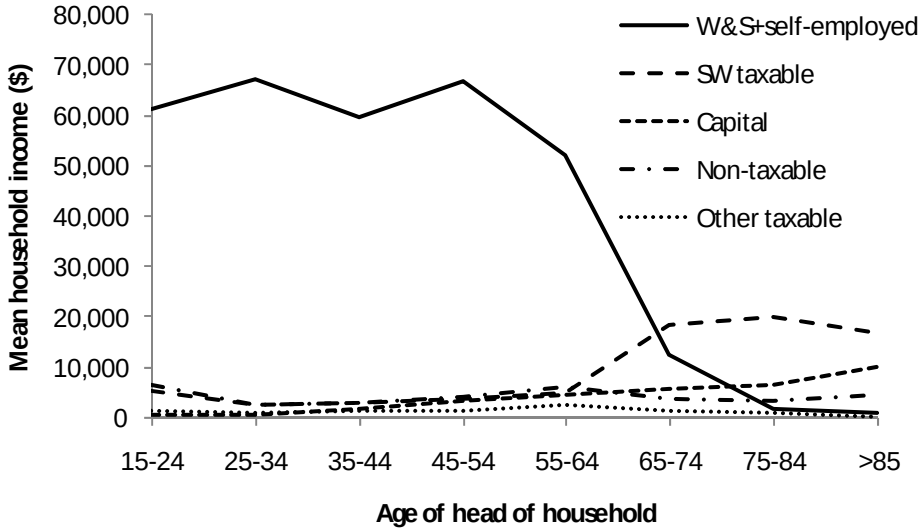


Figure 5 Median Household Income Components and Inter-Quartile Range

The variation with age of household head in arithmetic mean income components, as a proportion of total income, is shown in Figure 4. As expected, in the

higher age groups, earned income from wage and salary (W&S) and self-employment income falls substantially as transfer payments and, to a lesser extent, capital income become relatively more important. Figure 5 shows age variations in median income, along with upper and lower quartile: the inter-quartile range is indicated by the bars. In this case only income from wages and salaries and self employment are of significance until retirement age is reached, and only social welfare (SW) taxable income is significant in older age groups. This reflects considerable skewness in the distribution of income from other sources.

The Goods and Services Tax (GST) in New Zealand has a much broader base than similar value-added taxes in other countries. In particular, there are very few exemptions and none for groups such as food and domestic heating. An important implication of this broad base is that indirect tax revenue is likely to be less sensitive than otherwise to variations in the composition of total expenditure resulting from population ageing. Tax structures with considerable selectivity face a greater risk of the tax base being eroded if expenditure shifts towards exempt categories as a result of population ageing.

Nevertheless the coverage is not complete. For example, no GST is imposed on rents, house purchase payments and credit services, including banking fees. The variation, with the age of the household head, in average expenditure and the component parts of GST-liable and non-GST-liable goods and services is shown in Figure 6.[10] This demonstrates not only the typical humped pattern of expenditure over the life cycle but also the gradual increase with age in the proportion of expenditure devoted to GST-liable goods and services. The hump shape is partly, but not entirely, attributable to variations in household size with age, shown above. In the very old age groups, virtually all expenditure is liable to GST. Some idea of the variation within age groups is shown in Figure 7, which displays the median and inter-quartile range of the GST-liable and non-GST-liable components. These profiles indicate much greater stability over age groups than those for arithmetic mean.

The life-cycle variations displayed here combine with population ageing to influence variations over time in aggregate tax revenue and its composition. Before

[10] The expenditure data used here exclude the negative item ‘sales and refunds’, which is a very small proportion of total expenditure. It consists of money from selling items of property, furnishings, clothes or trade-ins.

examining such variations, the following section briefly discusses the way in which an initial cross-sectional household survey is artificially aged. This is achieved not by ageing the individuals in the dataset, but by adjusting the sample weights attached to different household types in order to achieve specified population age distributions.

Figure 6 Age and Mean Household Expenditure and its Composition

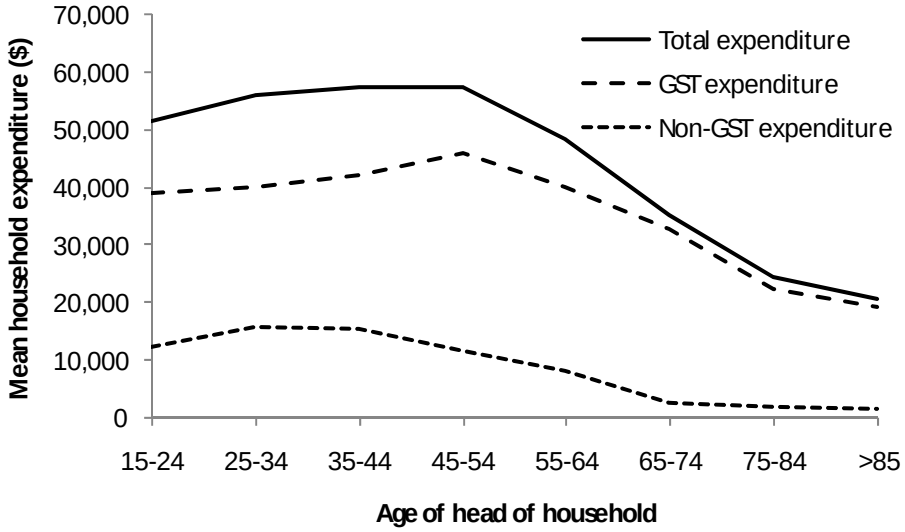
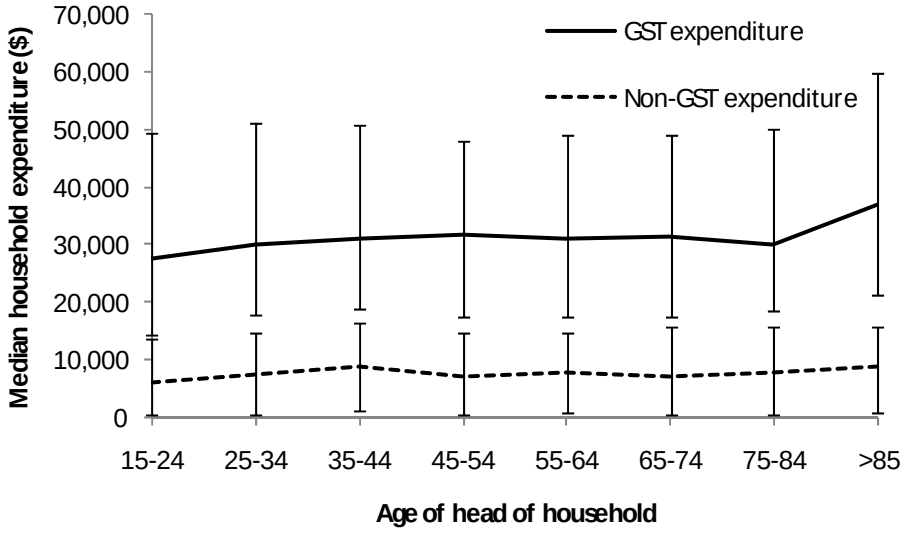


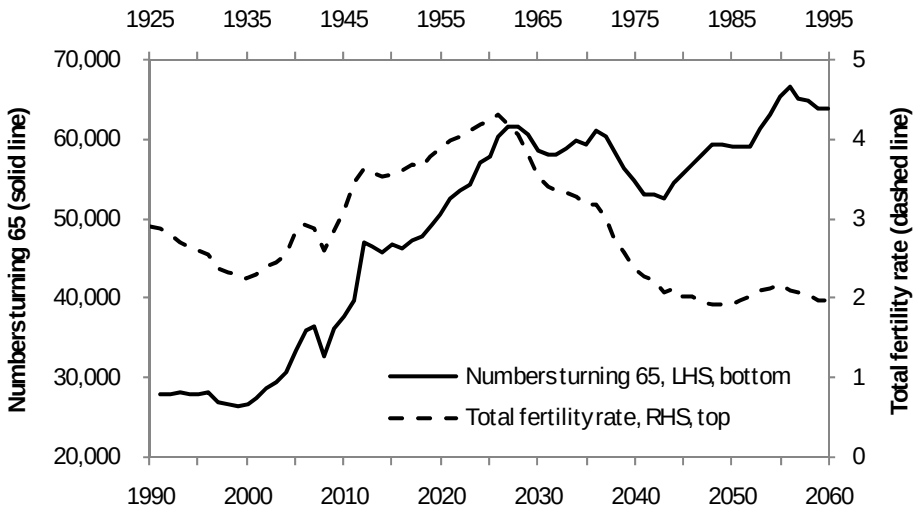
Figure 7 Median Houshold Expenditure and Inter-Quartile Range



3 Reweighting the Household Economic Survey

A broad indication of the expected demographic transition is illustrated in Figure 8.[11] This shows how the declining total fertility rate, beginning around 1960, is associated with a sharp increase, some sixty years later, in the number of individuals turning 65.

Figure 8 Fertility and Numbers Turning 65 Years

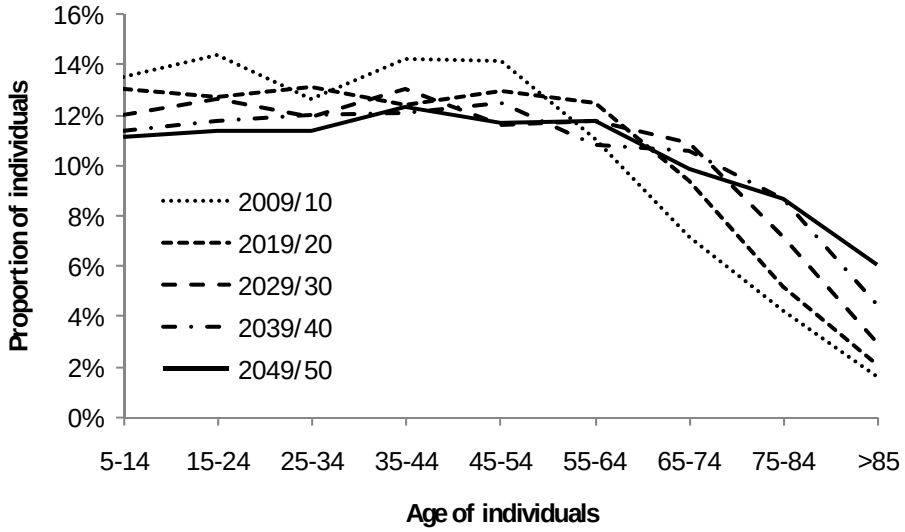


As mentioned above, the approach followed here is to concentrate only on the ageing aspect of this demographic change, thereby ignoring expected variations in the population size, as well as price and wage growth effects. This involves reweighting the Household Economic Survey households in order to impose pure population ageing. Statistics New Zealand population projections for the years 2009/10, 2019/20, 2029/30, 2039/40 and 2049/50 were used to generate age distributions of males and females such that the total population size is unchanged. The projections were from a 2006/07 base year, series 5. This series imposes medium fertility and mortality assumptions and an assumed long term annual net immigration of 10,000 people.[12]

[11] The data used here are from the Statistics New Zealand web site.

[12] Net migration in NZ is hard to predict as it is highly volatile. However, variations in net migration are unlikely to have a significant effect on the age distribution of the population, which is the primary focus here, rather than its absolute size.

Figure 9 The Changing Age Composition 2009/10-2049/50



The changing age distributions for males and females combined are shown in Figure 9. These clearly indicate a general increase in the proportion of the population in the older age groups over time, with a concomitant reduction in younger age groups. The profiles in Figure 9 appear to rotate around a point roughly corresponding to the proportion in the late 50s age group. The arithmetic mean age in the five periods increases from 36.9 in 2009/10 to 43.6 in 2049/50 (taking values of 39.0, 41.1 and 42.6 in the intervening years). When only those aged 15 years and above are included, the average age increases from 45.1 in 2009/10 to 51.4 in 2049/50 (taking values of 47.2, 49.0 and 50.5 in intervening years). The latter variation in average age corresponds roughly to the age range around the peak of the age-earnings profiles shown in Figure 1 above.

The projected age distributions were then used as calibration factors in computing new weights, following the basic method suggested by Deville and Särndal (1992). This involves generating new sample weights such that the revised age distribution of the population (obtained from the sample survey data using the weights) matches the calibration totals for the relevant year. The objective in revising the weights is to minimise the total distance, over all households, between the new and old weights, where the distance for each household is defined as a specified function of new and old weights. Clearly a wide range of functions could be used, but here the distance function used was the well-known chi-squared function (the square

of the difference between weights divided by the initial weight). An additional constraint was imposed such that the ratio of new to old weights for each household should lie within specified limits. This gives rise to a nonlinear optimisation problem which can be solved using an iterative solution algorithm. In each projection year the limits were varied in order to find the smallest range consistent with the iterative procedure successfully converging. The method is described further in Appendix A below.

The reweighting allowed only for calibration using the projected age distributions. It imposed no changes in, for example, aggregate labour force participation rates in each age group, or unemployment rates by age, or average real earnings by age. Hence, as discussed earlier, the analysis considers the effect of pure population ageing in circumstances in which age-profiles of important variables, such as real incomes, are assumed to remain unchanged.[13] In investigating 'pure ageing', the population size was held constant at the 2009/10 level (rather than 2006/07, the year of the Household Economic Survey used here). Information is given in the Appendix about the distributions of changes in sample weights required to achieve the calibration totals in each projection year.

4 The Composition of Tax Revenue and Welfare Spending

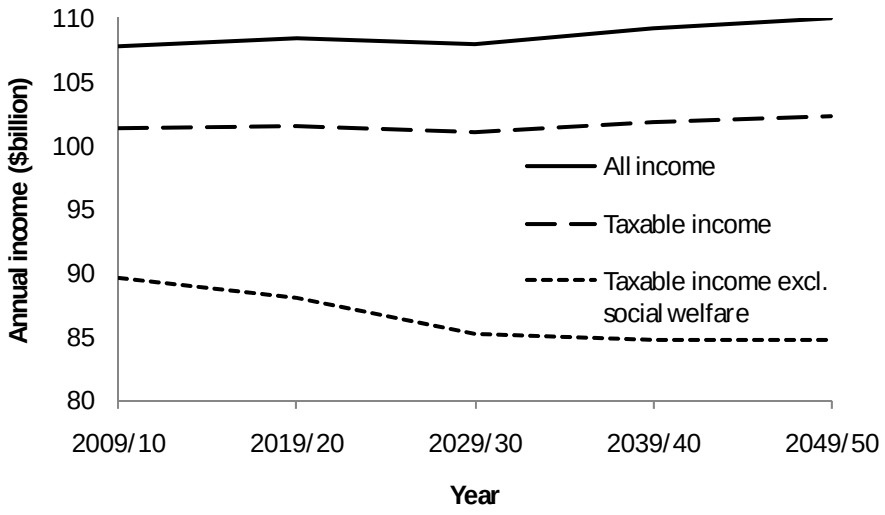
This section uses the revised survey weights for each of the projection years in order to investigate the potential implications of pure population ageing for the size and composition of tax revenues. The Household Economic Survey forms the basic database of the New Zealand Treasury's (non-behavioural) tax microsimulation model, Taxwell. Hence the various aggregates can be obtained using the built-in routines of the microsimulation model, which make use of the survey weights in order to produce population-level values.[14]

[13] Projections regarding such variations are of course subject to considerable uncertainty. In addition, the use of a much larger number of calibration conditions can often lead to convergence problems with the iterative reweighting procedure.

[14] It is therefore possible, as discussed below, to examine the implications of specified policy changes (for example to tax rates and thresholds, and benefit levels and abatement rates), under different population age distributions.

Figure 10 shows aggregate values of income, revealing that there is in fact little change in total income and taxable income over the projection period. It was mentioned above that the average age of those aged 15 years and over increases to 51.4 in the year 2049/50. When this is combined with the shape of the age-income profile, which does not turn down until some time after age 50, the relative stability in total income is less surprising. There is actually a small increase in measures of income from around 2029/30, but the diagram shows that this is entirely attributable to the role of transfer payments which are expected to increase as a result of population ageing.

Figure 10 Pure Population Ageing and Aggregate Income



The contribution of transfer payments to the changing composition of income is also revealed in Figure 11, which shows the variation of different income measures over the period. The decline in wage and salary and self-employment income (left-hand axis) is accompanied by increases in transfer payments, as expected, and a slight rise in investment income (right-hand axis; note different scale). The latter reflects a greater accumulation of wealth in an older population structure, and roughly compensates for a decline in self-employment income.[15]

[15] To the extent that there is some 'overtaking', more recent cohorts may be expected to accumulate more wealth at earlier ages, thereby increasing the growth of capital income further.

Figure 11 Components of Taxable Income

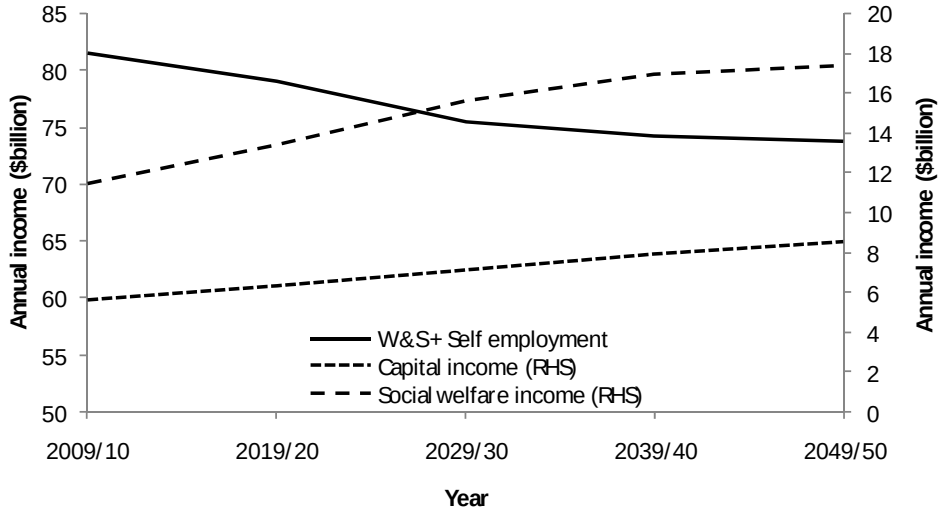
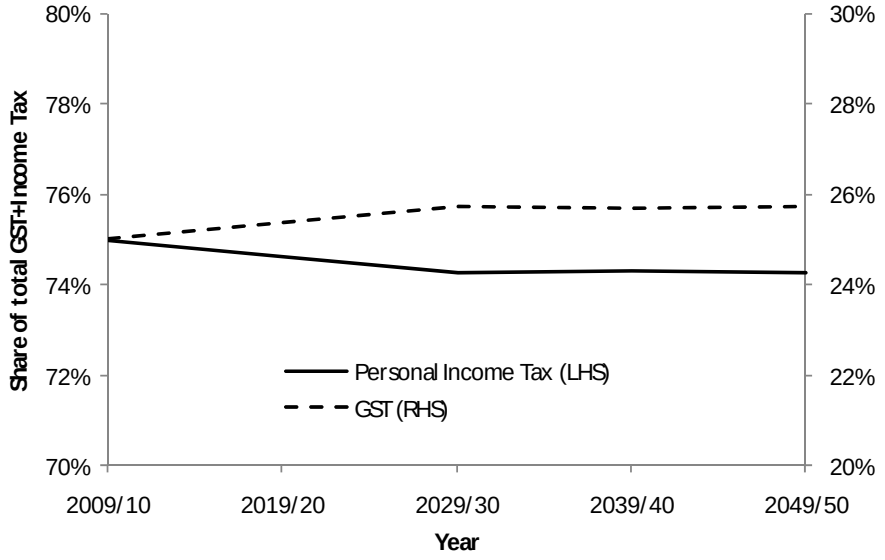


Figure 12 Shares of Personal Income Tax (PIT) and GST



The composition of tax revenue from income tax and GST over the projection period is shown in Figure 12. Here the share of GST in total revenue is relatively stable at around 25 per cent, but rising slightly over the first two decades. This reflects the relative stability shown above in the share of GST-liable expenditure in total expenditure, along with the stable value of total taxable income, and the fact that age-related saving rates have been assumed constant. The slight rise in the share of GST (and equivalent fall in personal income tax, PIT) is attributable to the small extent to which expenditure among the aged shifts away from rent, which does not attract GST,

as older households are more likely to own their houses. Although the share of income tax is correspondingly relatively stable, it has been seen above that the source of income tax revenues shifts away from earnings towards taxable transfer payments.

There are two direct consequences of the rise in social welfare income (mainly superannuation) relative to wage/salary and self-employment income. Firstly, with approximately constant income tax plus GST revenues, a greater fraction of that revenue (or equivalent revenue from other taxes) will be required to fund the rising social welfare payments. Secondly, a greater share of income tax plus GST revenue will be contributed by superannuitants as the population ages over the next 40 years. Clearly both of these depend on the persistence, or otherwise, of existing superannuation and tax policy settings.

Figure 13 shows changes in superannuation expenditure (NZS) and Working for Families (WFF) tax credit expenditure, expressed as ratios of total revenue from income tax and GST. The reduced WFF expenditure, associated with fewer children, could be expected to help compensate for rising NZS expenditure. Figure 13 also shows NZS expenditure net of associated income tax payments, net NZS.[16] In fact, Figure 13 shows that as NZS rises from around 22 per cent of tax revenue in 2009/10 to around 42 per cent in 2049/50 (left-hand scale), there is only minor compensation from reduced WFF payments, from about 7.5 per cent to 5 per cent of tax revenue (right-hand scale). The modest falls in WFF expenditure may reflect the fact that the numbers of under 15 year olds falls only slightly, from under 14 per cent of individuals to around 11 per cent: see Figure 9. Thus ageing involves an approximate doubling of the revenue cost of NZS over forty years, with the majority of this occurring in the next twenty years.

On the second revenue consequence of ageing – a greater fraction of tax being paid by the aged – Figure 14 reveals that the proportion of both income tax and GST contributed by NZS recipients rises from 4 per cent and 2 per cent respectively in 2009/10 to almost 8 per cent and 4 per cent respectively. Thus income tax and GST receipts become more dependent on the level of state pensions.

[16] As mentioned earlier, NZS may take some individuals into higher marginal income tax brackets, but this is ignored in producing the schedule shown above.

Figure 13 Transfers as a Percentage of Tax Revenue

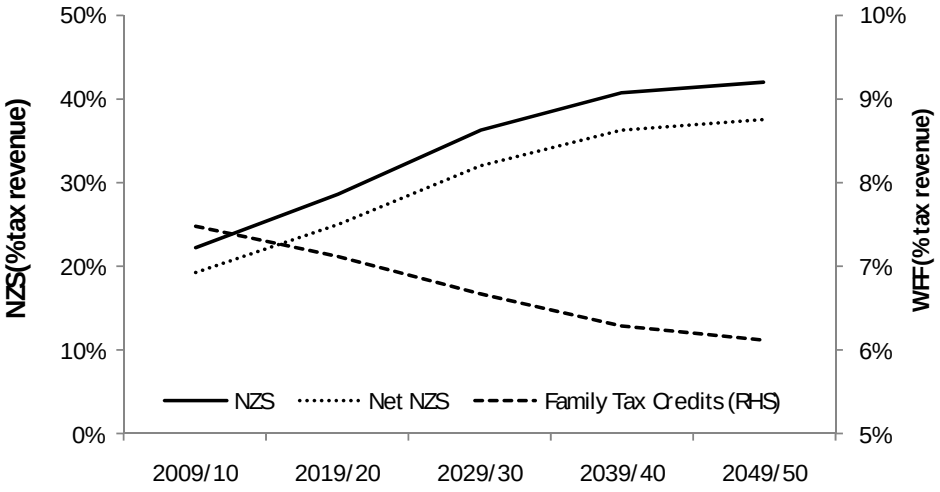
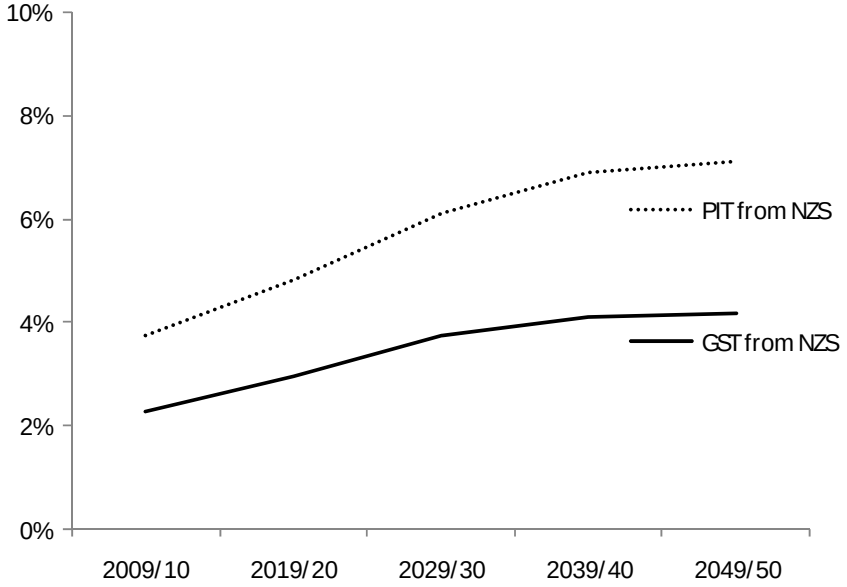


Figure 14 Share of PIT and GST Paid by Superannuitants (per cent)



To examined the dependence of tax revenues on NZS settings, two separate policy changes are examined below. First, all income tax rates are increased by 1 percentage point from their 2006/07 values (to 16, 22, 34 and 40 per cent). Secondly the level of gross NZS is increased by 10 per cent for both individuals and couples.

Figure 15 indicates that an increase in income tax rates by 1 percentage point reduces the revenue cost of NZS (left-hand axis) by around 2 per cent of income tax revenue in 2009/10, rising to an almost 5 per cent reduction by 2049/50. However, the effect on the share of income tax revenue contributed from NZS is minimal. This reflects the fact that such tax rate increases affect NZS and non-NZS taxpayers similarly. For example, a revenue-neutral policy of raising only the top marginal rate would have a different effect. Since NZS recipients are disproportionately represented among low income taxpayers, a top rate increase would raise less additional tax from NZS recipients than the general 1 per cent increase examined in Figure 15.

Figure 16 shows that a 10 per cent increase in NZS levels raises the cost of NZS (in terms of income tax revenue) by around 5 per cent in 2049/50 (left-hand axis), but only about 2.5 per cent currently. That is, for every $100 of tax revenue currently devoted to fund NZS expenditure, this will rise to around $190 by 2049/50 if policy setting do not change, but will rise to around $205 in 2049/50 if pension levels were to become 10 per cent more generous. These effects should be approximately symmetric for a similar reduction in pension generosity. Figure 16 also shows, as expected, that the 10 per cent rise in NZS increases the share of income tax revenue contributed from NZS. By 2049/50 the share would be around 1 per cent higher (compared with unchanged NZS settings) at 10.5 per cent.

The analysis so far has treated employment participation rates as constant; that is, the demographic ageing process does not induce pre- or post-retirement individuals to increase or extend participation, which may include part-time working.[17] However, increased longevity as well as reduced fertility may be expected to encourage increased labour supply. To give some indication of the potential orders of magnitude involved, suppose income earners (employees and self-employed) aged from 45 to 74 inclusive increase their earned incomes by 10 percent. This amounts to about 40 per

[17] The reweighting of the HES is carried out using only age distributions as calibration variables, as described earlier.

cent of all employed and self-employed income earners. There would be other changes associated with the tax and social welfare system, such as reduced family tax credit entitlement where relevant individuals' incomes increase. Simulations using Taxwell are summarised in Figure 17, which shows the outcomes for the same variables examined in Figures 15 and 16.

Figure 15 Effects on NZS and Tax Revenue of a 1 Percentage Point Increase in All Income Tax Rates

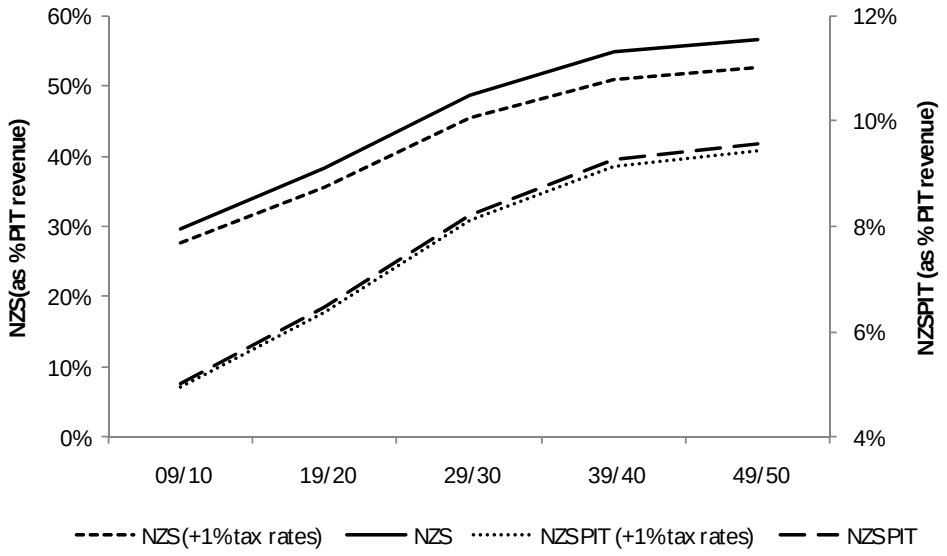
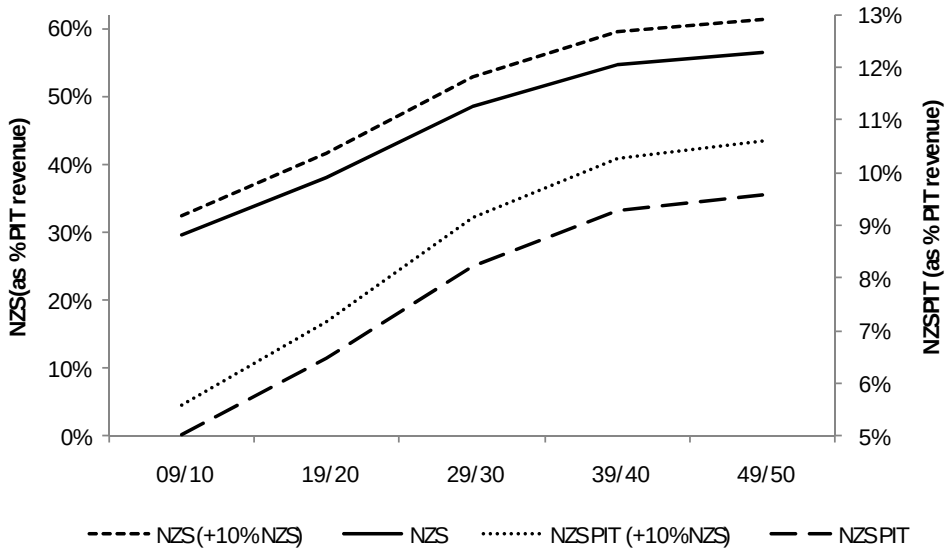
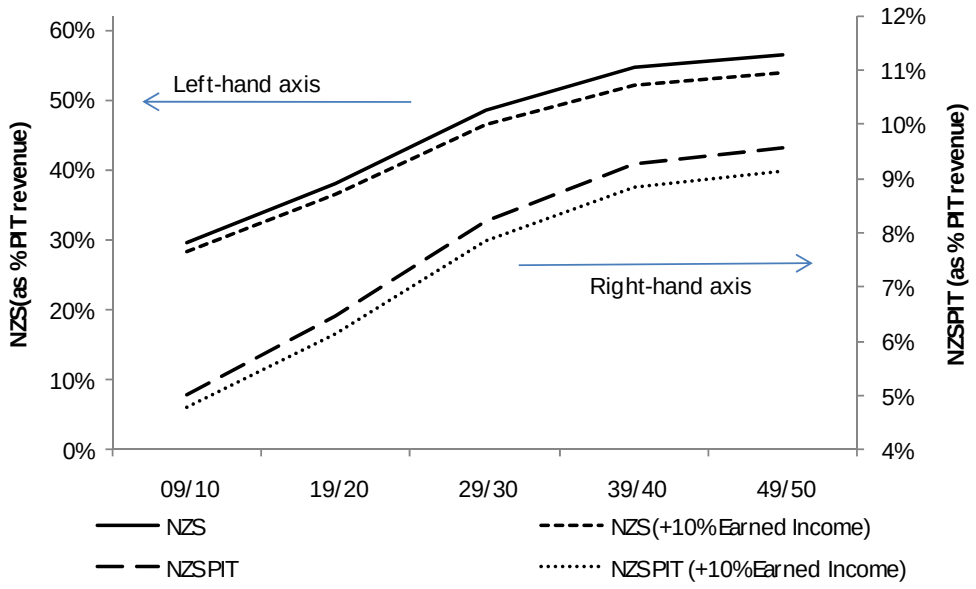


Figure 16 Effects on NZS and Tax of a 10 per cent Increase in NZS Levels



The 10 per cent increase in earned incomes of all 45-75 year old individuals has a very limited impact on the extent of tax-funding of NZS (top lines; left-hand axis). This shows that the rising tax-cost of NZS, previously from around 29 per cent of PIT revenues in 2009/10 to 56 per cent by 2049/50, becomes 54 per cent in 2049/50 with the greater income earning by older workers.

Figure 17 Sensitivity of Tax and Expenditure Shares to Age-Related Income Earning



There is also a small reduction in the share of income tax revenue contributed from NZS pensions: this falls from 9.6 per cent in 2049/50 (before the income increases) to 9.1 per cent (after the income increases). This suggests that a substantial increase in participation by older age groups would be required to contribute significantly to improved tax-financing of NZS over the next 20 to 40 years.

Finally, it might be suggested that, with migration playing an important role in New Zealand's labour market, the rising cost of NZS could be partly offset by increased immigration. The potential immigration requirement is indicated by, with current policy settings, the increased net cost of NZS between 2009/10 and 2049/50

from the pure ageing effect of around $4.7 billion (from $5.2 bn. to $9.9 bn. in 2008/09 prices over the 40 years).[18]

The New Zealand ordinary average wage for full-time equivalents in 2008/09 was around $47,000. The tax payable on this income will of course depend on individual and household circumstances. Based on an individual with taxable income arising only from their earned income, Treasury modelling estimates the total tax revenue generated on the average wage as around $16,600 when second-round effects are taken into account. Based on an overall additional cost of NZS of $4.7 billion, this represents approximately an additional 280,000 people by 2049/50, or equivalently, 7,000 per annum. This may be compared with Statistics New Zealand's population projection assumption of net immigration of 10,000 per year. An additional 7,000 migrant – earning average wages but generating no NZS expenditure over the next 40 years – would represent a substantial addition.

An alternative way of capturing the magnitude of the NZS funding problem is to consider the increase in aggregate labour force participation that would be required to fund the additional $4.7 billion of NZS expenditure (Figure 17 simulated a limited increase in the incomes of 45-74 year old existing earners only). This can be approximated by considering the increase in the labour force resulting from the additional 297,000 working individuals required to fund NZS, holding the unemployment rate constant. Based on data on labour force and unemployment for 2008/09, it is found that this represents a labour force increase from approximately 2.3 million in 2008/09 to 2.6 million. This, in turn, represents an increase in the labour force participation rate (labour force as a percentage of working age population; the latter was 3.3 million in 2008/09) from 68.6 per cent in 2008/09 to 77.9 per cent by 2049/50. The modelling in this paper has not allowed for a number of demographic factors which could affect participation rates, for example the tendency for declining

[18] This figure is net of income tax paid on NZS and indirect taxes arising from the associated consumption (second round effects) using standard Treasury modelling assumptions. Values quoted are in 2008/09 prices, the latest year for which the wage data are available.

fertility rates to encourage increased participation by younger aged females.[19] The feasibility of such an increase in participation is a useful avenue for further research.

5 Conclusions

This paper has considered the implications for personal income tax and GST revenues of pure population ageing in New Zealand over the next 40 years. It might be expected that an increase in the population share of pensioner groups would reduce aggregate incomes but increase the proportion consumed. However, the evidence presented here suggests this is not the case. With age-earnings profiles revealing an earnings peak in the 45-54 age group, and the expected average age of the population over the next 40 years passing through this age group, younger individuals with increasing incomes are expected to approximately counteract the declining incomes of older individuals. Income and consumption patterns suggest that although the proportion of income consumed appears to increase in the first retirement decade (ages 65-74), this is not sustained. There is a tendency for the savings proportion to increase in older pensioner age groups, especially those over 85.

The ageing process can be expected to increase the dependence of income tax and GST revenues to pension choices. Without changes in NZS settings, the costs of NZS are expected to approximately double over the next 40 years, with most of this occurring over the next 20 years. Measured in terms of personal income tax revenues, NZS expenditures, under current settings, are projected to rise from around 22 per cent currently to 36 per cent by 2029/30 and 42 per cent by 2049/50. There are likely to be only minor cost savings from reductions in child-related transfer spending. Analysing the impact of changes to income tax rates or the level of Superannuation (NZS) payments shows that changes to NZS rates have a non-trivial effect on the share of income tax and GST contributed from NZS incomes.

The projected substantial increase in the cost of NZS reported here is likely to represent an upper limit. First, no account has been taken of overtaking whereby younger cohorts earn higher real incomes than older cohorts at comparable ages. This would have the effect of increasing the income tax base, as well as the ability of

[19] Allowing for age-related participation increases would also need to recognise that as older people decide to remain in the labour force for longer, this is likely to involve fewer hours than the mean for the population as a whole.

individuals to save for retirement. Secondly, the projected lower fertility is likely to be accompanied by a higher labour force participation rate of women, whereas the reweighting of the HES has been based only on projected population age distributions. Third, no general equilibrium effects have been modelled, but one effect of population ageing is that wages are likely to increase, with associated positive effects on labour force participation. [20] Both effects will combine to increase the revenue from income taxation and extend the age of voluntary retirement. Fourth, projections of future costs and revenues, particularly extended over a long period, are highly sensitive to productivity growth, around which there is much uncertainty.

Despite these positive effects which are likely to reduce the burden below the estimates reported here, it does appear that some difficult choices are inevitable if policy parameters were to remain unchanged. Higher net immigration, as mentioned above, cannot be expected to solve the problem, and anyway no reliance can be placed on this in view of the considerable variability over time in immigration rates.[21] Thus, either tax revenue has to be increased (from income taxation, GST or other sources), or NZS expenditure has to be reduced, or some combination of both.

Increasing personal income taxation rates is likely to be counterproductive if it adversely affects incentives, given the importance of maintaining, and indeed increasing, labour force participation beyond current levels, and encouraging delays in voluntary retirement beyond current levels. Policy changes to NZS settings fall into two categories. First, one possibility, which has been followed in other countries, is to raise the age of entitlement. A second possible policy change is to break the link between NZS and average earnings. The linking with average earnings allows pensioners to share fully in productivity and real income growth, but is more generous than maintaining the real value at a constant level.[22] The existence of a formal link to

[20] Endogenous responses to ageing are stressed by Disney (1996) and Guest (2005, 2006, 2007a, b).

[21] To the extent that net immigration rates are sensitive to tax rates in NZ compared with overseas, relative increases in rates over the projection period may be expected to reduce the annual value below that assumed in the projections here but, as mentioned earlier, this is unlikely to affect the age distribution significantly.

[22] Following Aaron (1966) and Samuelson (1958), the tax financing of superannuation, or pensions, on a ‘pay as you go’ basis (allowing pensioners to share fully in productivity growth) involves a metaphysical ‘social contract’ among generations, the acceptance of which requires the sum of

wages also reduces the number of degrees of freedom in policy choices available and therefore eliminates one element of flexibility (in upward or downward directions, depending on the circumstances) available to governments.

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population and income growth to exceed the real rate of interest. Reduced population growth clearly places a strain on this condition.

Appendix A. The Calibration Method of Reweighting

This appendix describes the calibration method used to reweight the Household Economic Survey. The problem can be stated as follows. For each of K individuals in a sample survey, information is available about J variables; these are placed in the column vector:

$$x_k = [x_{k,1}, ..., x_{k,J}]' \tag{A1}$$

The vectors contain only the variables of interest for the calibration exercise, and in the present context the elements of x_k are $0/1$ variables. For example $x_{k,j} = 1$ if the k^{th} individual is in a particular age group, and zero otherwise. The sum $\sum_{k=1}^{K} x_{k,j}$ therefore gives the number of individuals in the sample who are in the age group.

The sample design weights, provided by Statistics New Zealand are denoted s_k for $k = 1, ..., K.$ These weights can be used to produce estimated population totals, $\hat{t}_{x|s}$, based on the sample, given by the J-element vector:

$$\hat{t}_{x|s} = \sum_{k=1}^{K} s_k x_k \tag{A2}$$

The independent population projections provide information about the new population totals, t_x. The problem is to compute new weights, w_k, for $k = 1, ..., K$ which are as close as possible to the s_k, while satisfying the set of J calibration equations:

$$t_x = \sum_{k=1}^{K} w_k x_k \tag{A3}$$

It is thus necessary to specify a criterion by which to judge the closeness of the two sets of weights. In general, denote the distance between w_k and s_k as $G(w_k, s_k)$. The aggregate distance between the design and calibrated weights is thus:

$$D = \sum_{k=1}^{K} G(w_k, s_k) \tag{A4}$$

The problem is therefore to minimise (A4) subject to (A3), for which the Lagrangean is:

$$L = \sum_{k=1}^{K} G(w_k, s_k) + \sum_{j=1}^{J} \lambda_j \left(t_{x,j} - \sum_{k=1}^{K} w_k x_{k,j} \right) \tag{A5}$$

where λ_j for $j = 1, ..., J$ are the Lagrange multipliers.

Deville and Särndal (1992) showed that if $G(w_k, s_k)$ is such that the differential with respect to w_k can be expressed as a function of w_k/s_k, so that:

$$\frac{\partial G(w_k, s_k)}{\partial w_k} = g\left(\frac{w_k}{s_k}\right) \tag{A6}$$

The K first-order conditions for minimisation can therefore be written as:

$$g\left(\frac{w_k}{s_k}\right) = x_k'\lambda \tag{A7}$$

Write the inverse function of g as g^{-1}, so that if $g(w_k/s_k) = u$, say, then $w_k/s_k = g^{-1}(u)$. From (A7) the k values of w_k are expressed as:

$$w_k = s_k g^{-1}\left(x_k'\lambda\right) \tag{A8}$$

If the inverse function, g^{-1}, can be obtained explicitly, equation (A8) can be used to compute the calibrated weights, given a solution for the vector, λ. The Lagrange multipliers can be obtained by post-multiplying (A8) by x_k, summing over all $k = 1, ..., K$ and using the calibration equations, so that:

$$t_x = \sum_{k=1}^{K} w_k x_k = \sum_{k=1}^{K} s_k g^{-1}\left(x_k'\lambda\right) x_k \tag{A9}$$

Finally, subtracting $\hat{t}_{x|s} = \sum_{k=1}^{K} s_k x_k$ from both sides of (A9) gives the nonlinear equations:

$$t_x - \hat{t}_{x|s} = \sum_{k=1}^{K} s_k \left\{g^{-1}\left(x_k'\lambda\right) - 1\right\} x_k \tag{A10}$$

where $s_k \left\{g^{-1}\left(x_k'\lambda\right) - 1\right\}$ is a scalar and the left hand side is a known vector. An iterative procedure to solve these nonlinear equations, based on Newton's method, was used here. The distance function used was the chi-squared function given by $G(w, s) = (w - s)^2 / 2s$ for which $g(w/s) = w/s - 1$ and $g^{-1}(u) = 1 + u$, with the additional requirement regarding the limits of variation of the weights. For further details of the weighting function and the iterative solution method followed, which is based on Newton's method of solving systems of nonlinear equations, see Creedy (2004).

Figure 18 Weights for Pure Population Ageing

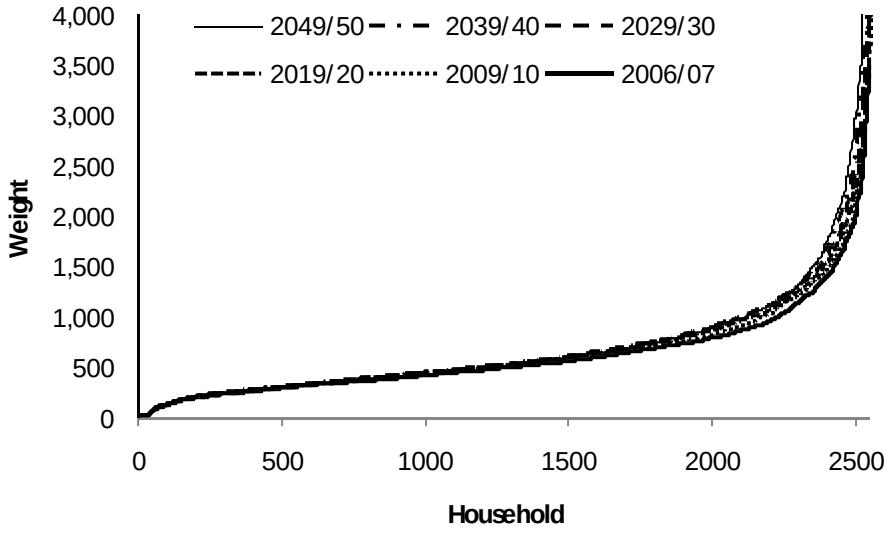
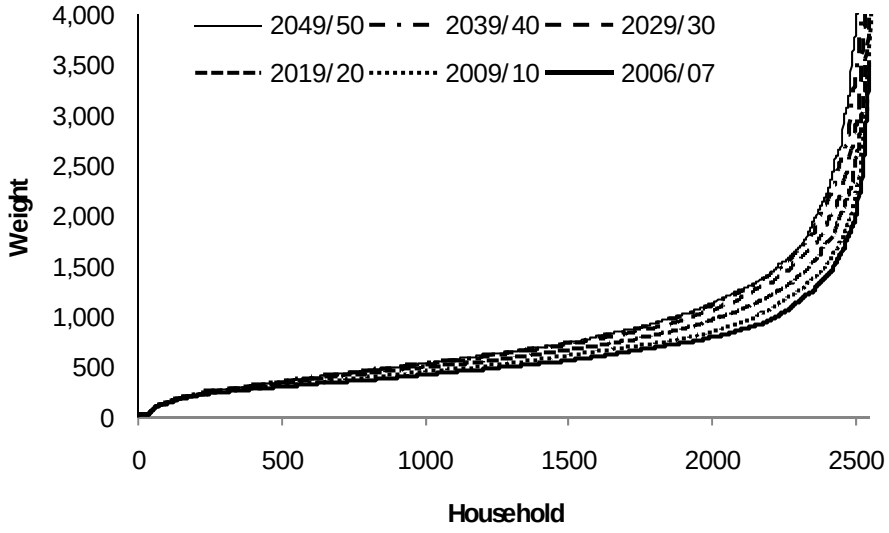


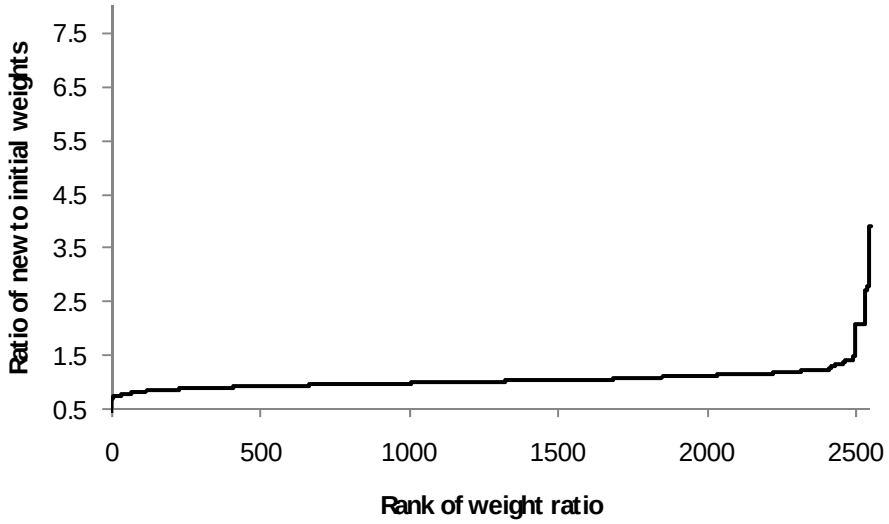
Figure 19 Weights for Population Growth and Ageing



Some indication of the way in which the weights change over the projection period is given in Figures 18 and 19. The first case is for pure ageing alone and the second figure shows the profile of weights for each year in the case of population change combined with ageing, where larger increases over time are needed. Thus the situation of pure population ageing examined here does not require excessive changes. These profiles indicate that the weights are similar for the large majority of households, but for a small number of households, the weights are very large

reflecting the under-representation of households with corresponding characteristic in the sample. Fortunately these are not concentrated on just a small number of types: it would, for example, be problematic for present purposes if they were to reflect only one or two particular age groups. [23]

Figure 20 Ratio of New/Initial Weights for 2009/10



Further information about the extent to which the household weights need to be adjusted is shown in Figures 20 and 21 for pure ageing and the years 2009/10 and 2014/50. In these cases the vertical axis shows the ratio of new to initial sample weights, ranked in ascending order. The dispersion of changes across the range of initial weights is indicated for the same years in Figures 22 and 23, where household are ranked along the horizontal axis according to the order of their original weights. Clearly, the range of variation in the weights is higher for the last projection period, 2009/10, and for a significant number of households the change is quite large in proportional terms. However, for each projection period and for the majority of households, the adjustment needed to obtain the required overall male and female age distributions is quite small.

[23] For example, of those 54 households with original weights of 2000 or more, the age of household h varies from 16 to 81 years, 28 have some form of core benefit income, and 11 have superannuation income. Furthermore 13 have 1 occupant, 15 have 2, 9 have 3, 7 have 4, then 10 have 5 or more. In terms of location 20 are in region 1 (north of north island), 22 are in region 2 (Auckland) leaving 12 scattered over the other four regions.

Figure 21 Ratio of New/Initial Weights for 2049/50

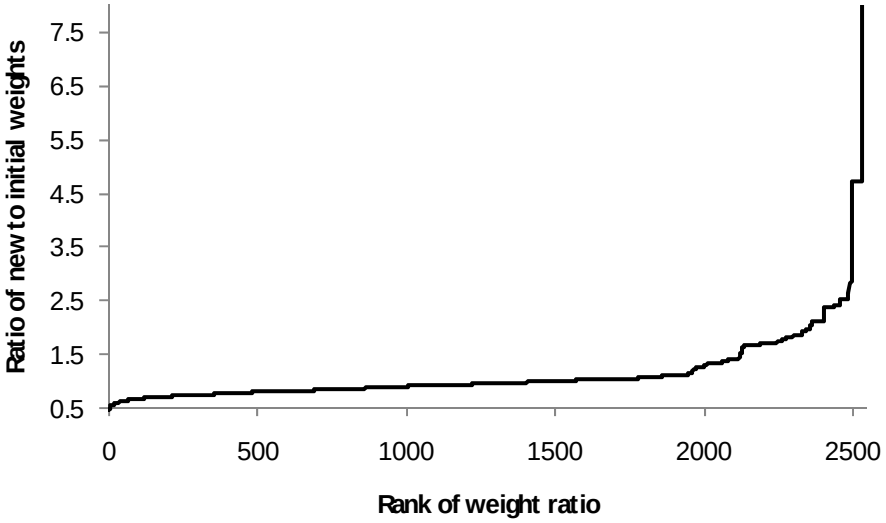


Figure 22 Changes in Weights by Initial Household Rank 2009/10

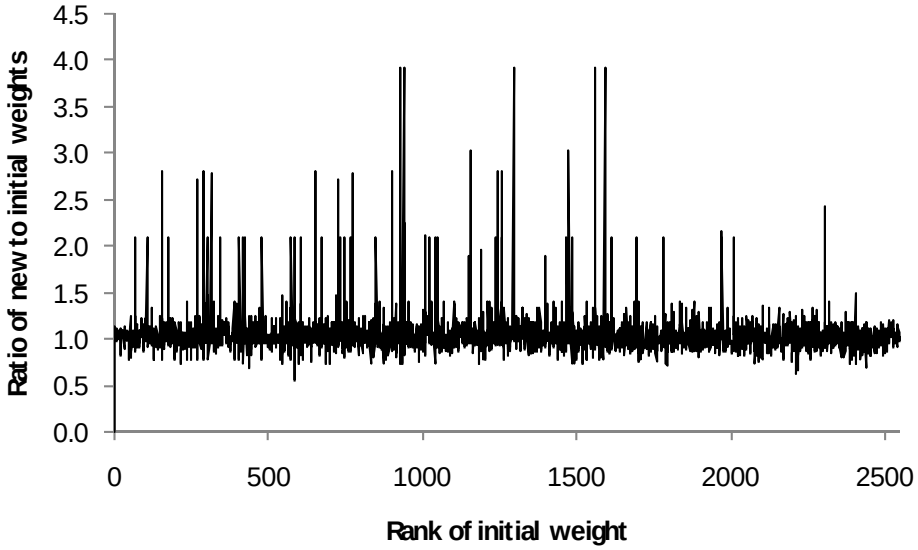
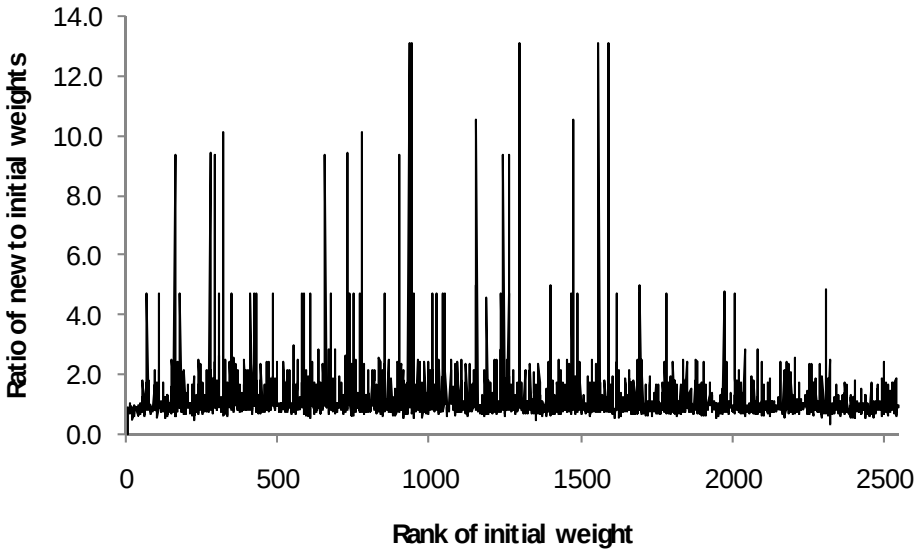


Figure 23 Changes in Weights by Initial Household Rank 2049/50



As only one calibration variable – age – has been used to reweight the sample data, it is useful to check if other characteristics, in particular the distribution of income, do not change in an erratic manner. The histograms of the distributions for each year, not shown here, indicated that no distortions appeared to arise from reweighting.

Appendix B. Tax Treatment of Income Sources in NZ

Earned Income Wage and Salary (and Redundancy) Self-Employment	Taxed according to the personal tax scheme
Capital Income* Interest income from banks, dividends, other income from investments, bonds, rental properties (including sourced from overseas) * Portfolio Investment Entities (PIEs) not included here as non-existent in 2006/07	Taxed according to the personal tax scheme
Other Taxable Income Income from hobbies, Protection Insurance, trusts, ACC, casual jobs, parental leave, overseas income from trusts, wage and salary jobs, benefits, pensions and other regular income	Taxed according to the personal tax scheme
Non-Taxable Income Income from maintenance, job super and retirement schemes, educational bursaries or scholarships, non-taxable lump sum payments, income from overseas war pensions, other irregular sources	Not taxed
Taxable social welfare income Domestic Purposes Benefit Independent Youth Benefit Invalids Benefit Sickness Benefit Unemployment Benefit Widows Benefit New Zealand Superannuation Veterans' pension Student Allowance	Taxed according to the personal tax scheme
Non-taxable social welfare income Accommodation Supplement, rehabilitation allowance, special, orphans and other benefits, war disability and surviving spouse pensions, community and work training schemes and programmes	Not taxed
Other transfers* Working for Families: Family Tax Credit In Work Tax Credit Parental Tax Credit Minimum Family Tax Credit * Independent Earner Tax Credit not included here as introduced after 2006/07	Not taxed

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