Are kiwis saving enough for retirement? Evidence from SOFIE

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Abstract

Saving for retirement is an important decision for individuals and couples. The extent to which people are saving for retirement is a key element in formulating public policy toward saving and retirement incomes. Little or no insight into retirement savings can be gleaned from aggregate measures of household saving rates. It is the accumulation of wealth that is the critical indicator. For this information is needed on the assets and liabilities of households. This paper uses new data on assets and liabilities from the Survey of Family Income and Employment. I develop a formal life cycle model of wealth accumulation to estimate the saving rates that people would need to have until retirement age in order to have an adequate income in retirement. Most of the population aged 45-64 has made adequate provision, especially among the lower income groups where New Zealand Superannuation represents the majority of their retirement income. Only one-eighth

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of the pre-retirement cohort (age 55-64) appear to be saving at rates below those needed to accumulate the required level of retirement wealth.

JEL CLASSIFICATION	D31 – Personal Income and Wealth Distribution D91 – Intertemporal Consumer Choice: Life Cycle Models and Saving J26 – Retirement
KEYWORDS	Consumption smoothing, household wealth, life cycle, retirement, savings

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1 Introduction

Saving for retirement is an important decision for individuals and couples. The extent to which people are saving for retirement is a key element in formulating public policy toward saving and retirement incomes. In contrast, no insight into retirement savings can be gleaned from aggregate measures of household saving rates. It is the accumulation of wealth that is the critical indicator. For this information is needed on the assets and liabilities of households.[1] This paper uses new data on assets and liabilities from the Survey of Family Income and Employment (SOFIE).

I develop a formal life cycle model of wealth accumulation which provides estimates of the saving rates that people would need to have until retirement age in order to have an adequate income in retirement. The analysis focuses only on ages 45-64 because people in this age range are old enough to start thinking seriously about preparing for retirement.[2] Significant parts of the population aged 45-64 appear to have made adequate provision. This is particularly true among the lower income groups where New Zealand Superannuation (NZS) represents the majority of their retirement income. Perhaps as few as one-eighth of the pre-retirement cohort (age 55-64) are apparently saving at rates below that needed to accumulate the required level of retirement wealth. Further work is underway to identify the characteristics of this group and assess the magnitude of their shortfalls.

The paper proceeds as follows. In the next section I give a brief description of the data, while an outline of the model follows in Section 3. The preliminary findings are set out in Sections 4 and 5. Section 6 concludes.

[1] See, for example, Burkhauser and Wilkinson (1983).

[2] It is more challenging to apply the model to younger ages as the further one is from retirement, the more imprecise projections of retirement wealth, income and consumption become.

2 Data

The primary data source in this study is SOFIE, a panel survey which started in October 2002 and is intended to run annually for eight years. SOFIE collects data on levels, sources and changes in income for New Zealand individuals and families. It also reports on major influences on income, such as employment and education experiences, household and family status and changes, demographic factors and health status. The survey covers 26,339 individuals from 10,244 households, representing 3,771,864 people.[3]

The data on assets and liabilities used in this study come from Wave 2, which ran from 1 October 2003 to 30 September 2004. These data contain several limitations, which necessitate assumptions, as outlined below.

Statistical unit SOFIE's statistical unit is the individual and the household, but the unit of analysis in the retirement model is the non-partnered person and the couple.[4] SOFIE provides no information on whom a person is partnered with, but I can infer this from people's role in their family nucleus and form partnered individuals into couples accordingly. The couple's income or wealth is made up of the income/wealth of both partners while the age of the couple refers to the age of the older partner.

Property Individuals were asked for the total value of each property and the number of other people who also own that property. I assume equal

[3]SOFIE's target population is ordinary residents who live in private dwellings. Excluded from the survey sample are short-term overseas visitors (intending to stay for less than 12 months), non-NZ diplomats and diplomatic staff and their dependants, members of non-NZ armed forces stationed in NZ and their dependants, and residents of offshore islands other than Waiheke Island (Statistics New Zealand, 2006).

[4]Retirement is an individual's or couple's decision, not a household's. This distinction is also sensible given the structure of NZS payments and their importance to retirement incomes.

ownership shares among owners.

Mortgages There is only one figure which refers to the total value of all mortgages, but no information on the number of mortgages or which property the mortgages are for. I assume that the total mortgage value is split between owner-occupied and other residential property such that the gearing ratio is equal between the two classes of property.[5]

Household items I ignore household items in the calculation of wealth, as these assets depreciate over time and they can not easily be liquidated. These assets are also valued inconsistently across individuals.[6]

Pension schemes Due to errors in the questionnaire, there is evidence that the reported participation rates in pension schemes and values of schemes are markedly lower than indicated by other sources.[7] Since the errors are complex and and difficult to remedy, I take the data as is, acknowledging that these errors understate total net worth by 2% on average and thus render the results 'conservative.'

3 Saving for retirement – the model

To model adequacy of retirement saving, I adopt a framework of joint determination of saving and replacement rates. This framework assumes that people seek to smooth consumption throughout the life cycle.

[5]Investment properties are normally more highly geared (for tax benefits), so such division of mortgages would tend to overstate borrowing for owner-occupied properties.

[6]The methods that were used to evaluate household items include: 1) Insured value for replacement (59.4%); 2) Insured value not for replacement (6.3%); 3) Amount that would be received if sold (13%); 4) Amount that was paid (8.1%); 5) Other method of estimation (11.7%); 6) Don't know; 7) Refused; and 8) Missing.

[7]Informal communications and unpublished notes from staff of Statistics New Zealand.

3.1 General assumptions

For simplicity, I ignore uncertainty. Specifically, this assumption means that an individual will retire at a certain age as planned; does not engage in the work force after retirement; knows exactly what their income until retirement will be; can accurately project the rate of return on investments; has a known life expectancy at the age of retirement; knows the amount of NZS that they will receive; plans and executes whatever bequests they wish to make; has no unexpected changes in health status that would affect income or expenditure; and assumes tax rates and other policies remain unchanged.[8]

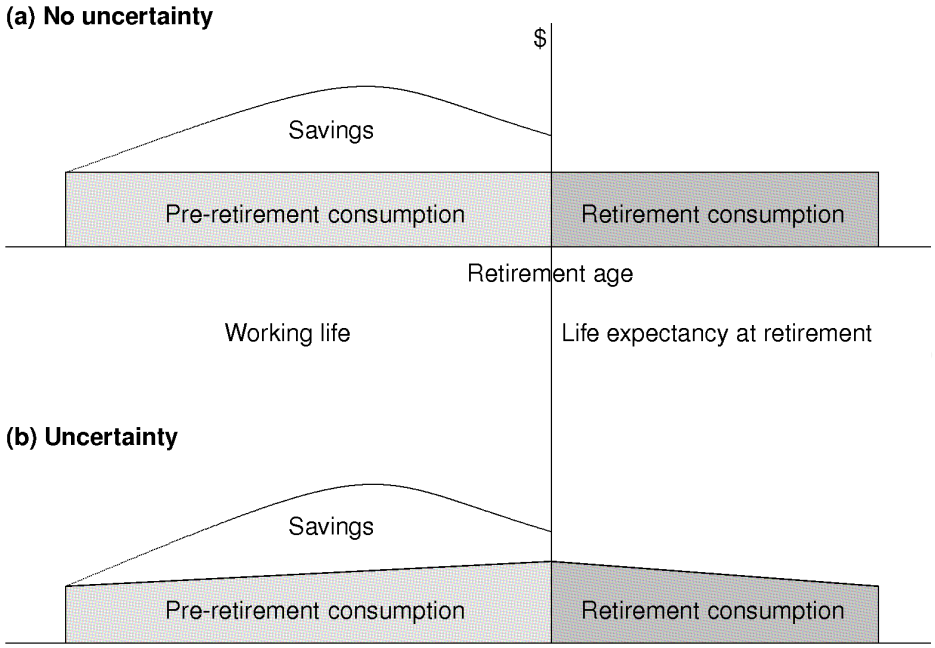
In the absence of uncertainty, the life cycle savings and consumption patterns can be illustrated as in Figure 1. The household chooses a level of consumption that can be financed from income over the working life, and then from savings during retirement. This implies (ignoring interest for the moment) that savings are equal to consumption needs in retirement.

This simple life cycle pattern can be modified to allow for uncertainty. As shown by Moore and Mitchell (1997), when life expectancy is uncertain, consumption will tend to rise until retirement and fall subsequently, rather than remaining uniform throughout (see Figure 1b). However, the basic pattern of earnings and savings before retirement and wealth decumulation throughout retirement to finance consumption is left unaltered. In the face of uncertainty, some precautionary savings may be accumulated, which, if not needed, may lead to bequests. Conversely, if accumulated savings prove inadequate due to unforeseen events, some source of assistance income in retirement would be required.

Abstracting from uncertainty has the advantage of significantly simplify-

[8]Uncertainty, including such sources as sickness, disability, employment, earnings, inheritances and life expectancy, can best be introduced using micro-simulation models. See, for example, Statistics Canada (2004).

Figure 1: A life cycle model of income, savings and consumption



Source: Adapted from Moore and Mitchell (1997)

ing the analysis. Clearly, the results can not be interpreted as applying to a particular individual whose incomes, expenditures, returns on assets and life expectancy are all subject to shocks. However, when these shocks are both unanticipated and distributed equally among both positive and negative changes, the outcomes illustrated here can be interpreted as expected values for any given population group.

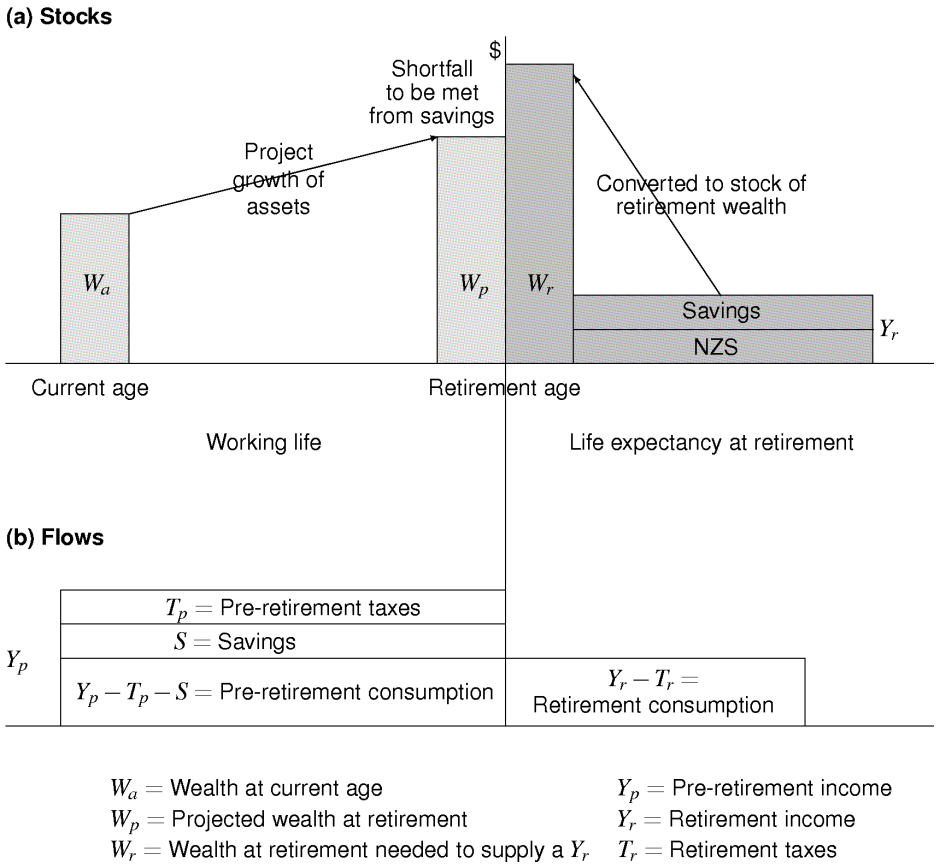
3.2 A model of joint determination of saving and replacement rates

This approach[9] calculates jointly the saving and income replacement rates for each person or couple. A complete derivation of the model is given in Scobie

[9]The approach adopted follows that of Moore and Mitchell (1997).

et al. (2005, Appendix C) and reprinted in Appendix A, while a graphical illustration is presented in Figure 2. At the current time a person/couple has a net worth W_a as measured by SOFIE. This wealth is projected to grow to W_p by the time they reach a pre-determined retirement age. In order to have a given level of consumption in retirement they would need to have accumulated a stock of wealth equivalent to W_r. Part of their retirement income is provided by NZS and the stock of wealth equivalent to the NZS income is incorporated in W_r and W_p.

Figure 2: A model of joint determination of saving and replacement rates



The difference between the required wealth W_r and the projected wealth W_p is the shortfall that would need to be accumulated between now and re-

tirement. This additional amount, in the absence of inheritances or unanticipated revaluation in asset values, would need to be built up through savings. These flows are depicted in Figure 2b.

The approach assumes that some fixed share of pre-retirement income will be saved ($s = S/Y_p$) and the replacement rate is given by the ratio of gross income in retirement to gross income pre-retirement ($R = Y_r/Y_p$). Under the New Zealand income tax system of TTE,[10] retirement taxes T_r are zero, so consumption is equal to income in retirement. Clearly, some values of retirement income could imply a substantial shortfall in retirement wealth, which might in turn require unrealistic or infeasible levels of savings before retirement. It is for this reason that the saving and replacement rates are jointly determined.

3.3 Specific assumptions

The retirement age is set at 65. I apply an after-tax, real rate of return of 2% per year for all compounding and discounting. I estimate age income profiles for each ethnic group/ gender/ education level and apply the pattern to each individual/couple to project their income until retirement. In estimating the age income structure, I ignore cohort effects, but allow for an annual growth rate of 1%, chosen to approximate the average rate of labour productivity and real wage growth in the economy.[11] These income profiles show that income is concave in age, much similar to the pattern illustrated in Figure 1. Specifically, income rises to a peak at around ages 45-55, then steadily decreases. The age at which income peaks and the steepness of the

[10]TTE refers to a system where the savings are made from after-tax income, the returns are taxed and the withdrawals are exempt. It differs from those systems which exempt savings or earnings from taxation and tax withdrawals (TET, ETT or EET).

[11]Since Y_p is no longer a linear function of Y_a, equations 6-9 (pages 24-25) need to be modified slightly, but the principle remains the same.

profiles depends on education, gender, ethnicity, occupation, job status etc, but the data only allow me to account for the first three variables. This model differs from our previous work (Scobie et al., 2007, 2005) where we assume that income increases linearly with age throughout the working life. NZS payments are assumed to grow at 1% annually in real terms, matching the growth in average real wages.[12] Bequests involve only the current equity in the principal residence.

The model for couples is complicated by the fact that the two partners of each couple may neither retire nor die at the same time. The retirement phase for couples is assumed to start when the older partner reaches 65. (The younger partner may continue earning an income, which can affect the value of NZS received by the retired partner.) I further postulate that after one partner dies, the surviving partner will have a consumption level equivalent to 60% of the couple's level.

I compute life expectancies from mortality rates projected by Statistics New Zealand. These projections take into account predicted changes in health status based on 'medium' assumptions around fertility, mortality and migration. I assume that Pacific Islanders have the same mortality rates as Maori and that mortality rates for other ethnic groups are the same as for Europeans. As such, I am able to calculate life expectancies at retirement for each gender, broad ethnic group and year of retirement.

[12]This growth rate is rather conservative. Treasury's (2006) Long-term Fiscal Model uses a growth rate of 1.5% for average labour productivity and real wages. Benefits are also assumed to grow at that rate.

4 Saving for retirement – results

The model in Section 3.2 prescribes saving rates as a share of gross income. These figures may not be immediately intuitive, hence for the empirical results I will report after-tax saving rates. To assess the level of consumption smoothing, I also compute a consumption replacement rate as the ratio of pre-retirement consumption to post-retirement consumption.

Some households are prescribed a negative saving rate. Literally, this means that these households should either draw down their current wealth before retirement or borrow against their NZS income to supplement their current consumption, which is hardly feasible in practice. Rather, those negative saving rates can be interpreted as showing that no further saving is needed to sustain consumption levels in retirement, given the household's current wealth.[13] Even without extra savings, these households would already be able to afford higher consumption in retirement than their present level.

4.1 Baseline results

Table 1 specifies the rate at which households need to save until age 65 so that they could enjoy a level of consumption in retirement similar to what they had before retirement. The required saving rates are both higher and more unevenly distributed among the older households. While the median prescribed saving rate for couples aged 45-54 is 11%, 10% would need to set aside over 35% of their after-tax income for retirement. The 'typical' couple aged 55-64 have a prescribed saving rate of 13%, but at the 90th percentile this rate rises to 44%.

[13] I have set negative prescribed saving rates to zero to preclude literal interpretation.

Table 1: Prescribed saving rates at various percentiles

	Percentile			
	25th	50th	75th	90th
Non-partnered individuals				
Ages 45-54	0	0	10	23
Ages 55-64	0	0	13	34
Couples				
Ages 45-54	0	11	23	35
Ages 55-64	0	13	31	44

Note: Entries are percentages. Saving rates here are expressed as a proportion of after-tax income.

The prescribed saving rates are considerably higher for couples than for non-partnered individuals (Table 2). There are at least three reasons for this. First, the retirement period for couples is longer; it extends from when the older partner retires until when the last partner dies. Second, couples earn more than twice as much as non-partnered people (reflecting the phenomenon of assortative mating), so they have a higher *per capita* consumption level to sustain. Third, the model does not account for economies of household size in consumption, but NZS does – it pays couples only 54% more than the rate for individuals.[14]

Across the wealth distribution, there is little variation in median prescribed saving rates for the lowest four quintiles. For couples aged 45-54, for example, the median prescribed saving rate ranges from 11% for quintile 1 to 14% for quintile 2, while it is zero for the 20% wealthiest people. For non-partnered individuals, median prescribed saving rates are zero for four out of the five wealth quintiles. These saving rates will enable them to attain a retirement consumption level of around 90% as much as their pre-retirement level. Couples aged 45-54 will expect to have median retirement consumption

[14]In 2003, NZS after-tax payment was $12,756 for non-partnered individuals (who live alone) and $19,624 for couples.

Table 2: Median prescribed saving rates, consumption replacement rates and retirement consumption

Wealth quintile	Ages 45-54			Ages 55-64		
	s_{at}	R_c	C_r	s_{at}	R_c	C_r
Non-partnered individuals						
1	0	100	12,400	0	100	9,100
2	0	100	14,600	0	100	11,600
3	1	99	16,500	0	100	12,400
4	0	100	18,900	6	94	16,700
5	0	100	26,800	0	100	23,300
Total	0	100	16,700	0	100	13,600
Couples						
1	11	89	32,400	12	88	25,700
2	14	86	36,700	18	82	30,000
3	14	86	43,300	19	81	33,300
4	13	87	52,700	15	85	45,200
5	0	100	70,400	0	100	67,900
Total	11	89	43,100	13	87	34,600

Note: s_{at} = prescribed after-tax saving rate, R_c consumption replacement rate, C_r retirement consumption. Entries for s_{at} and R_c are percentages.

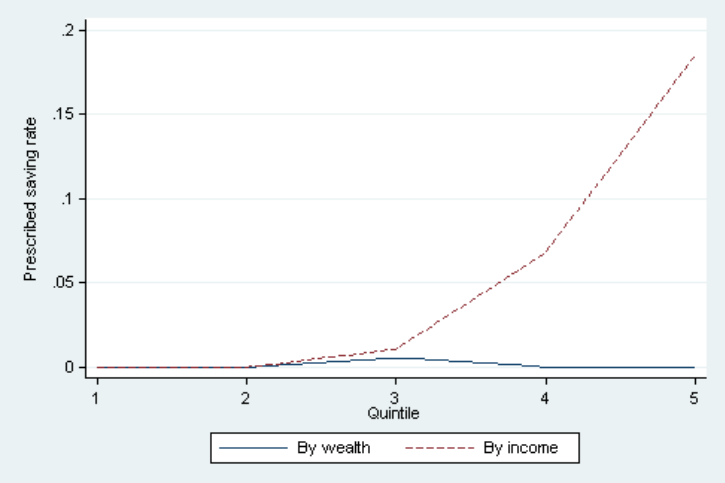
of $43,100, compared with $34,600 for those nearing retirement.

The prescribed saving rate rises with income level (Figure 3). While the 20% lowest earners should save no more for retirement, the 'typical' household in the top income quintile will need to save around a fifth of their after-tax income to smooth consumption over the life cycle.

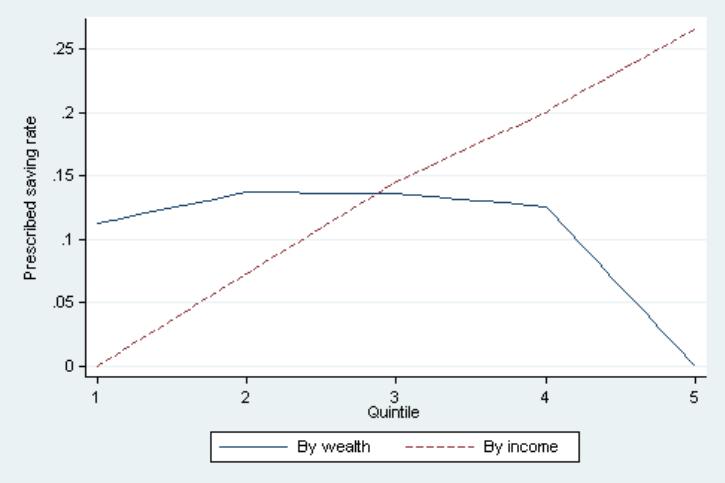
The model prescribes no further saving for 34% of couples and 61% of non-partnered individuals. These households either are earning too little or hold significant wealth. Indeed, 27% of non-partnered individuals and 9% of couples in the sample reported income that was below the current NZS payment; additional saving is not justified for these people as NZS would already provide them more consumption than their present level. Likewise, no more saving is necessary if the household has accumulated sufficient wealth

Figure 3: Median prescribed saving rates by wealth and income quintiles

(a) Non-partnered individuals aged 45-54



(b) Couples aged 45-54



Note: Saving rates here are expressed as a proportion of after-tax income.

to sustain their pre-retirement consumption levels. In other words, no more saving for retirement is required for those households if they are to retire at 65, given my assumptions in Section 3. It may still be advisable that they save for things other than retirement, for a different objective than consumption smoothing, for early retirement, more bequests, or simply as a

buffer against uncertainties about health, life expectancy and so on.

4.2 A variation to the baseline

The above results are indeed based on conservative assumptions. First, the level of wealth in private pension schemes reported in SOFIE has been underestimated due to some technical problems with the questionnaire. Second, I assume pre-retirement consumption will be sustained throughout retirement. However, empirical evidence has shown that people consume less in retirement years (Banks et al., 1998; Brown, 2001; Engen et al., 1999). One possible explanation is that increased mortality risk at older ages makes consumption less desirable.[15] Domeij and Johannesson (2006) alternatively hypothesise that the marginal utility of consumption increases with health status. Health depreciates at older ages, lowering the marginal utility of consumption, so consumption spending will necessarily fall. These authors observe that consumption expenditure of Swedish households rises with age until about 60, then declines by 25% by age 80. This finding largely matches the New Zealand pattern documented by Gibson and Scobie (2001).

As a variation to the baseline, retirement consumption is assumed to decline with age. I also impose a cap on retirement consumption; the cap has arbitrarily been chosen to be the 90th percentile value of after-tax income for 64-year-old individuals/couples.[16] Under these assumptions, prescribed saving rates are lower. Among the 55-64 age group, over 70% of non-partnered individuals and 50% of couples have no need to make further provision for retirement.

[15] See Banks et al. (1998), Engen et al. (1999), Hubbard and Judd (1987) and Hubbard et al. (1995).

[16] Equivalent to an annual consumption of $92,000 for couples and $46,000 for non-partnered individuals. This adjustment avoids treating as inadequate savers those who have saved enough to maintain retirement consumption at the said levels.

5 Saving adequacy

This section addresses the issue of adequacy. Specifically, I examine the relation between the rate of saving prescribed by the model and an estimate of the rate at which people are actually saving.

5.1 Actual saving rates

In order to conduct the comparison I need data on actual saving behaviour. Unfortunately, no surveys in New Zealand have been designed to measure savings at individual household level. Remarkably, this lack of data does not prevent many commentators from claiming that New Zealand households do not save 'enough.' Savings can be estimated as income less consumption,[17] but one complication is that SOFIE only collects limited information on expenditures. Therefore, I start by estimating consumption for SOFIE households using the approach suggested by Skinner (1987). Skinner combined demographic and partial expenditure data from the Panel Study of Income Dynamics (PSID) with comprehensive expenditure data from the Consumer Expenditure Survey (CEX) to impute total consumption for PSID households. In particular, Skinner regressed total consumption from the CEX on the consumption elements and demographic variables in the CEX that were also available in the PSID (food at home, food consumed away from home, value of the house, rent, utility payments and the number of automobiles). He then inserted the estimated regression coefficients into PSID data to derive total consumption for PSID households. This method implicitly assumes that a household's total expenditure depends on expenses on food, utilities and rent (for renters) or the house value (for homeowners)

[17]For examples of estimating saving as the difference between income and consumption see Attanasio (1998), Paxson (1996) and Deaton and Paxson (2000).

and the number of vehicles owned, and that this relationship is constant between the two surveys. This approach and its results have subsequently been applied or extended to derive total household consumption and savings for non-expenditure surveys.[18]

The CEX-equivalent data for my purpose come from the Household Economic Survey (HES).[19] With these data, I am able to adopt Skinner's method to impute expenditure for SOFIE households.[20] I then derive savings as the difference between observed household disposable income and imputed consumption expenditure. Household income by itself is already renowned for having high sampling errors. To make matters worse, SOFIE only collects data on gross income from individuals. I apply the appropriate tax rates to work out disposable income for each person and add up to get household disposable income. That calculation exacerbates the measurement error in the income variable. Consumption expenditure is imputed, so it is also error-ridden. As a result, my estimates of savings are subject to a large margin of error. Nevertheless, this is the best that can be done, given the lack of suitable micro data for examining household saving behaviour in New Zealand.

The advantage of this method is that the 'actual' saving rates (as estimated by imputation) relate to the same individuals for whom I have calculated the prescribed saving rates. This contrasts with the method used in Scobie et al. (2005) which could only compare the mean/median actual saving rates from the HES with the prescribed saving rates from Household

[18]Examples include Blundell et al. (2004a,b); Charles et al. (2006); Dynan et al. (2004); Palumbo (1999); Toledo (2006); Waldkirch et al. (2004); Ziliak and Kniesner (2005).

[19]The survey is briefly described in Appendix B while more information is available from Statistics New Zealand (2007). Some parts of HES annual expenditure are estimated by multiplying by 26 the expenditure information recorded by diary for a household for a two-week period. Therefore, even though expenditure is its primary focus, annual expenditure from the HES is still likely to be measured with errors.

[20]See Appendix C for further details.

Savings Survey (HSS) data for broad age groups.

5.2 Comparison

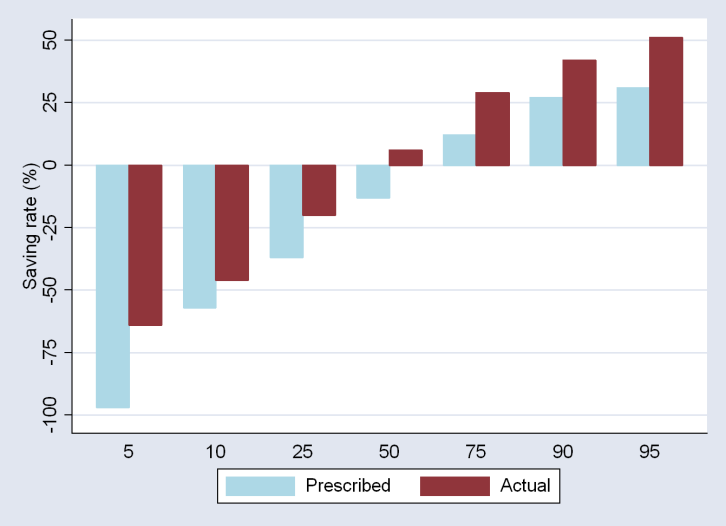
Figure 4 compares prescribed and actual saving rates. Overall, actual saving rates well exceed those prescribed by the model. For example, the median prescribed saving rate for non-partnered individuals aged 55-64 is negative, but the median actual saving rate for this group is estimated to be 10%. Although actual saving rates exceed prescribed saving rates at all quantiles, there may be some people for whom this pattern does not hold since they can occupy different ranks on the distribution of each variable. In fact, under the conservative baseline assumptions, around one third of the population are not saving enough for retirement (see Table 3). Using more realistic adjustments (described in Section 4.2) the proportion of 'problem savers' falls to below 20%. For the group approaching retirement, only 9% of non-partnered individuals and 13% of couples need to increase their saving rates in order to smooth out consumption between now and retirement. This finding is well in line with international evidence. For example, Scholz et al. (2006), who use more sophisticated methods, also find that over 80% of Americans are preparing sufficiently for retirement.

Table 3: Proportions of the population who appear to be saving inadequately for retirement

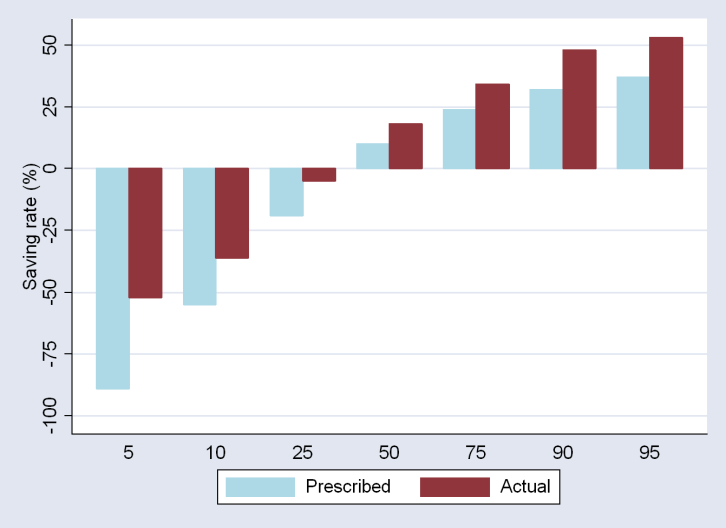
	Baseline (%)	Adjusted (%)
Non-partnered individuals		
Ages 45-54	34	18
Ages 55-64	28	9
Couples		
Ages 45-54	37	26
Ages 55-64	37	13

Figure 4: Prescribed and actual saving rates at various percentiles

(a) Non-partnered individuals aged 55-64



(b) Couples aged 55-64



Note: Saving rates here are expressed as a proportion of after-tax income.

6 Conclusions

Both individuals and society have an interest in assuring adequate incomes in retirement. A range of policies including NZS, the Superannuation Fund,

Kiwisaver, financial education and tax policies are all aimed at addressing the provision of retirement income.

Solid data at the household level must inevitably underpin the foundation of policy. It is widely recognised that income and saving rate measures alone are not an adequate basis for judging final preparedness for retirement. Data on the accumulation of assets and liabilities are an essential ingredient of sound policy analysis. After lagging in this area, New Zealand is now developing the data on which more meaningful analysis can be based. The first step was the release of the HSS (2001). It was the first national study of the assets and liabilities of New Zealand households. Subsequently, SOFIE has been initiated. This panel study incorporates a module covering assets and liabilities in every second wave. I use the results of Wave 2 (for 2003/2004) as the basis of the analysis in this paper.

The primary focus is on the shedding some light on the question: are New Zealanders saving 'adequately' for retirement? There are two challenging conceptual and measurement issues embodied in this question. The first is how should we define what we regard as 'adequate'? The second is how do we measure the rate at which people are actually saving? Reasonable people may hold a range of views on both matters – there is no single 'right' answer.

I have chosen to address the first issue by using a life cycle model where adequacy refers to the ability to maintain one's standard of living in retirement (measured by consumption expenditure) at a level comparable to that enjoyed pre-retirement. For the second issue I have used an indirect method, extrapolating from the HES, to assess the saving rate of those in the SOFIE sample. This step was forced on me as while SOFIE contains income data, there are no data on consumption and savings per se. Once Wave 4 of SOFIE (for 2005/2006) become available, estimates of actual saving behaviour for

all individuals in the panel will be available by analysing the change in net wealth between Waves 2 and 4 after adjusting for asset revaluations.

I find that for the majority of people in the lower income brackets no further saving should be required as NZS offers a higher income than their projected pre-retirement income. Likewise wealthy individuals and couples would not need further accumulation. Overall 60% of non-partnered individuals and one third of couples are estimated to require no more saving for retirement. After adjusting these baseline results for more 'realistic' assumptions these proportions rise to over 70% of non-partnered individuals and one half of couples.

Somewhere between one-eighth and one third of the pre-retirement population have current saving rates below that required for 'adequacy'. Further research is underway to identify the characteristics of this group and to assess the magnitude of their shortfalls, as well as to consider how changes in policy might alter their saving behaviour.

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Appendices

A Derivation of the model of joint determination of saving and replacement rates

The framework outlined in this appendix is drawn from Moore and Mitchell (1997). They argue that it is necessary to develop a model which allows the replacement rate and the pre-retirement saving rate to be jointly determined. The reasons for this are twofold. Firstly, in view of a household's actual and projected income and assets, the saving rate needed to achieve some pre-specified replacement rate may be infeasible. Secondly, the replacement rate depends in part on the rate of taxation in retirement, which in turn depends on the level of retirement income, itself a determinant of the replacement rate. Only when the tax rates in retirement were pre-determined would this second issue be avoided.

The starting point is the condition that real consumption (ie income net of taxes and saving) be equal before and after retirement, as given by:

$$Y_p - T_p - S = Y_r - T_r \tag{1}$$

where:

$Y_p =$ pre-retirement gross income;
$T_p =$ pre-retirement taxes;
$S =$ savings;
$Y_r =$ retirement gross income;
$T_r =$ retirement taxes.

Next define

$s =$ pre-retirement saving rate $= (S/Y_p)$
and $R =$ replacement rate $= (Y_r/Y_p)$

so that substituting these definitions in (1) and dividing by Y_p gives:

$$1 - (T_p/Y_p) - s = R - (T_r/Y_p) \tag{2}$$

Now let $T_p = t_p Y_p$ and $T_r = t_r Y_r$ where t_p and t_r are the pre- and post-retirement proportional tax rates, so that:

$$s = (1 - t_p) - (1 - t_r)R \tag{3}$$

Equation (3) defines a set of combinations of s and R which satisfy the condition specified in (1). By first finding a value for R, I can then solve for the corresponding value of s that satisfies (3).

The retirement income flow (Y_r) can be converted to a lump sum at retirement by applying an annuity factor (α).[21] This expresses the stream of retirement income in terms of a stock in wealth at the time of retirement. In other words, were a person to have accumulated this amount they would be able to receive a lifetime annuity of Y_r. Denoting the 'required' wealth needed to generate Y_r as W_r, then:

$$W_r = \alpha Y_r = \alpha[(1-s)Y_p - T_p + T_r] \tag{4}$$

The amount of savings needed to reach this required level of retirement income W_r will depend on:

- the existing stock of net wealth W_p
- the expected returns on investment
- future income
- tax rates.

I define W_p as the projected level of wealth, so that the shortfall is:

$$W_r - W_p = \alpha[(1-s)Y_p - T_p + T_r] - W_p \tag{5}$$

I am now in a position to derive the rate of saving needed to reach the required level of wealth. This rate is the share of pre-tax income the household would need to save in order to have the level of income Y_r in retirement.

The amount accumulated by retirement would then be:

$$W_r - W_p = \sum_{t=1}^{T} sY_a(1+g)^t(1+r)^{T-t} = sY_a\left[\sum_{t=1}^{T}(1+g)^t(1+r)^{T-t}\right] = sY_aZ \tag{6}$$

where:

$Y_a =$ actual income in year $t = 1, \cdots, T$;
$T =$ number of years from the person's current age until the predetermined age of retirement;
$g =$ annual growth rate of income;
$r =$ after-tax real rate of return on savings;
$Z = \sum_{t=1}^{T}(1+g)^t(1+r)^{T-t}$.

[21] The annuity factor is given by $[(1+r)^n - 1]/r(1+r)^n$, where n is the number of years for which the annuity is to be paid and r is defined in equation (6).

Using (5) and (6) I can solve for the saving rate:

$$s = \frac{\alpha(Y_p - T_p + T_r) - W_p}{Y_p[\alpha + \frac{Z}{(1+g)^T}]} \tag{7}$$

where $Y_p = Y_a(1+g)^T$. Now dividing by Y_p gives:

$$s = \frac{\alpha t_r R + \alpha(1 - t_p) - \frac{W_p}{Y_p}}{\alpha + \frac{Z}{(1+g)^T}} \tag{8}$$

It is argued that in the context of the New Zealand system of income tax, private retirement saving is made from after-tax pre-retirement income $Y_p - T_p$, and the earnings on the investments are taxed. However, once those accumulated funds are withdrawn (in this case to purchase an annuity), there is no further taxation on the income received in retirement. Furthermore, NZS payments are received net of tax. Hence under this system, $T_r = 0$. With this simplification the saving rate is no longer dependent on the replacement rate:

$$s = \frac{\alpha(1 - t_p) - \frac{W_p}{Y_p}}{\alpha + \frac{Z}{(1+g)^T}} \tag{9}$$

and from (3), the replacement rate can be derived as:

$$R = 1 - t_p - s \tag{10}$$

B The Household Economic Survey

The HES collects information on household income (both gross and disposable) and expenditure, as well as demographic information on individuals and households. Participants must be New Zealand resident private households living in permanent dwellings. The survey was run annually from 1973 to 1998 and thereafter three-yearly. In this paper I only use data for 2003/2004, to match the timing of SOFIE's Wave 2 data. The 2003/2004 sample contains 2,854 households. I made every effort to ensure that the conditioning variables used in equations (11) and (12) are similarly defined between the two data sets.

C Imputing consumption expenditure and estimating saving rates

Following Skinner (1987), I impute expenditure for SOFIE households by drawing on a similar household survey that has expenditure data, the HES. First, I regress household expenditure on several variables using HES data:[22]

$$C_{HES} = \boldsymbol{\beta}_{HES} \boldsymbol{X}_{HES} \tag{11}$$

where:

C_{HES} = household consumption expenditure, as observed in the HES;

$\boldsymbol{X}_{HES}$ = a vector of conditioning variables (disposable income, type, size, number of dependent children, tenure of dwelling and region of residence of the household, and age, education, ethnicity and labour force status of the household head), as observed in the HES. The expenditure elements that are common between HES and SOFIE are dwelling expenses, which include land/water/Body Corporate rates and rent (for renters) or mortgage payments (for homeowners).

I then plug the estimated coefficients $\hat{\boldsymbol{\beta}}_{HES}$ into SOFIE data to predict consumption:

$$\hat{C}_{SOFIE} = \hat{\boldsymbol{\beta}}_{HES} \boldsymbol{X}_{SOFIE} \tag{12}$$

Excluded from my definitions of consumption expenditure are education fees, medical costs, life/health insurance, mortgage principal payments and other capital outlays, as they are investment expenses. There is controversy over how durables (motor vehicles, leisure equipment and household items) are treated. Some argue that durables are stocks which provide flows of services over a number of years, thus treating outlays on durable goods as current consumption will overstate consumption and hence understate savings. Others contend that household expenditures on durables are non-zero – households must either own or rent some – so overlooking durables consumption will exaggerate savings.

Ideally, I should account for durables consumption by using a measure of the value of services that the household receives from durables. That measure, termed the annual user cost AUC, can be estimated as:

[22] Equation (11) is estimated in log forms (of income and expenditure). The R-squared was around 60%.

$$AUC_i = D_i(r + \delta_i) \tag{13}$$

where:

$D_i =$ value of stock of durables type i;
$r =$ risk-free interest rate (after-tax);
$\delta_i =$ annual depreciation rate for durables type i (available from Inland Revenue Department).

Unfortunately, SOFIE data on D_i are unreliable. In particular, values of durable assets in SOFIE were estimated by different methods.[23] Consequently, the stock value of durables is exaggerated, as *insured value for replacement* and *amount that was paid* were used over two thirds of the time. Indeed, the average value of household items for people who used *amount that would be received if sold* is markedly lower than that estimated by *insured value for replacement* ($6,579 vs. $35,863). While people who used the former may be richer than those using the latter, the gap is too large to warrant that estimation methods have no impact on reported values of durables.

Only 13% used *amount that would be received if sold* (the 'right' method to use). I selected a sub-sample of households where all members who owned any household items used this method to value those items and estimated their annual user costs of durables using equation (13). Thus, for these household we have three definitions of consumption expenditure:

a) current consumption expenditure;

b) current consumption expenditure + outlays on durables;

c) current consumption expenditure + annual user cost of durables;

and correspondingly three definitions of savings. Saving rates are expressed as a proportion of disposable income.

Of course, the saving rates from a) are the highest. The average saving rates obtained from b) and c) are broadly similar. This is explainable by the fact that in the long run total acquisition costs should be the same as total rental costs. If purchases are evenly distributed across time, then total acquisition costs and total rental costs for each year should also be equal. Since I can not derive annual user costs of durables for all households, I use saving rates from b) as baseline estimates of actual saving rates.

[23] See footnote 6 (page 3).