Figure 9: Impact of growth - expenses

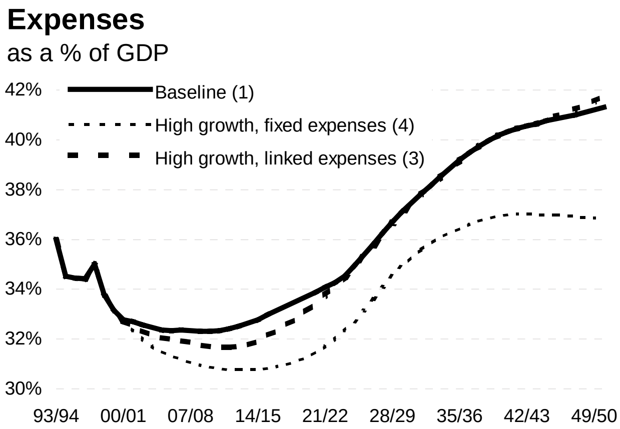
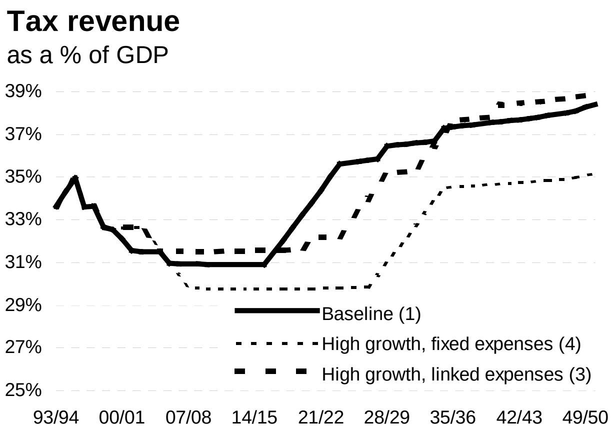


Figure 10: Impact of growth - revenue



However the most critical of the two factors in this result is the difference between economic growth and government spending growth. When per capita social expenses are linked to output growth (ie also grow at 2.0% pa), there is no differentiable difference in the fiscal outlook from the baseline scenario (See Figures 9 and 10). Higher growth does allow a reduction in the build-up in national debt, to 113.4% of GDP in 2050/51 (compared to the baseline's 130.9%). But what this shows is that we can not rely on growing ourselves out of fiscal problems—there also has to be a significant degree of fiscal discipline.

Reducing the Government's public pension bill

With the Government's annual public pension bill likely to double over the next fifty years (from 5.3% to 10.7% of GDP), it would seem this would be a likely area to look for fiscal savings. Two approaches to reducing superannuation payments are modelled:

- reducing the number of people eligible for superannuation by steadily increasing the age at which one becomes entitled to superannuation,

- reducing the average weekly superannuation payment by reducing it to the level of the unemployment benefit.

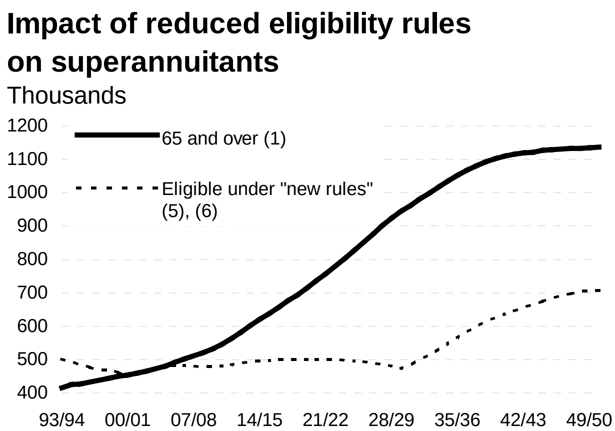
The reasoning behind the first approach is that a potential reason for market failure in the private provision of retirement incomes is related to the uncertainty of each individual's life expectancy. One does not know how long one will live for and this makes it difficult for setting retirement savings targets. A way around this would be to provide a publicly funded pension scheme for those who do live longer, say beyond 74 years old, but require individuals to fend for themselves before this age. This encourages greater private provision of retirement income, but reduces the likelihood of market failure as each individual has a more definite planning horizon.

The thinness of the private sector annuity market has led some to question whether there might be market failure in the annuity market which would make the shift to private pension provision sub-optimal (despite favourable impacts on economic growth). Valdivia (1997) argues that the absence of an annuity market means that the largest costs of private pension provision are born by retirees that have extensive retirement spells. Thus he argues that there may be merit in raising the age of eligibility to superannuation, eg from the current 65 to 75. This means that individuals would be responsible for ensuring sufficient income from 65-75, but the government would have a role in looking after those people with extensive retirement spans. Such an approach could be a useful compromise solution to retirement saving pressures as it would:

- provide increased incentive for greater private saving,
- would ease government's medium term fiscal concerns,
- be administratively simple to operate,
- provide a more definite saving target while providing a safety net for longer retirement spells.

This rule was modelled by assuming that the percentage of over 64 year olds eligible for superannuation will fall by 2% a year from 2005/06 until 2025/26 when only the over 74 year olds will receive the benefit plus an allowance for needy over 64 year olds[8]. From this point on total numbers eligible for superannuation would increase with the increase in over 74 year olds.

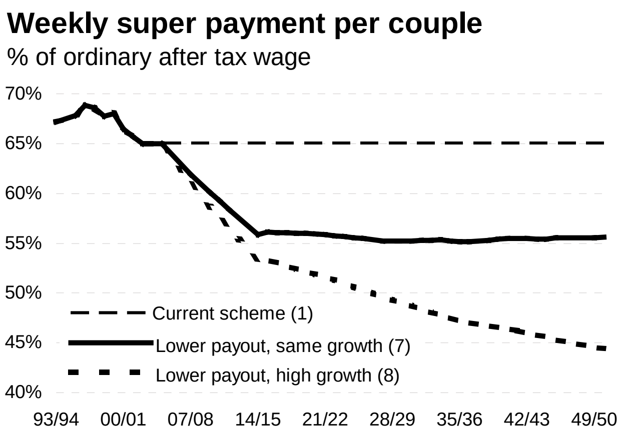
Figure 11



[8] The allowance for needy over 64 year olds was set at 35% of 65 to 74 year olds, this being the proportion of 65 year olds identified from the distributional analysis who are unlikely to have sufficient wealth to fund a standard of living equivalent to the unemployment benefit (see chapter 3). To simplify the modelling process, it was assumed that these people received the full superannuation payment and not just a hardship allowance.

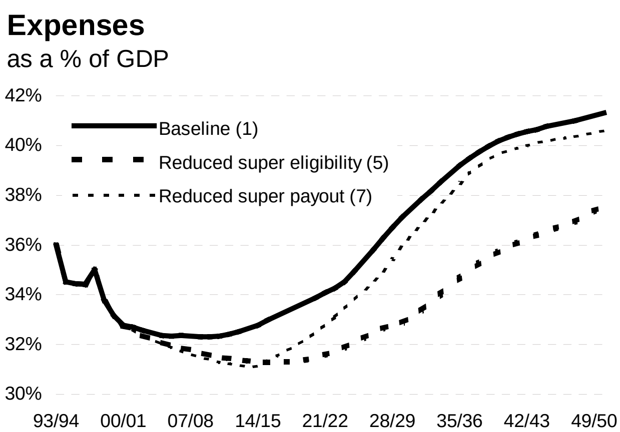
The other approach is to allow the average weekly superannuation payment to slip through the current 65% of average wages floor from 2005/06 by linking super payments to the government's cost of living adjustment (essentially the CPI) until payments match the unemployment benefit (estimated to take place in 2015/16). The logic behind this approach is that government provision of superannuation should just be there to prevent undue hardship. By setting superannuation payments at the same level as the unemployment benefit the government would be removing many disincentives for private savings. By linking superannuation payments to the unemployment benefit it is also likely that the superannuation bill will be less sensitive to growth outturns. Under the current regime superannuation is linked to wage growth which is more likely to keep pace with economic growth than the unemployment benefit.

Figure 12



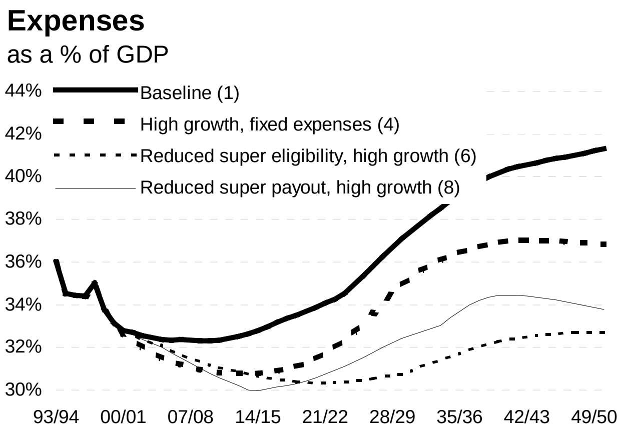
As would be expected, both approaches reduce government expenses and revenue projections. By 2050/51 lower superannuation eligibility would reduce government expenses from 41.3% to 37.6% of GDP. Lower average payments results in slightly lower savings, expenses fall to 40.6% of GDP.

Figure 13: Expense impact of cheaper superannuation schemes



However, the fiscal benefit of lower superannuation payments increase when there is greater economic growth (see Figure 14). Linking superannuation payments to the unemployment benefit means that like the unemployment benefit, superannuation in this scenario is being treated as a safety net to guard against dire hardship and not as an alternative to privately providing for one's retirement. This means that with stronger economic growth super payments continue to fall relative to the average wage (see Figure 12).

Figure 14: Lower super payments and higher growth



Combining the two superannuation adjustments together (ie lower eligibility and lower payments) indicates that the two approaches complement each other in terms of their impact on the fiscal position (see Figure 15). As noted above, if the change in superannuation rules do not have any impact on economic growth, then more fiscal savings are available form reducing eligibility than from reducing the generosity of superannuation payments. The contribution from lower payments becomes more evident if there is a growth dividend.

Figure 15: Combining reduced eligibility to super with lower super payments

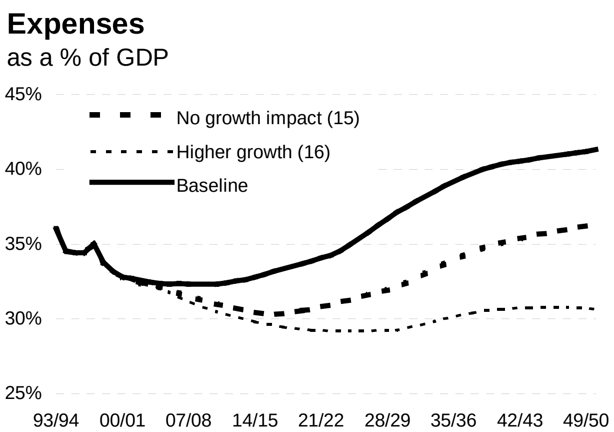
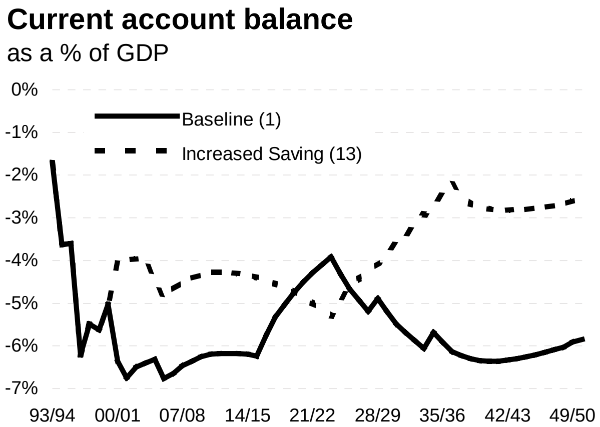


Figure 15 also demonstrates the types of policy changes required to achieve the Government's long term fiscal objective of reducing expenses to less than 30% of GDP. Scenarios 16 and 17 are the only ones that reduce expenses to levels consistent with the Government's expense aims. This implies that unless the government directly addresses its superannuation burden, while maintaining spending control in other areas, it will have to be even more strict on its other spending growth. This is assuming that the Government is actually serious about reducing expenses to below 30% of GDP. Recent research carried out at the New Zealand Inland Revenue Department argues that economic performance will suffer even if the 30% to GDP target was achieved (see for example Scully (1996a,b) or Branson and Lovell (1997)).

Increasing private savings

An increase in private savings would improve the national debt liability, but will not of itself greatly improve the fiscal outlook. When the private consumption proportion of GDP is assumed to be 2% lower in each year, the national debt liability (including private and public debt) in 2050/51 is projected to be 74.4% of GDP compared with the baseline projection of 130.9%. However, there is little difference in government expense and tax requirements. If anything it slightly increases the income tax burden as a reduction in consumption reduces GST revenue.

Figure 16: Effect of higher private saving



Also decreasing consumption can have its costs. If it does not raise growth it implies lower lifetime consumption, which in turn can mean lower lifetime living standards. Indeed this raises the issue of how the increase in saving is induced. If it comes about from removing a disincentive to save it may well be both welfare and growth enhancing. But if the policies that induced higher saving also distorted normal behaviour so as to lead to a misallocation of resources they could lower growth thus removing the advantages of higher saving.

Indeed an attempt to model the impact of savings incentives produced very few discernible benefits. The withholding tax on interest income was assumed to fall to 12.5% (ie the same as the GST rate). This would remove the tax wedge between decisions to save or spend, but would of course open up an investment wedge between physical and interest bearing investments. It was also assumed that this tax rule change would lower domestic interest rates by a 20% reduction in the size of the bond gap. This is the mechanism that results in a projected national debt liability of 107.2% of GDP in 2050/51 compared with the 130.9% baseline projection. The fiscal position deteriorates slightly because of the reduction in withholding tax.

It is unlikely that this model can capture the full effect of saving incentives. Our view is that the looked for improvement in interest rates would not materialise (or last) as the investment wedge is likely to be more important than the wedge between spending and saving. This is because the amount of revenue raised from taxing interest income is quite a small component of total tax revenue. In 1996/97 resident withholding tax revenue amounted to $1 billion. Income from other investment activities are far more important to the economy, for example, the revenue from company taxes alone were close to $5 billion. Indeed the hypothesised reduction in interest income tax rates modelled here would have reduced government revenue in 1996/97 by only $400 million. Thus an incentive of this nature is likely to distort investment behaviour and so lower growth prospects.

Figure 17

Summary of scenario results

	Scenarios	Projected national debt liability % of GDP in 2050/51	Government expenses % of GDP in 2050/51	Income Tax Rates 2000/01 - 2050/51 Low	High	Average
1	Baseline (1.5% trend productivity growth)	130.9%	41.3%	20.3%	30.3%	26.2%
2	Slow tax reaction	76.6%	43.6%	19.3%	42.3%	25.7%
3	Higher growth (2%), linked expenses	113.4%	41.7%	21.3%	32.3%	26.1%
4	Higher growth (2%), fixed expenses	97.0%	36.8%	18.3%	26.3%	22.0%
5	Reduced super eligibility, no growth impact	122.8%	37.6%	19.3%	25.3%	22.3%
6	Reduced super eligibility, higher growth (2%)	104.2%	32.7%	17.3%	20.3%	19.1%
7	Reduced super payments, no growth impact	109.8%	40.6%	20.3%	32.3%	24.7%
8	Reduced super payments, higher growth (2%)	104.7%	33.8%	17.3%	22.3%	19.9%
9	Saving incentives, reduced growth (1.25%)	124.9%	45.1%	23.3%	38.3%	28.9%
10	Saving incentives, no growth impact	107.2%	42.3%	21.3%	34.3%	26.9%
11	Saving incentives, increased growth (1.75%)	107.3%	39.0%	20.3%	30.3%	24.6%
12	Increased private saving, reduced growth (1.25%)	87.6%	44.5%	22.3%	37.3%	29.2%
13	Increased private saving, no growth impact	74.4%	41.6%	21.3%	34.3%	26.9%
14	Increased private saving, increased growth (1.75%)	68.5%	39.2%	20.3%	30.3%	24.4%
15	Reduced super eligibility & payments, no growth impact	134.7%	36.3%	19.3%	23.3%	21.3%
16	Reduced super eligibility & payments, higher growth (2%)	105.8%	30.7%	16.3%	17.3%	17.5%
17	Reduced super eligibility & payments, increase private savings, higher growth (2%)	79.4%	30.3%	16.3%	16.3%	17.8%

6 Conclusions

This paper has presented the results of modelling the impacts that economic, regulatory and taxation policies might have on a population that will increase in average age over the next 50 years.

The results suggest that unless government spending control is maintained, demographic pressures will induce a considerable increase in tax rates from about 2015 onwards.

If all the adjustment came through income taxes, tax rates in 2050/51 would need to be 7 cents in the dollar higher than they will be later this year.

Such an increase in taxes will impose significant costs on future generations.

The major increases in government spending will come in health and superannuation. Health spending is projected to increase from its current 5.9% of GDP to 11.0% of GDP in 2050/51. Superannuation is expected to increase by similar amounts, from 5.3% to 10.7% of GDP.

Control of government social spending would be the most direct way of alleviating these fiscal and intergenerational pressures. Holding real per capita spending in social areas (health, education and benefits) at 0.5% lower than trend growth would remove most of these pressures and reduce required tax rises by 4 cents in the dollar.

Two methods of reducing the Government’s superannuation bill are also examined: increasing the age of eligibility to 75 and reducing the weekly payment to the level of the unemployment benefit. Either of these approaches would reduce required tax rates by a further 2 cents in the dollar.

A combination of expense control and either of these superannuation adjustments would leave tax rates in 2050/51 at similar levels to those expected to prevail in 1998/99 (scenarios 6 and 8).

Increased private saving would improve the national debt position, but will have little impact on fiscal settings. How the extra savings are achieved is important—if the policies that induce higher saving also distort normal behaviour so as to lead to a misallocation of resources they could lower growth thus removing the advantages of higher saving.

3 Projections of the level and distribution of wealth - a microsimulation analysis

1 Introduction

This paper outlines the results of various scenarios which project the distribution of wealth at retirement for two age cohorts - one aged 45-49 in 1996 and one aged 15-19 in 1996. Retirement for these two cohorts is assumed to occur at or around age 65 (although there is nothing special about this age in the model). We are interested in the distribution of wealth at around age 64 and the time profile of wealth accumulation prior to that age.

The next section outlines the model. Section 3 presents a baseline scenario for each cohort, with a collection of alternative scenarios being presented in Section 4. Additional material is presented in appendices C-F.

2 The MIDAS model

The projected profiles and distribution of wealth are obtained using the MIDAS model - Microsimulation of Income Dynamics and Accumulation of Savings. The model was originally developed for the 1992 Task Force on Private Provision for Retirement, but has undergone considerable enhancement since that time.[1] As part of this project for the ISI almost the entire database has been updated and recalibrated to the requirements of the project. Details are provided in Appendix C.

The model simulates the process of wealth accumulation for a given cohort of individuals from the age of 20. Whilst the cohort is hypothetical in the sense that no individual in the cohort corresponds to a specific real world counterpart, the characteristics of the individuals are derived from real world data. These characteristics are sex, ethnicity, age, marital status and income. Associated with each value and combination of these variables is an annual savings rate. Changes in wealth occur via various means:

- personal savings (a function of age - in 5 year intervals, sex, ethnicity, marital status, and income),
- a share of savings by couples
- a share of a partner's net worth at marriage
- a share of a couple's net worth at separation
- inheritance of a partner's assets at death
- other inheritances
- changes in asset values (capital gain)

[1] See Stroombergen, A., D. Rose and J. Miller, *Wealth Accumulation and Distribution: Analysis with a Dynamic Microsimulation Model*, Business and Economic Research Ltd, September 1995.

The form in (housing, shares etc) which wealth is held is not modelled. Income from interest, dividends, etc. is treated the same as other income, being available for either consumption or saving (re-investment).

All dynamic simulation models require certain assumptions about the future behaviour and economic/social environment of a present day cohort. For example it is assumed that the income distribution of women who will be aged 50 in 2026 will be the same as that of women who were aged 50 in 1996 (for given ethnicity and marital status). That is, the income dynamics of females who were born in 1946 is assumed to apply to those born in 1976. Similarly for marriage rates, divorce rates, death rates and so on. Whilst we know that such assumptions are unlikely to prove correct, the model needs a set of base data. And the advantage of using a model for this type of research is that the effects of alternative assumptions may be readily examined. Further discussion of this is given in Appendix D.

Savings data in the model is sourced from the Household Economic Survey, aggregated over two years to expand the sample size. Savings is simultaneously cross classified by age (17 5-yearly groups), sex, ethnicity (3 groups), marital status (2 groups) and income (10 groups). This degree of disaggregation implies a multi-dimensional matrix of 2160 cells, although many of these have extremely low counts. Hence a savings function is econometrically estimated from this database.

Individuals move between income deciles over their lifetime according to income transition probabilities derived from Inland Revenue longitudinal unit record data covering the inter-censal period 1991-1996. This data is differentiated by age and sex, with an ethnicity variable being introduced by calibrating the data to 1996 census information on income by age, sex, and ethnicity. Transition between income groups is modelled over five year intervals using the technique of Monte Carlo simulation.

Data on marriage and divorce rates are derived from Justice Department statistics. Again ethnicity is not recorded in this information and is imputed by calibration to census data. This calibration also adjusts for the formation and dissolution of *de facto* marriages. As with income, transition between marital states is modelled over five year intervals using the technique of Monte Carlo simulation.

The model allows for income sharing within a family and includes routines for income and asset sharing at point of marriage, asset split at separation, inheritances from outside the immediate (nuclear) family and inheritances through death of a spouse or partner. Various degrees of sophistication are incorporated depending on data quality and availability and on trade-offs between model comprehensiveness and the resources allocated to the project.

At the point of marriage or couple formation the standard assumption is that assets are combined and then split equally, such that. During marriage (including *de facto*) it is assumed that expenditure is allocated equally between adults and that dependent children receive one third the weight of adult expenditure. All family income is combined and savings (the difference between income and total expenditure) is equally split between both partners.[2]

[2] Although dependants are not explicitly modelled, they are taken into account in the calculation of savings from HES data.

On separation assets are split in equal proportions. The model contains sufficient flexibility for this to be easily altered.

Inheritances on the death of a partner are handled in a straightforward manner by assuming that 50% of the assets of the deceased partner are inherited by the surviving partner, although again it is a very simple adjustment to alter this proportion. Inheritances received from outside the family are modelled as a function of the age and income of the recipient. Data limitations prevent a richer specification.

3 Baseline scenarios

As noted above the model has been used to produce two baseline scenarios - one for a cohort aged 45-49 in 1996 and one for a cohort aged 15-19 in 1996. The baselines are not intended as forecasts; rather they are intended to constitute plausible projections of wealth accumulation for two age cohorts 30 years apart - in rough terms the generation which is currently in its prime earning years and the children of that generation, who are at the beginning of their earning years.

To ensure that the model is producing sensible results a process of calibration was undertaken. This is described in Appendix C. For the baseline scenarios two key inputs are required:

- the rate of growth in real income, which is set at 1.0% pa;

- the real rate of appreciation in asset values, which is set at 1.5% pa.

These values are consistent with New Zealand's long term experience, although in subsequent scenarios we may wish to examine alternative values. Again more detail is given in Appendix C.

The full model output for the two scenarios is shown in two tables in Appendix E. Each table consists of three panels:

1. mean wealth by age for each sex/ethnicity group,

2. wealth decile boundary points for age group 60-64,

3. wealth decile means for age group 60-64[3],

4. proportion of people aged 64 with wealth less than the NPV of NZ Superannuation.

For the 45-49 cohort, mean wealth at age 64 for males is $242,000 compared to $167,000 for females. For the younger cohort the corresponding estimates are $383,000 and $287,000. There is also considerable variation between ethnic groups with people of European ethnicity having a clear advantage.

[3] The means over all deciles are not exactly the same as the means for the 60-64 age group in panel 1 due to random number effects.

To put these results into perspective it is useful to calculate the size of the lump sum that would be needed at age 64 to purchase an annuity which would pay the present real rate of New Zealand Superannuation until death. For this calculation the following inputs are used:

- the current mean rate of superannuation is about $892 net per month,
- it is assumed that it keeps pace with the growth in real income (1.0% pa),
- the real interest rate is 2.5% pa (which is higher than over the past 20-30 years),
- average life expectancy at age 64 is 15 years for males and 19 years for females.

The implied wealth levels are:

	cohort 45-49 in 1996	cohort 15-19 in 1996
Males	$156,200	$210,500
Female	$188,800	$254,500

Given these values, the model determines the proportion of people aged 64 who are projected to attain this level of wealth. Note that this includes wealth which is tied up in owner occupied dwellings. If this is excluded the proportions are markedly different, on the assumption that 70% of wealth is in the form of housing and that house values appreciate at a real rate of 1.5% pa.

Proportion of people aged 64 accumulating less wealth than NPV of NZ Superannuation

	Males	Females
Run 400		
Cohort aged 45-49 in 1996		
- including housing	29%	65%
- excluding housing	81%	97%
Run 100		
Cohort aged 15-19 in 1996		
- including housing	18%	46%
- excluding housing	78%	93%

The results suggest that <u>based on current savings behaviour</u> a significant proportion of the population could not finance their own retirement if this begins at age 64, especially if they can not or do not liquidate their housing assets. For women the situation is much worse than for men.

Which set of results is the more informative as regards the formation of superannuation policy depends on two considerations; one social and one financial:

- If state pensions are other than universal, should eligibility for a state pension be tied to wealth exclusive of owner occupied dwellings, or should retirees be expected to deplete some or all of their accumulated wealth over their retirement before receiving a public pension?

- If retirees are expected to deplete their entire wealth over their retirement, is there an adequate financial market to make this a viable and fair proposition by removing the uncertainty of length of life, such as through reverse annuity mortgages?

The response to the first question may depend on the level and distribution of wealth at age 64. Thus in the next section we examine the effects on wealth accumulation of stronger higher economic and higher private savings.

4 Additional scenarios

For each of the two cohorts we examine the effects of two changes:

- The rate of growth in real per capita income is raised from 1.0% pa to 1.5% pa, and the real rate of appreciation in asset values is raised from 1.5% pa to 2.0% pa (Runs 101 and 401). The increment to growth is not applied to superannuation.

- The marginal propensity to save out of income is raised by 25% between ages 20 and 64 (Runs 102 and 402).

In addition, for each of the above two alternatives there are two options for the proportions of wealth held in housing assets; the default average of 70% and a lower average of 60%.[4] This variation is also supplied for the baseline scenarios.

A final scenario, Run 103, provides a preliminary look at the impact of costs for secondary health care during retirement if these were not to be covered by public provision.

Full results are given in Appendix F. A summary table (excluding Run 103) is presented below.

Cohort aged 15-19 in 1996

Half a percent extra growth in real income and asset value raises mean wealth at age 64 (for males and females) by about one third. Over a 45 year period this represents about 0.6% pa. The difference between this and the exogenous 0.5% pa is attributable to the nonlinear relationship between savings and income. This increment in wealth is worth $130,000 for males and $95,000 for females. Note that in the baseline scenario (Run 100) the level of New Zealand superannuation maintains its current relationship to real income, but in this scenario it falls behind by 0.5% pa. After 45 years this generates a cumulative difference of 20%, effectively reducing the relative value of the pension to approximately the level of the unemployment benefit. This is reflected in the marked fall in the proportion of people - especially females - who have net worth which is less than the NPV of NZ Superannuation.

Excluding investment in housing, the proportion falls by a similar amount for males. For females, however, the relative fall is much less owing to the fact that the lower overall wealth of females means that the NPV of the pension, albeit a lower pension than in the baseline, constitutes a sizeable share of non-housing assets. Also, higher economic growth raises the value of housing assets in one's investment portfolio. That is, not all of the increment in net worth from higher growth can be assumed to go into non-housing assets. Indeed the default assumption is that the composition of wealth does not change.

[4] A linear scale is assumed starting from 100% at minimum wealth, passing through 70% at the mean and continuing to a minimum of 50%, which is usually reached somewhere in decile 8 or 9.

Alternative scenarios:
mean wealth and proportion of people with wealth
less than NPV of NZ Superannuation
at age 64

	Cohort 15-19 in 1996		Cohort 45-49 in 1996	
	Male	Female	Male	Female
Baseline (runs 100 & 400)				
Mean wealth	$383,000	$287,000	$242,000	$167,000
% with wealth < NPV NZ Super.				
including housing	18	46	29	65
excl housing (mean 70%)	78	93	81	97
excl housing (mean 60%)	68	88	73	94
Higher growth (runs 101 & 401)				
Mean wealth	$515,000	$382,000	$320,000	$221,000
% with wealth < NPV NZ Super.				
including housing	9	28	17	46
excl housing (mean 70%)	67	85	73	89
excl housing (mean 60%)	57	76	62	83
Higher savings (Runs 102 & 402)				
mean wealth	$701,000	$495,000	$453,000	$299,000
% with wealth < NPV NZ Super.				
including housing	3	14	5	26
excl housing (mean 70%)	56	77	61	82
excl housing (mean 60%)	46	67	50	73

If the composition of wealth does change as a result of higher growth, with say 55-60% of the marginal increase in housing assets being redirected elsewhere, the proportion of people who have net worth which is less than the NPV of NZ Superannuation falls from 78% to 57% for males and from 93% to 76% for females.

A lift in the savings propensity of 25% also generates a substantial increase in wealth at age 64. For males the increase is 36% or $186,000, whilst for females it is 30% or $113,000. Without any change in the composition of savings the proportion of people who have net worth which is less than the NPV of (a relatively lower) NZ Superannuation is about the same as in the higher economic growth scenario with a change in the composition of savings.

If a lift in the savings propensity is associated with a change in its composition away from housing, as one might expect if public provision of retirement income is reduced, less than half (46%) of males aged 64 have net worth (excluding housing) which is less than the NPV of NZ Superannuation. For females the proportion falls to 67%.

Arguably, however, the shift away from housing might be even greater than the shift assumed above, where the housing share of total assets falls from an average 70% to an average 60%, corresponding to a marginal shift of 55-65%. If the marginal shift were 50% higher (not shown in the table) the proportions would fall to 41% for males and 62% for females.

Cohort aged 45-49 in 1996

For the older cohort the effects of higher real income and asset growth are of course much less dramatic as over their lifetime the level of income is below that of the younger cohort. Nevertheless, had real growth been 0.5% higher over the past 30 years and if this were to continue for another 15 years, the mean wealth of males at retirement would be nearly $80,000 higher and that for females over $50,000 higher. There is a concomitant fall in the proportion of people who have net worth which is less than the NPV of NZ Superannuation, with about one sixth of males being in this position and one half of females.

Excluding housing, the proportions are 73% and 89% respectively, which represent declines of about eight percentage points in each case, relative to the baseline. If less wealth is held in the form of housing, the proportions fall by a further eleven percentage points for males and six for females.

Under the higher savings scenario, which could be interpreted as what might have occurred and might to continue to occur in the absence of a relatively generous state pension, the proportion of males with insufficient wealth to purchase an equivalent annuity is projected at 5%. For females the proportion is 26%. Again, however, when housing is excluded, even with some extra diversification of wealth, the proportions with insufficient wealth rise to 50% and 73%.

It should also be noted that these alternative scenarios for the 45-49 age group are really only "what if" projections. In terms of actual projected wealth at age 64 they err on the high side as this cohort has only 15 years left to experience the benefits of higher growth or higher private savings, unless of course future real growth and private savings rise by even more than the increases assumed above.

A preliminary look at secondary health costs

As has been discussed in previous sections, expenditure on health is projected to increase rapidly over the next few decades if current age specific funding formulae remain. The share of GDP devoted to health may well become unsustainable unless more health provision is taken up by the private sector on a fee for service basis. If this occurs it would be particularly felt by the retired population for whom health care costs can be rather high.

We examine an extreme situation where all secondary health care costs are paid for privately and where medical insurance for those aged over 65 is too expensive to be economic for most people. Thus people are effectively forced to save for medical expenses which they might incur during retirement. For convenience the 25% higher savings scenario of Run 102 (for the 15-19 cohort) is used to assess the adequacy of savings in this situation. We are interested in what happens to the profile of wealth after age 65.

Individual health expenditure is modelled via the use of age specific concentration curves as described in Appendix G. The results are labelled Run 103 in the table below.

By assumption there is no difference in wealth at age 64 between the scenarios 102 and 103. Beyond that, however, the differences become progressively larger. For example at age 74 the average wealth of males is lower by about $19,000 whilst that for females falls by $15,000, although these average differences conceal a very uneven distribution of differences. By age 84 the differences are much greater, with that for females now being the larger difference; $36,000 for males versus $40,000 for females. Beyond age 84 the differences increase at a markedly faster rate as secondary health expenditure becomes far more commonplace.

At all ages, however, the levels of wealth in Run 103 are higher than in Run 101, which does not have the increase in savings, by quite substantial margins. The numbers suggest that on average savings would need to be higher by less than 10% to cover statistically expected secondary health care costs during retirement – and this is under the extreme assumption of no public provision.

Wealth estimates for age 60+
excluding and including direct medical costs

	Run 101 (higher growth)		Run 102 (higher growth & higher savings)		Run 103 (higher growth & higher savings + medical costs)	
Age	Males	Females	Males	Females	Males	Females
60-64	514.5	382.1	701.4	495.1	701.4	495.1
65-69	554.0	417.5	759.2	545.7	752.2	538.7
70-74	605.1	461.1	834.2	607.4	815.3	592.2
75-79	663.5	512.8	920.5	679.7	892.1	650.7
80-84	676.4	526.3	947.8	702.6	911.6	663.4
85-89	690.0	537.7	979.4	722.5	924.1	664.8
90-94	692.3	546.7	999.3	738.9	924.3	662.2
95-99	673.9	554.4	995.5	753.0	897.8	657.8
100	629.5	564.0	960.3	768.9	845.9	656.3

Accordingly we may infer that an increase in direct payment for hospital care does not have a major effect on the wealth required to support oneself during retirement, but two implications should be noted:

1. For some people unexpected high health costs will be unaffordable, so there has to be some residual state support,

2. If wealth which is tied up in housing is not able to be accessed, the proportion of people who would be dependent on state support would be much higher.

Further research is required to quantify these proportions with any degree of accuracy.

Conclusion

The above scenarios demonstrate that economic growth and savings behaviour have an extremely powerful effect on savings and on the ultimate wealth position that people would be in by the time they reach retirement age (assumed to be 65 for convenience). Under the higher growth plus greater private savings scenario the proportion of the cohort currently aged 15-19 with net worth at retirement which is less than the NPV of a reduced New Zealand Superannuation pension is very low indeed - 3% for males and 14% for females. However, without a huge change in savings behaviour most people would still not be able to purchase the required annuity without liquidating part or all of their housing assets – even more so for the cohort currently aged 45-49.

Thus higher growth even with greater private savings does not remove the need for a public pension, especially if housing assets are not counted as part of one's potentially consumable wealth. Whether this proves too costly an option in terms of the implication for macroeconomic efficiency or growth, and if so how the cost could be ameliorated, is investigated in Section 2.

Whilst arguably there may be some over-investment in housing under the current taxation regime, under a more neutral regime there is no guarantee that the resultant level of investment in housing would be optimal from a simple "annuity for retirement" point of view. Other factors such as family demographics, security, and asset value retention for bequests are also important.

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Appendix A: Savings model incorporating private and public sectors

The discussion on savings issues presented in the body of the report is based on the model developed in this section. This model is developed along the lines of Campbell and Mankiw (1989) where consumption behaviour is allowed to differ between:

- *liquidity-constrained* households who have no practical access to any credit and so their spending patterns will be highly correlated with their current income, and
- *forward-looking* households who attempt to maximise their lifetime welfare by smoothing their consumption over time through the use of savings and asset accumulation.

The model incorporates an overlapping generations framework with discrete-time form which incorporates a definite probability of death (a la Frenkel and Razin (1992)). As such the model is quite similar to the consumption model underpinning the Reserve Bank's core forecasting model (see Black et al (1997)). The extension offered by our model is to explicitly incorporate the consumption of public goods.

The basis of the model is that individuals attempt to maximise the present value of expected lifetime utility, subject to a budget constraint. The level of satisfaction or utility experienced by household, a, will depend on the amount of private and public goods they expect to consume over the next ν time periods, after accounting for: the relative satisfaction accruing from consuming a different mix of private and public goods, the extent to which future consumption is discounted relative to current consumption (adjusted by a probability of survival), and one's willingness to avoid or accept risk. Thus the utility function for representative household, a, over the next ν periods can be presented as:

$$U_a = E\left(\frac{1}{1-\theta}\sum_{\nu=0}^{\infty}\left(\gamma_a\delta_a\right)^{\nu}\left(C_{a,t+\nu}^{\beta} + G_{a,t+\nu}^{1-\beta}\right)^{1-\theta}\right) \qquad \text{(A1)}$$

Where:

	E =	an expectations function based on information available at time t
	θ =	risk preference function (= $1/\sigma$, the reciprocal of the intertemporal elasticity of substitution, σ
	γ =	probability of survival
	δ =	discount factor, (Therefore $(\gamma\delta)^{\nu}$ is the effective discount factor for the next ν periods given one's probability of surviving each period, γ
	C =	consumption of private goods and services
	G =	consumption of public goods and services (this would include factors such as the provision of publicly funded superannuation schemes and unemployment benefits)
	β =	society's relative preference for consuming private goods instead of public goods.

For presentational simplicity, we assume that there are two sectors in the economy the private sector, p, and the government sector, g, that exclusively produce the two goods demanded by society, C and G respectively. The production of public and private goods can be defined as:

$$\begin{aligned} Y_t &= C_t + G_t \\ &= Q_p + Q_g \\ &= \alpha_p K_p^{\phi p} L_p^{(1-\phi p)} + \alpha_g K_g^{\phi g} L_g^{(1-\phi g)} \end{aligned} \qquad \text{(A2)}$$

If we assumed that the government is required to always balance its budget, then the amount of resources available for the production of government services will depend on the amount of tax collected:

$$G_t = Q_{gt} = \tau_{yt} Y_t + \tau_{ct} C_t \qquad (A3)$$

Where τ_y and τ_c are the effective tax rates on income and consumption respectively.

The amount of private consumption, C_t, will in turn also depend on the economy's ability to earn income. Consumption is defined as:

$$C_t = \lambda_t Y_t^d + (1-\lambda_t)(1-s_t) W_t^p \qquad (A4)$$

Where: $\lambda_t =$ proportion of liquidity-constrained households at time t

$Y_t^d =$ disposable income ($= Y_t - \tau_{yt} Y_t$, where τ_{yt} is the effective income tax at time t)

$s_t =$ marginal propensity to save private wealth, W^p_t

For the liquidity-constrained, the amount spent on private consumption goods at any point in time will be directly determined by the amount of after-tax income earned in that time period[1]. This group can not plan for the future as they need all their available resources for consumption in the current time period. For the rest of society an ability to save and accumulate assets gives households the ability to smooth consumption over time. By saving, households can build up a buffer against adverse shocks (eg unexpected periods of unemployment for workers or a decline in agriculture prices for farmers). Or conversely, forward looking households will be prepared to dissave when they experience a temporary fall in incomes. Saving also allows individuals to maintain a target level of consumption after retirement. Savings can also provide a mechanism for accumulating assets and thus increasing lifetime wealth.

Private wealth can be defined as human wealth, H, less the interest paid on private sector indebtedness, B^p, at the market real rate of interest, r:

$$W_t^p = H_t - (1 + r_{t-1}) B_{t-1}^p \qquad (A5)$$

Where human wealth can in turn be defined as the discounted present value of expected income over the next ν periods, (where ρ is the compounded *market* discount factor) ie:

$$H_t = \sum_{\nu=t}^{\infty} (\gamma\rho)^{\nu-t} Y_\nu \qquad (A6)$$

Private indebtedness can be defined as the addition to debt plus an interest adjustment to the preceding period's debt position:

$$B_t^p = C_t - (1 - \tau_t) Y_t + (1 + r_{t-1}) B_{t-1}^p + \mu \qquad (A7)$$

Where μ is a random variable with zero mean that accounts for unanticipated capital gains or losses. Note that there is an addition to wealth if the individual is in a net asset position (and so earns interest income) and/or if debt is reduced (or assets are accumulated) due to saving part of current income.

Frenkel and Razin (1992) demonstrate that the utility-maximising marginal propensity to save one's wealth can be presented as:

[1] In reality the liquidity constrained will still save eg if cash on hand exceeds some minimum requirement, but their ability to plan for the future is severely limited by their inability to access credit. This means that equation A4 should ideally also include a marginal propensity to consume out of current income term for the liquidity constrained ($1-s_\lambda$). The key here is that the consumption behaviour will be highly correlated with current levels of disposable income as limited access to credit will limit their ability to smooth consumption over time.

$$s_t = 1 - \left[\sum_{v=t}^{\infty} \left(\gamma^{v-t} \frac{r_v}{r_t} \right)^{1-\sigma} \left((\gamma\delta)^{v-t} \right)^{\sigma} \right]^{-1} \quad \text{(A8)}$$

Where r = the market present value factor (real interest rate)
δ = subjective discount rate
σ = the intertemporal elasticity of substitution
γ = probability of survival

The marginal propensity function presented in equation (A8) implies that one's willingness to save will be influenced by one's life expectancy; the inter-relationship between one's personal incentives to save (δ) and the market interest rate (r); and one's risk aversion ($1/\sigma$).

Substituting equation (A4) into equation (A3) would yield:

$$G_t = \tau_{yt} Y_t + \tau_{ct} \left(\lambda_t (1 - \tau_{yt}) Y_t + (1 - \lambda_t)(1 - s_t) W_t^p \right) \quad \text{(A9)}$$

Thus the amount of government services ultimately depends on the income earning potential of the economy. If the balanced budget assumption assumed in equation (A3) is relaxed so that the government can also spend anticipated future income, then consumption of government services over the next v periods can also be expressed in terms of discounted future tax flows from future income growth corrected for interest adjustments to the government's debt position:

$$\sum_{v=t}^{\infty} G_t = \sum_{v=t}^{\infty} \delta^v \tau_{\iota,t+v} Y_{t+v} - (1 + r_{t-1}) B_{t-1}^g \quad \text{(A10)}$$

Where: $B_t^g = G_t - \tau_{\iota,t} Y_t + (1 + r_{t-1}) B_{t-1}^g$ (A11)

and τ_ι is the effective tax burden summing across all forms of tax collection. As long as governments are responsive to the desires of society, we would expect the average of τ_ι to tend to the value of $(1-\beta)$ in equation (A1) over time.

Likewise combining equations (A4) - (A7) and accounting for the impact of taxes on private sector activity indicates that private consumption is determined by:

- the after-tax income of liquidity-constrained households, plus
- the forward planning households propensity to spend out of their discounted flow of expected after-tax income over the next v periods, but
- corrected for their debt position (which from a national perspective can be interpreted as a balance of payments constraint on domestic activity)[2]:

$$\begin{aligned} C_t = {} & \lambda_t (1 - \tau_{y,t}) Y_t + (1 - \lambda_t)(1 - s_t) \left(\sum_{v=t}^{\infty} (\gamma\delta)^v (1 - \tau_{y,v}) Y_v \right) \\ & - (1 - s_t) \left(\sum_{v=t}^{\infty} (\gamma\delta)^v (1 - \tau_{y,v}) Y_v - \sum_{v=t}^{\infty} (1 + r_{v-1}) \left((1 - \tau_{c,v}) C_v - (1 - \tau_{y,v}) Y_v + (1 + r_{v-2}) B_{v-2}^p \right) \right) \end{aligned} \quad \text{(A12)}$$

[2] By assumption the forward-planning households hold all the nation's fixed assets and/or debt. Therefore the third term in equation A12 does not need to be weighted by the proportion of forward-planners, $(1-\lambda)$. Strictly speaking this should also be the case in equations A4 and A9, ie the $(1-\lambda)$ weighting should only be applied to the human wealth component of total wealth. This has not been done in an attempt to simplify the presentation.

Appendix B: Model developments

The balance of payments is key to the link between fiscal policy and private sector behaviour. This is demonstrated in the national income identity:

$$(S_P + S_G) - I = (X - M)$$

which states that the current account balance, (X - M), is equal to the sum of private and public savings, $(S_P + S_G)$, less the amount of investment that requires funding. In other words a current account deficit arises if domestic saving is not sufficient to fund the desired level of investment activity If the government's fiscal position deteriorates it reduces national saving, which either requires a decline in investment activity or an increase in overseas borrowing.

This demonstrates how an increase in government activity can crowd-out private sector activity. If the government raises taxes to fund this extra activity it will directly strip resources from the private sector and so lower private sector activity. An increase in government activity can still crowd-out private activity even if it borrows funds rather than increases taxes. By not matching the increase in spending with an increase in revenue, the government will reduce its amount of saving, S_G. According to the identity presented above, a decrease in government saving must result in an increase in private savings, a reduction in investment, a decrease in the current account balance or some combination of the three. The usual market transmission path will be through an increase in interest rates. An increase in either public or private debt will influence investor perceptions about the riskiness of investing in New Zealand and this often leads to an increase in New Zealand interest rates relative to overseas (referred to here as the bond gap, but also known as the risk premium). An increase in interest rates raises the cost of funding investment and the consumption of large ticket items, and so will act to dampen private sector demand.

Although the long run effect of a fiscal easing depends on the current state of the government's finances, the immediate impact of a decline in public sector saving is a stimulation to domestic demand. As a result it is likely that a decline in the fiscal balance will be associated with an increase in inflation.

Behavioural equations

To capture these types of interactions between the public and private sector, five behavioural equations were estimated. The specific equations and their statistical properties are reported in full at the end of the appendix (see *Equation estimates* section below). This section focuses on the theoretical basis for these equations and how they link into the fiscal model.

There are five behavioural equations determining inflation, interest rates, private consumption, and private investment. The equations provide a feedback mechanism in the fiscal model between the private and public sectors and also allow for the calculation of the national current account balance.

Inflation
Inflation is modelled as a function of the output gap and last year's fiscal balance. The output gap is the difference between actual GDP and a measure of potential output. A positive output gap implies that there are excess demand conditions in the economy and would be expected to be associated with an increase in inflationary pressures. As discussed above a decrease in the fiscal balance would be expected to increase economic activity and inflation. Over the estimation period the inclusion of the output gap allows for changes in demand over the business cycle and so its inclusion in the estimated equation helps to improve the parameter estimate for the fiscal balance. However, the output gap is expected to be on balance zero in forecast years and so has no impact on the model scenarios.

Interest rates
Interest rates are modelled as being based on world bond rates. New Zealand government bond rates are defined as being world bond rates plus a bond gap measure which picks up the sovereign risk of investing in New Zealand. An estimated equation relates the bond gap to New Zealand inflation, the

current account balance and changes in the net public debt burden. Thus perceptions about the risk of investing in New Zealand increase with an increase in inflation (implies greater exchange rate risk and a greater threat of tightening monetary conditions), a deterioration in the balance of payments and an increase in net public debt.

Short term interest rates are represented by 90 day bank bill rates. The difference between bank bill rates and government bond rates is the yield gap. The yield gap will be smaller and even negative in times of high demand and strong inflation pressures. Thus the yield gap equation indicates that bank bill rates will increase relative to government bond rates, the stronger demand conditions are (proxied by the output gap) and the more inflation there is (proxied by ex-credit CPI inflation).

Private consumption
There are numerous factors that can influence consumption behaviour. Private consumption is modelled here as a positive function of the relative price of consumer goods relative to the general price level and lagged real GDP growth, and as a negative function of real short term interest rates and inflation. Economic growth is used to proxy changes in household wealth. Real interest rates measure the opportunity cost of consuming, so an increase in interest rates would be expected to encourage more saving and hence less consumption.

The inflation term is used as a proxy for economic uncertainty. An increase in inflation often indicates that the current pace of growth is unsustainable. Uncertainty can also increase as it is more difficult to make judgements about relative prices in times of inflation. However, relative price rises can also be associated with increases in consumption activity, for example an increase in consumer demand can itself push-up consumer prices and there may even be a consequent burst of consumption if consumers believe that prices are about to rise further. Thus the positive term on the relative price term in the private consumption equation indicates that consumer demand pressures, rather than supply factors, tend to dominate variations in consumption behaviour in New Zealand.

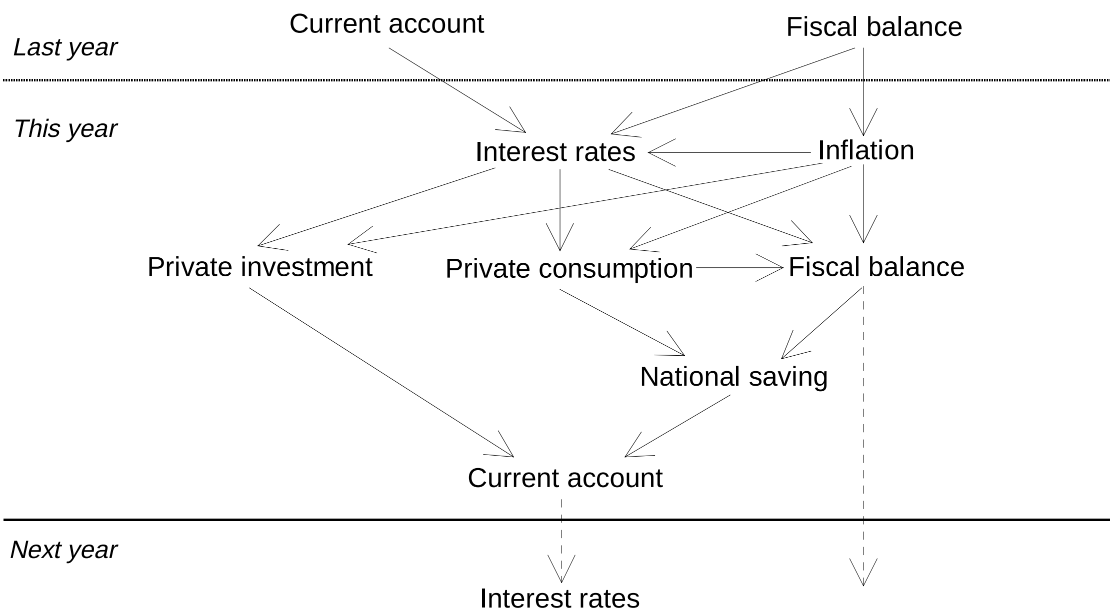
Private investment
The investment function estimated is a hybrid accelerator/neo-classical investment model. Investment is a positive function of economic growth and a negative function of the unemployment rate, inflation and real interest rates. Economic growth is often used in investment functions as a proxy for expected future demand. While interest rates are a major factor in determining the cost of capital. The inflation term is used once again as a proxy for economic uncertainty. The unemployment rate is used as a proxy for changes in the price of capital relative to the price of labour. Increases in unemployment put downward pressure on real wages, which improves the profitability of less capital intensive industries.

Model structure

The behavioural equations act as a satellite to the main fiscal model. The behavioural model acts in a recursive way. In each time period the behavioural equations feed-off the economic assumptions in the main fiscal model (eg economic growth, world interest rates) and incorporate historical fiscal results from the model. The behavioural equations then influence the model's estimation of current time period fiscal outcomes, which in turn influence future results of the behavioural equations (see Figure 2). There is no simultaneity in the model, ie there is no inter-dependence between current period equations—there are no reverse flows (double arrowheads) in the transmission paths in Figure 2. If the model incorporates any expectations behaviour, it is adaptive. This recursive nature of the model reduces the sophistication of the model, but it also simplifies the solution process (there are no algorithms) and means that the model can remain spreadsheet based.

Figure 2

Schematic transmission path of behavioural equations



The impact of the behavioural equations onto the fiscal results are that it:

- allows the calculation of the national current account in each time period, and this in turn allows a calculation of the national debt liability of each scenario and model run, and
- makes the fiscal model less tolerant of unsustainable fiscal scenarios—the feedback of the model into the private sector can demonstrate how seemingly small imbalances in fiscal settings can quickly explode. As a result modellers are made more aware of potentially unsustainable assumptions and are forced to devise a fiscal rule that explicitly adjusts fiscal parameters to compensate (eg to increase or decrease tax rates).

There of course remain a number of limitations to the model:

- growth remains exogenous to the model and so requires the use of assumptions and scenarios rather than any form of measured impact on economic activity.

- the behavioural equations were estimated over a short time period relative to the 50 year forecast period. The shortness of the estimation period means that the "experiences" of the behavioural equations are limited and this may limit the range of estimated outcomes.

- the results will be influenced by the simplicity of the equations estimated and the equation structures chosen. Although the equation statistics are satisfactory and the model performs in a stable and plausible way, one will never build a model that truly represents economic or human behaviour.

Equation estimates

Inflation

$$\Delta CPI = \underset{(2.35)}{3.583} + \underset{(3.81)}{1.414}\,QGAP - \underset{(2.43)}{0.680}\,FB_{-1} \text{ + interventions (1984, 1987)}$$

$R_D^2 = 0.879$ $\hat{\sigma} = 1.729$ $Q(8,6) = 5.305$ N = 0.902

Estimation period: 1979 - 1997 (annual, n=17)

Interest Rate Determination

$$GB \equiv WGB + BGAP$$

$$BB \equiv GB - YGAP$$

$$RBB \equiv BB - \Delta CPI$$

Where:

$$BGAP = \underset{(0.52)}{0.0020} + \underset{(2.19)}{0.0599}\,\Delta CPI - \underset{(4.93)}{0.378}\,\Delta CAB_{-4} + \underset{(1.72)}{0.0665}\,\Delta NPD\%_{-1} + \underset{(1.77)}{0.0659}\,\Delta NPD\%_{-2}$$

+ interventions (1991.2, 1994.3) + seasonals

$R_S^2 = 0.513$ $\hat{\sigma} = 0.0036$ $Q(9,6) = 3.69$ N = 0.220

Estimation period: 1986.1 - 1997.3 (quarterly, n=42)

$$YGAP = -\underset{(0.32)}{0.0017} - \underset{(3.30)}{0.585}\,QGAP_{-3} - \underset{(2.75)}{0.569}\,\Delta CPIX_{-1} \text{ + seasonals}$$

$R_S^2 = 0.511$ $\hat{\sigma} = 0.0038$ $Q(9,6) = 10.79$ N = 1.182

Estimation period: 1986.2 - 1997.3 (quarterly, n=41)

Private Consumption

$$C\% = \underset{(66.34)}{0.6366} + \underset{(3.00)}{0.371}\,TOT - \underset{(2.48)}{0.00266}\,RBB_{-1} + \underset{(1.35)}{0.137}\,\Delta GDP_{-7} - \underset{(2.07)}{0.220}\,\Delta CPI +$$
intervention (1989.3) +seasonals

$R_S^2 = 0.604$ $\tilde{\sigma} = 0.0116$ $Q(9,6) = 4.82$ N = 1.70
Estimation period: 1986.3 - 1997.3 (quarterly, n=40)

Private Investment

$$I\% = \underset{(33.48)}{0.249} + \underset{(4.69)}{0.232}\,\Delta GDP - \underset{(13.34)}{0.00892}\,UR_{-1} - \underset{(4.06)}{0.180}\,\Delta CPI_{-4} - \underset{(2.49)}{0.00143}\,RBB_{-3} +$$
seasonals

$R_S^2 = 0.621$ $\tilde{\sigma} = 0.0061$ $Q(9,6) = 4.19$ N = 1.04
Estimation period: 1986.3 - 1997.3 (quarterly, n=40)

All estimations were carried out using the STAMP 5.0 time series analysis package (Koopmans et al, 1995)

All equations were estimated using quarterly data except the inflation equation, which uses annual fiscal balance data. The estimated equations also incorporated seasonal variables and intervention dummies where noted, but their specific numbers are not reported here as they do not impact on the annual forecast data in the medium term fiscal model. Equation degrees of freedom, n, are given after each equation.

Explanation of Test Statistics

t-statistics are presented in brackets under parameter estimates
R_*^2 - measure of equation goodness of fit (subscript D compares against a random walk plus drift model, subscript S compares against a random walk plus drift and fixed seasonals model)
$\tilde{\sigma}$ - standard error of equation
Q(P,d) - Box-Ljung Q-statistic based on the first P residual autocorrelations and distributed approximately as χ_d^2 (tests for serial correlation in equation residuals). The critical value with 6 degrees of freedom is 12.6.
N - the Bowman-Shenton normality statistic, distributed approximately as χ_2^2 (tests for excess skewness and kurtosis in equation residuals). The critical value with 2 degrees of freedom is 6.0.

Variables

Variable	Definition	Source
ΔCPI	Annual % change headline consumers price index	SNZ
ΔCPIX	Annual % change ex-credit consumers price index	SNZ
QGAP	Output gap, % of real production GDP	Infometrics
FB	Fiscal operating balance, linked to adjusted fiscal balance, % of GDP	Treasury
GB	10 Year government bond rate	RBNZ
WGB	Average world bond rate	Infometrics
BB	90 day bank bill rate	RBNZ
RBB	real bank bill rate	Infometrics
BGAP	Bond gap, difference between New Zealand and world bond rates	
YGAP	Yield gap, difference between bond and bill rates	
ΔCAB	Annual change in current account balance as % of GDP	SNZ
ΔNPD%	Annual change in net public debt as % of GDP	Treasury, Infometrics
C%	Private consumption, % of GDP	SNA
I%	Private investment, % of GDP	SNA
ΔGDP	Annual % change in real production GDP	SNA
UR	Unemployment rate, % of labour force	HLFS
TOT	Relative price measure defined as annual % change in CPI less annual % change in GDP deflator	SNZ, Infometrics

Appendix C: Calibration of the MIDAS model

Because the model has been almost completely updated for the this project it needs to be recalibrated before being used to examine future scenarios for savings and wealth accumulation.

The current database is founded primarily on the 1996 census, the 1994/95 and 1995/96 Household Economic Surveys and 1990/91 - 1995/96 IRD income data. Thus it does not relate to any particular population age cohort. We start off therefore by calibrating it to produce wealth estimates for the currently retired cohort that are broadly in accordance with other evidence, notably those produced by the Westpac/FPG household savings survey as reported in the draft July 1997 Todd report.

The key problem with data such as that from the Westpac/FPG survey is that it relates to the whole population at a point in time. That is, it does not relate to a specific population cohort - even members of the retired cohort may be more than 25 years apart. Apart from the effect of age *per se,* people aged 65 in 1997 can be expected to have a rather different wealth profile than people aged 90 in 1997, since the two cohorts have experienced different economic conditions during their prime savings years. The implication of this is that it is unlikely that the model will produce wealth estimates for all retired persons - from age 60 onwards - that match any point-in-time estimates. The draft Todd report provides data for only two sub-groups of the retired population, those age 60-69 and those aged 70 or over. This is far from ideal, especially for the latter group, but a finer disaggregation is likely to be unreliable owing to sample size problems.

The following table shows the results of calibrating the model to reproduce the Westpac/FPG estimates of the mean level of net worth (wealth) for the 60-69 and 70+ age group. The model's results for the 5-year age groups that constitute these two aggregated groups are weighted by the projected size of each 5-year cohort in order to yield figures that relate to the two aggregated groups.

Calibration of Mean Wealth for Retired Persons

	Todd report	MIDAS		
		Run 1 cohort 60-69 in 1996 constant + $600 >65 coeff + $0	Run 2 cohort 60-69 in 1996 constant + $1000 >65 coeff - $7000	Run 3 cohort 70+ in 1996 constant + $100 >65 coeff + $0
Age 60-69	$140,000	$138,000	$144,000	$103,000
Age 70+	$125,000	$172,000	$123,000	$125,000

There are four main calibration parameters:

- the real rate of mean per capita income growth,
- the real rate of asset appreciation,
- the constant term in the savings equation,
- the shift term in the savings equation for savings of people greater than 64.

Real per capita income growth is set at 1.0% pa and real asset value appreciation is set at 1.5% pa. These rates are consistent with experience over the last 30 years or so.[3] As noted above, the model

[3] Consider the following: The changes in real wage rates over 1961 to 1996 was 0.4% pa; the change in real income (census definition) over 1961 to 1996 averaged 0.7% pa; the change in real GDP/capita over 1956 to 1996 averaged 1.6% pa; the change in real house prices over 1962 to 1996 averaged 1.8% pa, the mean real rate of return on 10 year government bonds over 1970 to 1997 was 1.3% pa and the change in the real share price index over 1970 to 1997 was -1.2% pa.

generates savings partly on the basis of income and various demographic factors, using a savings function which has been econometrically estimated from HES data. Amongst the parameters in that equation are a constant term and a term for age greater than or equal to 65, with coefficients of -$5054 and -$1446 respectively.[4]

Other parameters such as the marriage and divorce rates are partially calibrated; the model being forced to reproduce the observed 1991 pattern of age and sex specific marital status. Death rates are not adjusted. All of these may require some fine tuning if their implied projections over the next few decades seem unrealistic.

In Run 1 the model is set so as to simulate the cohort who were aged 60-69 in 1996 (or thereabouts) and the constant term in the savings function is calibrated to produce the Westpac/FPG estimate for mean wealth at age 60-69. This adjustment may be interpreted as compensation for increments in wealth which are may be overlooked when savings is measured as income minus expenditure, and are therefore missing from the model's coverage. Examples would be employer contributions to pension schemes or imputed returns in other forms of investment - but not asset value appreciation which is handled with a separate model parameter.

Only a small change to the intercept term of +$600 (in current prices) is sufficient to produce a mean wealth estimate which aligns closely to the Westpac/FPG estimate. Exact conformity is of course possible, but would be spuriously accurate.

Simultaneously the model produces a projection of mean wealth for this same cohort aged 70+. The model suggests that mean wealth of the 60-69 group will continue to rise, at least sufficiently to yield a mean net worth when over 70 that is higher than the mean over ages 60-69. In contrast the Westpac/FPG data shows that the wealth of people currently aged 70+ is less than that of people currently aged 60-69. Now for the reasons discussed above we should not expect these two numbers to be the same, but what degree of difference might one expect?

Run 2 incorporates adjustments to both the constant term and the 65+ term in order to calibrate the wealth estimates for both age groups to the Westpac/FPG results. This requires an increase in the constant of $1000 and a reduction in the 65+ term of $7000. Whilst the former change is plausible, still being only 20% of the estimated value, the latter seems high, being nearly five times the estimated value. It may, however, signify that income which flows from a previously purchased annuity has not been properly counted as negative savings.

In Run 3 the model is reset and calibrated to produce the Westpac/FPG result for the 70+ group (ignoring the 60-69 group) using only the constant, which needs to rise by a mere $100. However, the model still shows wealth rising after age 60-69. In other runs which are not reported here the model also displays a consistent tendency to ascribe more wealth to the 70+ group than to the 60-69 group.

There seem to be three possible reasons why the model and the Westpac/FPG survey yields different results:

- The model is incorrect with the term in the savings equation for age 65+ needing to be reduced (or some other change being required[5]), because mean net worth for the 70+ group really is less than what this group had when aged 60-69.

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[4] The latter corresponds to a negative level shift in savings for people aged 65 and over, implying that for given sex, ethnicity, marital status and income, someone in this age group will save an average $1446 less per year than someone younger than 65. The value of the constant term does not have much meaning since it corresponds to a European male aged 0 who is not in any income decile.

[5] Another factor which may influence the results is the assumption that on the death of a spouse the remaining spouse inherits 50% of the deceased person's share of the couple's assets - assumed to be 50%. Thus 25% of the couple's net worth is assumed to go elsewhere, such as to other family members. Even with this 25% "loss" a considerable amount of dis-saving would need to occur before there is a fall in the net worth of the surviving spouse.

- The average net worth of people currently aged over 70 is below what it was when they were 60-69, not because of simple age effects (which the model ostensibly tracks), but because of factors unique to that cohort - such as a perceived security of state funded retirement income.

- The model is correct and the Westpac/FPG survey is unreliable.

All possibilities are probably true to some extent. Unfortunately the reliability of the Westpac/FPG survey is not known - for example we know nothing about error margins or how reliably household assets are reported and shared by married respondents. Thus one is wary of forcing the model to exactly replicate its results, particularly if it entails large changes to model parameters.

The Westpac/FPG survey implies that total private wealth is about $250 billion (as at 31 December 1996), an estimate which should be more robust than those for particular age groups.[6] Spreading this across the population aged over 20 gives a mean net worth of $97,300 per person. The mean age of those aged 20 or more is 47. Thus if the model is reset so as to relate to the corresponding age cohort (45-49) and the model-estimated wealth at each age for that cohort is then weighted by the current population in each age group, one might expect the resulting estimate of total wealth to be reasonably close to $250 billion, unless that particular cohort is very dissimilar to those around it - which may well be the case. The result is shown as Run 4 in the table on the following page.

Implied total wealth is $168 billion, suggesting that savings during the HES survey period were unusually low by historical standards - which the national accounts confirm.[7] Raising the constant term in the savings equation by $1200 produces a closer result - see Run 5. However, the implied mean worth for those currently aged 45-49 when they reach 60-69 is considerably above the mean worth of people currently aged 60-69 (in real terms). The difference is even more striking for the 70+ age group.

Calibration of Total Wealth for Persons 20+
based on Cohort Aged 45-49 in 1996

	Westpac/ FPG	MIDAS		
		Run 4 constant + $0 >65 coeff + $0	Run 5 constant + $1200 >65 coeff + $0	Run 6 constant + $1500 >65 coeff - $5000
Age 20+ (total)	$250 bn	$168 bn	$246 bn	$246 bn
Age 60-69	$140,000	$140,000	$196,000	$202,000
Age 70+	$125,000	$171,000	$251,000	$211,000

Run 6 shows a variation on Run 5 where total implied wealth is still around $250 billion, but it is achieved by raising the constant term by $1500 and lowering the 65+ coefficient by $5000, in order to remove (most of) the sharp upward lift in wealth after age 60-69. This is similar to the adjustment in Run 2. Obviously even more extreme adjustments are possible so as to effect a drop in wealth beyond age 60-69.

[6] An approximate check is as follows: the mean house value as at 31 December 1996 was $167,000 (Valuation New Zealand); the number of private households is about 1.1 million (SNZ); and housing assets constitute about 70.4% of all household assets (Westpac/FPG); implying total household net worth of about $261 billion.

[7] See *New Zealand Institutional Sector Accounts: Experimental Series 1987-1996*, Statistics New Zealand, March 1997.

The critical question of course is: How valid is it to change econometrically estimated parameter values by amounts which exceed their standard error? Is it just a way to offset other model deficiencies or is it a reasonable way of dealing with data deficiencies or simulating new trends in savings behaviour; for example where private savings during the main income earning years are higher than historical data suggests, in order to generate an adequate stock of wealth to be consumed during retirement. This may be something to explore in subsequent scenarios.

Meantime however, in order to formulate a baseline scenario, we assume that:

1. the savings function and its underlying HES database, especially as regards the savings of those over 65, may be reasonably applied to projecting the future wealth of younger cohorts, but;

2. we should also attach some credence to the Westpac/FPG figures for mean wealth at ages 60-69 and 70+.

Given an annual rate of increase in asset values plus an allowance for additional savings due to income growth, we can project wealth at ages 60-69 and 70+ for any given age cohort, and calibrate the model accordingly. The rationale here is that the difference in wealth at a given age between different cohorts, should reflect the difference in real economic growth that occurs over the intervening years. When today's children reach their parents' age, they should be richer by the amount of economic growth that occurs over the next 25-30 years - other things equal..

We will take two cohorts, those currently aged 45-49 and those currently aged 15-19, as representative of two generations whose pattern of wealth accumulation is relevant to the formation of policy on savings and superannuation.

The approximate projections using the method just described are as follows. Real asset value appreciation is set at 1.5% pa and a further 0.5% pa (approximately) is added for the savings effect.

Mean Wealth Projections for Two Age Cohorts

	cohort 45-49 in 1996	cohort 15-19 in 1996
At age 60-69	$200,000	$340,000
At age 70+	$215,000	$370,000

Interestingly, both projections imply higher wealth in the latter age group, consistent with the model's inherent tendency and in contrast to the current situation.

The projections for the 45-49 cohort are very close to those obtained in Run 6, certainly within the margin of error, implying that a reasonable baseline scenario for this cohort involves the constant term being raised by $1500 and the coefficient on savings for age 65+ being lowered by $5000. This does suggest that the retired population is dis-saving to an extent not captured in the HES.

(Some additional minor refinements to Run 6 for the 45-49 cohort regarding the ethnicity/sex weights and marriage rates, which were included at a later stage, mean that the results from the final version of Run 6, labelled as Run 400 in the main text, are not precisely the same as those obtained above).

For the 15-19 cohort the model yields mean wealth estimates at ages 60-69 and 70+ of $343,000 and $374,000 respectively, if the constant term in the savings function is raised by $2200 and the coefficient on savings for age 65+ is lowered by $5800. These seem reasonable adjustments when compared to those for the 45-49 cohort. This run is referred to as Run 100 in the main text.

Hence we now have two baseline scenarios, one for the 45-49 cohort and one for the 15-19 cohort. These are not set in concrete. For example a higher rate of asset appreciation would accommodate a smaller increase in the savings constant, for a given level of wealth. The baselines are intended to represent plausible projections of future wealth under economic and demographic conditions which are similar to those that have existed over the past few decades.

Appendix D: Age Effects, Cohort Effects and Period Effects

Dynamic microsimulation models are essentially concerned with projecting the characteristics and behaviour of one or more cohorts over time. Ideally the characteristics of each cohort should be described by data relating to that cohort, especially as regards transition probabilities which portray movement between states over time. In practice it is not possible to obtain such cohort specific data, partly for the obvious reason that the future behaviour of individuals is not known. Thus we must utilise historical data sources, but in so doing we become subject to three types of effects which may be difficult to disentangle.

Age Effects

Age effects are simply those that occur as individuals age. For example the probability of marriage first rises with age and then declines. Likewise for income.

Cohort Effects

Cohort effects describe characteristics which are peculiar to a given cohort - individuals born during a specific time period such as a particular year or even a particular decade. For example an unusually low birth rate for a few years might mean that cohort experiences better teacher/pupil ratios at school than neighbouring cohorts.

Period Effects

Period effects also relate to a specific time period, but to all cohorts alive at that time whatever their age profile. Historically for example, the onset of major wars impacted on the fertility of a number of cohorts simultaneously. The effects of major changes in economic growth (such as the 1930's depression) might impact on the health of all cohorts in existence at the time.

In a dynamic life-cycle model we are primarily interested in the effects of age. The interaction of cohort and period effects with age effects in snapshot and longitudinal data may be summarised as follows:

Data Source	Cohort Effects	Period Effects
Cross-section	not controlled for	may be unique
Longitudinal	may be unique	not controlled for

When in our model we use cross section data to assume that the earnings profile of people who will be 40 in the year 2006 will be similar to the earnings profile of 40 year old persons in 1996, we are assuming that different cohorts experience similar earnings profiles at each age and that any period effects are discounted. However, cohort and/or period effects may mean for example, that in 20 years time the earnings profile of women may look more like that of men.

Longitudinal data, such as that which portrays the movement between income groups between 1991 and 1996, contains cohort specific information for a number of adjacent cohorts. However, the information relates to a particular time period and is incomplete - we do not know the income distribution in 2006 of individuals born in 1976. Higher economic growth in the future may affect the distribution of income at all ages for all cohorts.

Over time progressively more information can be amassed so that for example, different sets of cross-section data may be compared with one another. This helps to correct for unusual period or cohort effects. Of course every cohort and period is unique in some way and ultimately it is a matter of judgement as to what is unusual and what constitutes a reasonable assumption.

Appendix E: Baseline Scenarios

Runs 100 and 400

- Baseline scenarios for cohorts aged 15-19 in 1996 and 45-49 in 1996 respectively.

Microsimulation of Income Dynamics and Accumulation of Savings

Run No **100** **Cohort Aged** **15-19** **in 1996**
Sample size 10000

Mean Wealth by Age ($000)

Age	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	14.6	10.5	14.8	10.6	15.8	11.7	11.9	8.6
25-29	34.9	26.3	36.4	27.8	33.1	25.7	28.8	19.3
30-34	61.8	44.6	65.4	47.3	55.5	42.7	49.9	33.1
35-39	97.4	68.4	104.2	72.4	84.0	64.9	77.4	51.9
40-44	143.5	101.3	153.9	107.0	122.1	95.0	113.0	78.7
45-49	199.6	142.4	215.0	150.5	167.8	131.9	155.0	112.3
50-54	267.7	193.4	288.2	204.7	224.2	176.7	209.5	154.7
55-59	332.4	242.9	357.5	257.1	278.7	221.1	261.3	195.4
60-64	382.7	287.0	411.0	303.2	321.1	261.9	304.0	233.4
65-69	398.1	301.5	429.6	320.3	326.3	270.5	314.2	241.0
70-74	419.7	320.1	455.4	342.6	336.7	283.0	326.2	247.9
75-79	443.0	342.5	484.1	367.9	349.3	301.0	333.8	259.8
80-84	439.4	343.2	482.1	368.8	344.5	303.2	323.0	258.1
85-89	432.8	342.1	477.7	368.4	331.2	300.1	312.1	255.8
90-94	414.7	339.3	461.6	365.8	309.4	296.1	287.7	253.3
95-99	378.5	335.7	427.7	362.1	268.0	293.3	245.8	249.3
100	322.0	333.2	370.3	359.4	212.9	291.7	192.1	246.6

Decile Boundaries at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Min	-32.8	-8.3	-32.8	2.2	2.9	28.7	-27.1	-8.3
D1-2	167.0	129.3	188.9	142.3	139.7	139.1	112.1	77.7
D2-3	218.3	170.0	244.6	181.1	185.0	172.6	163.4	114.9
D3-4	260.5	203.3	291.3	217.7	219.7	197.3	196.3	148.1
D4-5	303.5	235.2	337.1	250.7	251.2	220.1	230.6	182.3
D5-6	350.7	266.5	388.1	283.6	284.5	242.9	269.3	213.1
D6-7	402.9	302.4	442.9	320.6	326.8	268.0	314.1	249.7
D7-8	467.6	340.6	502.1	358.3	380.3	306.5	363.5	289.6
D8-9	541.8	389.0	570.4	407.8	443.2	347.7	436.7	339.1
D9-10	645.6	471.9	670.5	491.4	550.1	410.1	560.4	403.6
Max	1382.8	1014.9	1382.8	1014.9	1082.5	871.4	1105.3	798.8

Decile Means at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
D1	114.7	91.4	135.1	102.7	107.1	108.9	63.7	53.4
D2	194.0	151.1	218.6	163.0	162.3	155.1	142.9	96.3
D3	239.7	186.3	267.2	199.7	203.2	186.0	180.4	131.3
D4	281.7	219.0	312.9	234.4	234.4	209.8	213.9	168.0
D5	326.2	250.4	361.7	267.2	267.5	231.6	248.5	196.9
D6	375.8	283.6	415.4	301.5	304.5	255.4	288.9	231.8
D7	434.3	321.3	472.1	338.0	353.1	286.4	336.2	269.9
D8	503.2	364.2	535.6	381.8	409.7	325.6	396.7	315.1
D9	587.7	425.7	616.6	447.0	495.7	376.4	496.4	371.0
D10	750.5	572.9	774.7	596.4	672.9	483.4	672.0	500.0
All	380.7	286.5	411.0	303.2	321.1	261.9	304.0	233.4

Proportion at Age 64 with Wealth below NPV of NZ Super. (%)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Incl hsg	18.4	46.4	13.4	41.2	27.7	54.7	33.5	61.1
Excl hsg (a)	77.8	92.9	75.9	91.5	82.7	97.1	82.0	96.2
Excl hsg (b)	67.5	87.7	64.3	85.2	75.2	94.1	76.3	93.8

Infometrics Report

Microsimulation of Income Dynamics and Accumulation of Savings

Run No **400** **Cohort Aged** **45-49** **in 1996**

Sample size 10000

Mean Wealth by Age ($000)

	Total		European		Maori		Other	
Age	Male	Female	Male	Female	Male	Female	Male	Female
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	8.4	5.2	8.4	5.1	9.6	5.9	6.0	3.4
25-29	20.7	14.3	21.3	14.8	19.3	13.7	15.4	9.0
30-34	37.6	25.0	39.4	25.8	32.0	23.6	27.2	16.8
35-39	59.9	38.5	63.1	40.0	48.8	35.7	44.3	26.2
40-44	89.2	57.7	94.3	60.0	71.0	52.7	64.9	40.0
45-49	125.3	82.5	132.7	85.8	98.9	74.2	89.7	59.1
50-54	168.5	112.1	178.7	116.5	131.8	100.8	120.3	82.2
55-59	210.3	141.0	223.0	146.3	164.5	127.3	150.8	105.5
60-64	242.0	167.2	256.5	173.6	189.6	150.2	175.4	124.6
65-69	249.8	173.3	265.5	180.7	192.4	154.2	177.7	123.8
70-74	259.8	181.8	277.5	190.2	195.1	159.8	179.9	125.3
75-79	271.7	192.2	291.4	202.1	198.3	165.4	184.9	128.0
80-84	267.1	190.3	288.7	200.5	187.4	163.3	171.5	122.5
85-89	258.0	186.5	280.7	197.0	174.6	158.6	155.5	118.1
90-94	241.5	182.0	265.1	192.3	154.1	154.9	136.2	114.0
95-99	212.1	177.2	236.0	187.3	123.2	150.7	107.2	109.4
100	170.5	173.3	193.1	183.2	85.5	147.4	72.8	105.7

Decile Boundaries at 60-64 ($000)

Min	-17.7	-10.8	-17.7	-10.8	8.2	3.0	-8.2	-6.4
D1-2	94.2	63.5	106.2	65.3	74.7	68.0	46.4	29.9
D2-3	129.4	89.9	143.7	92.3	100.8	90.0	73.4	51.0
D3-4	160.4	110.6	177.4	115.0	124.3	105.7	101.8	73.0
D4-5	188.8	132.3	207.2	137.4	150.9	124.6	127.0	93.0
D5-6	221.8	153.7	243.1	159.7	170.3	139.5	156.0	112.3
D6-7	259.3	176.1	278.8	183.0	194.2	156.8	186.2	135.7
D7-8	299.1	203.5	316.9	213.1	231.7	176.8	214.0	153.9
D8-9	349.0	236.0	367.1	250.9	269.0	205.5	258.5	192.4
D9-10	415.3	291.3	427.5	302.3	335.9	240.4	336.5	233.9
Max	809.8	644.6	879.5	644.6	607.0	496.8	661.2	393.3

Decile Means at 60-64 ($000)

D1	60.1	41.1	71.5	42.6	51.4	51.2	20.8	13.2
D2	112.2	77.3	126.4	79.4	88.7	80.1	61.1	40.8
D3	145.2	100.4	160.3	103.9	112.6	97.9	88.2	63.1
D4	174.9	121.3	192.1	126.6	137.5	115.1	114.1	82.5
D5	205.1	142.8	224.9	148.7	160.4	131.9	141.7	103.3
D6	240.2	164.5	261.0	170.9	181.2	147.8	168.5	123.2
D7	278.5	189.4	297.6	198.4	212.6	166.8	200.8	144.9
D8	322.0	219.4	342.2	229.7	248.6	190.0	235.1	173.7
D9	380.0	261.4	395.8	273.7	299.9	222.4	295.8	210.9
D10	481.7	352.8	493.1	361.7	403.0	298.6	427.3	290.1
All	239.9	167.0	256.5	173.6	189.6	150.2	175.4	124.6

Proportion at Age 64 with Wealth below NPV of NZ Super. (%)

Incl hsg	28.7	64.8	23.9	61.8	42.7	74.8	50.0	78.6
Excl hsg (a)	81.3	97.5	80.4	97.1	87.3	99.2	87.2	99.0
Excl hsg (b)	72.7	94.4	70.3	93.5	80.7	98.0	82.8	98.3

Appendix F: Additional Scenarios

Runs 101 and 401

- rate of growth in real per capita income raised from 1.0% pa to 1.5% pa (excluding the old age pension),
- real rate of appreciation in asset values raised from 1.5% pa to 2.0% pa.

Runs 102 and 402

- as for Runs 101 and 401 plus,
- marginal propensity to save out of income is raised by 25% between ages 20 and 64.

Run 103

- as for Run 102 with direct private payment for secondary health care costs after age 64.

Microsimulation of Income Dynamics and Accumulation of Savings

Run No 101 Cohort Aged 15-19 in 1996

Sample size 10000

Mean Wealth by Age ($000)

	Total		European		Maori		Other	
Age	Male	Female	Male	Female	Male	Female	Male	Female
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	15.2	11.1	15.4	11.1	16.4	12.3	12.5	9.2
25-29	37.7	28.5	39.4	30.1	35.7	27.8	31.3	21.4
30-34	69.6	50.3	73.7	53.3	62.5	48.0	56.6	38.0
35-39	114.1	80.0	122.0	84.6	98.3	75.3	91.0	61.4
40-44	174.3	122.4	186.9	129.4	148.1	113.6	138.0	96.0
45-49	251.3	177.8	270.5	188.3	210.7	162.8	196.3	141.3
50-54	349.0	250.0	375.7	265.1	291.2	225.4	274.4	201.1
55-59	442.9	320.9	476.5	340.4	369.5	287.8	349.5	259.2
60-64	514.5	382.1	552.8	404.6	428.9	343.4	410.0	311.6
65-69	554.0	417.5	597.3	444.1	452.6	369.3	441.8	337.3
70-74	605.1	461.1	655.0	493.3	486.0	402.5	478.8	364.1
75-79	663.5	512.8	721.7	550.0	526.3	445.7	513.4	400.0
80-84	676.4	526.3	737.1	563.8	536.9	460.6	516.0	410.5
85-89	690.0	537.7	754.3	576.3	539.3	468.1	523.7	420.6
90-94	692.3	546.7	760.0	585.8	534.6	474.5	515.5	430.3
95-99	673.9	554.4	746.6	593.4	505.8	482.8	482.8	437.5
100	629.5	564.0	703.4	602.9	459.5	492.9	434.7	446.7

Decile Boundaries at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Min	-24.0	-6.2	-29.5	4.8	9.1	36.3	-4.8	-6.2
D1-2	224.0	168.3	254.4	184.4	184.3	179.4	146.9	102.2
D2-3	291.1	220.6	326.3	236.5	245.6	221.8	223.4	149.9
D3-4	349.1	263.7	388.3	283.8	292.1	254.1	263.9	194.4
D4-5	405.5	307.9	451.5	330.2	330.7	287.1	308.9	241.7
D5-6	469.0	351.8	520.9	374.9	379.3	318.8	359.5	281.7
D6-7	541.0	401.0	596.5	425.8	436.1	352.5	417.9	330.7
D7-8	628.8	452.8	674.6	479.1	507.7	405.0	486.2	387.1
D8-9	728.4	524.4	767.1	549.9	591.9	461.1	596.4	455.2
D9-10	869.1	636.5	903.4	665.1	745.9	547.8	751.2	542.2
Max	1895.2	1387.3	1895.2	1387.3	1470.2	1220.2	1516.9	1131.7

Decile Means at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
D1	156.6	119.5	184.5	134.3	141.8	139.4	89.5	70.8
D2	259.7	195.9	293.5	211.8	215.2	199.2	192.7	126.3
D3	320.3	242.2	357.3	260.3	268.4	238.1	241.9	171.7
D4	376.6	286.0	418.8	307.6	310.8	270.7	285.9	219.4
D5	436.8	329.9	484.9	352.4	355.4	302.2	333.7	260.4
D6	504.3	374.6	557.3	399.9	405.3	334.7	387.2	305.6
D7	582.9	427.2	634.3	450.6	470.9	374.7	451.3	358.1
D8	676.6	487.0	719.6	512.9	548.0	430.5	533.1	422.7
D9	792.0	572.9	831.1	603.1	667.1	499.2	671.1	498.6
D10	1014.3	779.8	1047.1	813.0	905.6	644.7	913.9	682.4
All	511.9	381.4	552.8	404.6	428.9	343.4	410.0	311.6

Proportion at Age 64 with Wealth below NPV of NZ Super. (%)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Incl hsg	8.6	28.0	6.1	23.8	13.8	30.2	17.1	43.5
Excl hsg (a)	67.2	85.2	63.8	83.6	75.2	88.4	75.5	86.8
Excl hsg (b)	57.2	75.9	52.6	74.5	65.8	79.8	66.8	78.8

Microsimulation of Income Dynamics and Accumulation of Savings

Run No **102** **Cohort Aged** **15-19** **in 1996**

Sample size 10000

Mean Wealth by Age ($000)

	Total		European		Maori		Other	
Age	Male	Female	Male	Female	Male	Female	Male	Female
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	23.3	16.7	23.7	16.7	24.6	17.9	19.7	14.6
25-29	56.5	40.4	58.7	42.1	53.5	39.3	47.9	32.4
30-34	101.8	69.5	107.0	72.8	92.5	66.6	84.6	55.4
35-39	163.6	108.3	173.8	113.8	143.2	102.2	133.3	87.1
40-44	246.0	163.3	262.2	171.8	212.2	151.2	199.3	133.0
45-49	350.2	234.6	374.9	247.4	297.8	213.9	280.2	192.7
50-54	481.5	327.1	515.5	345.7	406.8	293.5	387.6	271.0
55-59	606.6	417.5	649.4	441.5	511.6	372.4	489.3	346.7
60-64	701.4	495.1	750.2	522.9	590.3	442.2	570.8	414.2
65-69	759.2	545.7	814.0	578.5	627.6	480.3	620.8	454.1
70-74	834.2	607.4	897.0	647.2	679.6	527.9	680.0	496.2
75-79	920.5	679.7	993.8	725.7	742.9	588.7	737.2	550.6
80-84	947.8	702.6	1024.4	748.8	767.1	612.7	750.6	570.8
85-89	979.4	722.5	1060.7	770.2	783.0	627.2	775.3	589.6
90-94	999.3	738.9	1085.3	787.1	793.1	639.9	782.1	607.6
95-99	995.5	753.0	1088.5	801.2	774.1	654.3	759.0	621.2
100	960.3	768.9	1055.5	817.1	735.5	670.7	715.6	636.8

Decile Boundaries at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Min	-4.8	-0.2	-4.8	13.1	42.6	50.4	-4.8	-0.2
D1-2	332.0	225.7	368.8	247.4	275.5	233.2	234.9	147.0
D2-3	417.7	292.2	463.2	309.4	357.8	286.4	333.2	208.6
D3-4	494.7	345.8	542.9	372.1	417.0	330.8	385.6	263.5
D4-5	564.8	399.7	619.0	430.1	467.8	372.0	437.0	326.5
D5-6	642.7	456.8	713.1	485.8	527.4	410.3	505.2	378.8
D6-7	734.4	519.0	804.7	546.9	601.9	453.5	584.2	437.6
D7-8	844.6	586.1	903.5	618.1	691.3	521.0	673.6	509.6
D8-9	973.8	676.0	1019.7	706.9	807.4	590.1	820.7	605.5
D9-10	1156.0	813.1	1198.0	851.9	997.9	698.7	1001.9	711.8
Max	2464.7	1730.0	2464.7	1730.0	1920.2	1551.2	2006.4	1467.9

Decile Means at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
D1	243.7	166.9	279.6	185.3	219.5	187.1	153.6	106.1
D2	376.7	261.2	420.5	280.2	316.0	261.4	290.5	179.2
D3	455.3	318.4	502.8	340.1	385.2	309.0	357.7	237.2
D4	527.8	373.5	580.2	399.4	439.9	350.4	411.0	297.5
D5	602.9	429.5	663.6	457.8	499.1	391.7	474.6	351.6
D6	689.5	486.3	755.4	516.8	561.0	432.3	542.9	406.2
D7	789.2	550.8	853.8	580.6	645.1	482.2	623.9	472.6
D8	907.5	629.1	960.9	661.0	741.7	551.5	732.3	555.4
D9	1054.1	734.5	1104.5	771.8	897.4	639.5	906.4	650.9
D10	1339.6	994.7	1380.8	1036.3	1197.7	816.6	1215.1	885.0
All	698.4	494.3	750.2	522.9	590.3	442.2	570.8	414.2

Proportion at Age 64 with Wealth below NPV of NZ Super. (%)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Incl hsg	2.8	13.9	1.7	11.2	3.3	13.3	8.3	28.8
Excl hsg (a)	56.1	77.2	51.5	75.4	65.1	81.6	66.0	79.1
Excl hsg (b)	45.5	66.8	41.3	64.3	55.1	70.8	55.5	70.8

Infometrics Report

Microsimulation of Income Dynamics and Accumulation of Savings

Run No **103** **Cohort Aged** **15-19** **in 1996**

Sample size 10000

Mean Wealth by Age ($000)

Age	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	23.3	16.7	23.7	16.7	24.6	17.9	19.7	14.6
25-29	56.5	40.4	58.7	42.1	53.5	39.3	47.9	32.4
30-34	101.8	69.5	107.0	72.8	92.5	66.6	84.6	55.4
35-39	163.6	108.3	173.8	113.8	143.2	102.2	133.3	87.1
40-44	246.0	163.3	262.2	171.8	212.2	151.2	199.3	133.0
45-49	350.2	234.6	374.9	247.4	297.8	213.9	280.2	192.7
50-54	481.5	327.1	515.5	345.7	406.8	293.5	387.6	271.0
55-59	606.6	417.5	649.4	441.5	511.6	372.4	489.3	346.7
60-64	701.4	495.1	750.2	522.9	590.3	442.2	570.8	414.2
65-69	759.2	545.7	814.0	578.5	627.6	480.3	620.8	454.1
70-74	834.2	607.4	897.0	647.2	679.6	527.9	680.0	496.2
75-79	920.5	679.7	993.8	725.7	742.9	588.7	737.2	550.6
80-84	947.8	702.6	1024.4	748.8	767.1	612.7	750.6	570.8
85-89	979.4	722.5	1060.7	770.2	783.0	627.2	775.3	589.6
90-94	999.3	738.9	1085.3	787.1	793.1	639.9	782.1	607.6
95-99	995.5	753.0	1088.5	801.2	774.1	654.3	759.0	621.2
100	960.3	768.9	1055.5	817.1	735.5	670.7	715.6	636.8

Decile Boundaries at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Min	-4.8	-0.2	-4.8	13.1	42.6	50.4	-4.8	-0.2
D1-2	332.0	225.7	368.8	247.4	275.5	233.2	234.9	147.0
D2-3	417.7	292.2	463.2	309.4	357.8	286.4	333.2	208.6
D3-4	494.7	345.8	542.9	372.1	417.0	330.8	385.6	263.5
D4-5	564.8	399.7	619.0	430.1	467.8	372.0	437.0	326.5
D5-6	642.7	456.8	713.1	485.8	527.4	410.3	505.2	378.8
D6-7	734.4	519.0	804.7	546.9	601.9	453.5	584.2	437.6
D7-8	844.6	586.1	903.5	618.1	691.3	521.0	673.6	509.6
D8-9	973.8	676.0	1019.7	706.9	807.4	590.1	820.7	605.5
D9-10	1156.0	813.1	1198.0	851.9	997.9	698.7	1001.9	711.8
Max	2464.7	1730.0	2464.7	1730.0	1920.2	1551.2	2006.4	1467.9

Decile Means at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
D1	243.7	166.9	279.6	185.3	219.5	187.1	153.6	106.1
D2	376.7	261.2	420.5	280.2	316.0	261.4	290.5	179.2
D3	455.3	318.4	502.8	340.1	385.2	309.0	357.7	237.2
D4	527.8	373.5	580.2	399.4	439.9	350.4	411.0	297.5
D5	602.9	429.5	663.6	457.8	499.1	391.7	474.6	351.6
D6	689.5	486.3	755.4	516.8	561.0	432.3	542.9	406.2
D7	789.2	550.8	853.8	580.6	645.1	482.2	623.9	472.6
D8	907.5	629.1	960.9	661.0	741.7	551.5	732.3	555.4
D9	1054.1	734.5	1104.5	771.8	897.4	639.5	906.4	650.9
D10	1339.6	994.7	1380.8	1036.3	1197.7	816.6	1215.1	885.0
All	698.4	494.3	750.2	522.9	590.3	442.2	570.8	414.2

Proportion at Age 64 with Wealth below NPV of NZ Super. (%)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Incl hsg	2.8	13.9	1.7	11.2	3.3	13.3	8.3	28.8
Excl hsg (a)	56.1	77.2	51.5	75.4	65.1	81.6	66.0	79.1
Excl hsg (b)	40.9	61.5	36.5	59.4	50.1	67.3	51.5	66.6

Infometrics Report

Microsimulation of Income Dynamics and Accumulation of Savings

Run No 401 Cohort Aged 45-49 in 1996

Sample size 10000

Mean Wealth by Age ($000)

	Total		European		Maori		Other	
Age	Male	Female	Male	Female	Male	Female	Male	Female
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	8.7	5.4	8.7	5.4	9.9	6.2	6.3	3.7
25-29	22.2	15.5	22.9	16.0	20.7	14.8	16.8	10.0
30-34	42.0	28.1	44.0	29.1	35.9	26.6	30.7	19.3
35-39	69.5	45.0	73.1	46.7	56.7	41.5	51.9	31.1
40-44	107.1	69.5	113.1	72.3	85.4	63.0	78.7	48.9
45-49	155.5	102.4	164.6	106.6	122.9	91.4	112.5	74.3
50-54	216.3	143.9	229.3	149.7	169.4	128.1	155.9	106.4
55-59	275.8	184.9	292.4	192.1	215.5	164.9	199.4	139.2
60-64	320.3	221.0	339.4	229.9	250.3	195.9	233.6	165.6
65-69	342.3	239.3	363.4	249.6	264.6	210.4	247.5	174.1
70-74	369.5	262.1	393.5	274.2	280.2	228.1	263.1	186.8
75-79	402.0	289.3	429.4	303.8	298.9	247.4	285.1	202.4
80-84	407.9	295.0	437.9	310.0	295.3	252.2	278.1	202.7
85-89	410.3	297.9	442.3	313.3	291.2	253.4	270.2	204.7
90-94	405.9	299.8	439.6	315.0	279.5	256.0	260.0	206.8
95-99	385.2	301.0	420.3	316.1	254.0	257.9	231.8	207.9
100	348.0	303.6	383.0	318.6	217.3	261.1	194.8	210.4

Decile Boundaries at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Min	-12.7	-8.6	-12.7	-8.6	15.6	5.5	-5.9	-4.3
D1-2	124.4	84.1	142.9	86.4	99.2	88.9	64.8	40.6
D2-3	171.5	117.4	190.1	121.0	134.6	115.5	97.2	68.3
D3-4	212.2	144.2	234.1	150.7	164.3	136.0	136.6	97.9
D4-5	250.3	172.3	274.5	179.8	196.7	159.4	167.6	122.0
D5-6	292.6	200.9	320.8	207.8	223.1	180.2	206.0	149.1
D6-7	341.5	232.0	367.8	242.2	256.0	204.2	248.8	176.7
D7-8	393.1	267.3	419.1	280.5	306.4	231.8	280.0	203.6
D8-9	461.7	312.8	484.5	331.7	353.5	267.4	343.5	254.0
D9-10	547.1	388.4	565.4	404.8	443.9	318.4	447.7	316.5
Max	1084.8	886.7	1180.2	886.7	807.3	674.0	876.4	528.8

Decile Means at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
D1	82.5	55.1	97.9	57.0	69.1	66.9	30.5	20.0
D2	149.0	100.9	167.4	104.0	117.3	102.7	83.4	55.1
D3	191.7	130.8	212.6	135.9	148.2	126.3	118.2	84.9
D4	231.3	158.5	253.7	165.7	182.0	147.8	153.7	109.0
D5	271.1	186.1	296.7	194.2	210.9	169.7	188.3	134.9
D6	316.8	215.6	344.2	225.0	237.9	191.3	223.2	163.0
D7	367.2	249.5	392.1	261.1	281.6	216.5	266.1	191.5
D8	425.2	289.5	452.3	304.3	328.0	248.6	309.7	230.4
D9	502.7	347.6	523.4	364.7	395.9	291.8	394.0	280.3
D10	638.4	474.4	653.9	487.2	532.2	397.3	569.1	386.7
All	317.4	220.7	339.4	229.9	250.3	195.9	233.6	165.6

Proportion at Age 64 with Wealth below NPV of NZ Super. (%)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Incl hsg	16.7	46.2	12.7	43.2	27.8	54.0	36.2	63.4
Excl hsg (a)	72.8	89.0	70.3	87.8	80.2	94.9	80.7	95.9
Excl hsg (b)	62.2	82.9	59.3	79.9	70.9	91.7	73.4	92.4

Infometrics Report

Microsimulation of Income Dynamics and Accumulation of Savings

Run No **402** **Cohort Aged** **45-49** **in 1996**

Sample size 10000

Mean Wealth by Age ($000)

	Total		***European***		***Maori***		***Other***	
Age	Male	Female	Male	Female	Male	Female	Male	Female
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-24	14.8	9.5	14.8	9.5	16.0	10.3	11.5	7.4
25-29	35.9	23.9	36.8	24.5	33.6	23.2	28.4	17.5
30-34	65.3	41.7	67.9	42.8	57.2	40.0	50.1	31.1
35-39	104.9	64.9	109.6	67.0	88.4	60.5	81.6	48.3
40-44	158.1	97.9	165.9	101.4	130.2	89.5	121.0	73.3
45-49	225.8	141.9	237.5	147.2	183.9	127.2	169.8	108.2
50-54	310.1	197.1	326.7	204.4	249.8	176.0	232.2	152.0
55-59	391.7	251.3	412.9	260.5	314.2	224.3	293.8	196.9
60-64	452.5	298.8	477.0	310.2	362.5	264.7	341.3	232.5
65-69	486.7	327.3	513.6	340.5	387.3	288.0	366.7	249.6
70-74	529.3	362.4	559.9	377.9	415.0	315.8	396.2	273.1
75-79	580.8	403.4	615.6	421.9	448.2	346.1	435.5	300.7
80-84	597.1	415.3	635.5	434.6	451.9	356.6	434.1	305.7
85-89	611.5	423.2	652.6	443.0	456.8	361.9	435.3	312.6
90-94	619.3	429.2	662.9	448.9	454.0	368.8	435.7	319.2
95-99	607.4	433.9	653.3	453.4	434.8	374.3	410.0	323.8
100	574.9	440.0	621.3	459.4	401.3	380.9	372.9	329.7

Decile Boundaries at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Min	-3.6	1.3	7.2	1.3	38.6	20.2	-3.6	-1.3
D1-2	198.5	123.6	222.5	127.0	164.9	131.0	123.6	71.9
D2-3	259.7	166.4	286.6	171.3	209.6	163.9	166.3	112.5
D3-4	314.7	202.2	342.1	209.3	253.8	191.2	216.9	147.9
D4-5	364.0	236.6	395.5	246.6	295.5	215.6	263.4	173.2
D5-6	417.4	272.4	452.5	282.8	328.1	242.5	308.2	213.4
D6-7	480.2	313.4	512.2	327.9	373.9	274.9	366.6	250.4
D7-8	546.0	358.5	579.7	375.5	434.2	306.1	406.9	285.3
D8-9	634.1	416.8	662.0	438.0	498.7	357.7	486.8	349.2
D9-10	745.8	509.3	766.3	536.9	610.3	421.1	622.3	425.0
Max	1427.6	1102.7	1573.2	1102.7	1068.9	857.7	1176.4	682.0

Decile Means at 60-64 ($000)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
D1	144.3	87.0	165.3	89.6	125.5	100.9	71.3	40.5
D2	231.1	146.7	255.6	150.7	190.7	145.7	145.9	90.0
D3	287.6	183.8	314.6	190.8	232.9	176.7	191.1	130.5
D4	338.7	218.7	368.4	228.1	275.3	203.9	242.8	161.7
D5	390.9	254.2	422.2	264.8	313.2	229.9	280.7	193.1
D6	448.3	292.0	483.5	304.9	347.7	259.6	329.4	229.7
D7	512.5	335.2	544.9	349.3	404.1	290.3	385.1	265.2
D8	587.8	386.2	621.2	405.5	464.6	331.8	440.2	317.3
D9	685.7	459.2	713.1	480.4	548.8	387.2	553.6	382.6
D10	861.7	621.1	881.2	637.9	722.0	520.5	773.3	514.1
All	448.7	298.3	477.0	310.2	362.5	264.7	341.3	232.5

Proportion at Age 64 with Wealth below NPV of NZ Super. (%)

	Total Male	Total Female	European Male	European Female	Maori Male	Maori Female	Other Male	Other Female
Incl hsg	4.9	26.3	3.3	24.5	8.8	29.2	16.6	43.4
Excl hsg (a)	60.7	82.1	57.5	80.4	69.4	87.0	73.4	85.5
Excl hsg (b)	50.4	73.2	46.7	71.6	60.1	79.0	59.7	77.6

Appendix G

Estimation of Health Cost Concentration Curves

A concentration curve, also called a cumulative spending distribution is a plot showing what proportion of the population account for which proportion of the nation's total health costs. Ideally such a curve could be calculated from a data base containing each and every hospital admission in the country, and executing a cross-tabulation query which seeks to link each admission by a common field (in this case the patient EHC number), which is unique for each and every single person in New Zealand. Individuals could then be sorted from the "most costly" to the "least costly" and a cumulative curve drawn. However, exploiting such a method was beyond the resources of this project.
Hence a concentration curve was estimated by a series of indirect calculations.

Funding for secondary care is based upon the numbers of persons resident within a given area, multiplied by a set of cost weights subdivided by race (Maori, Pacific Islander, and other) and gender. These cost weight factors were amalgamated with census data on the total population of each race and gender, within each particular age group, so as to calculate total secondary health costs across the country for each particular age group under scrutiny.

This table shows an example of these calculations.

Age 15 to 24	Race	Maori		PI		Other		Grand Totals
	Sex	male	female	male	female	male	female	
	pop ('000)	43.87	44.7	17.83	17.46	196.99	190.13	
	cost weight	0.294	0.728	0.223	0.548	0.267	0.434	
	total	12.898	32.542	3.976	9.568	52.596	82.516	194.096

By such a method it was possible to produce the following breakdown of New Zealand's secondary health expenditure:

Age	0 to 4	5 to 14	15 to 24	25 to 44	45 to 64	65 to 74	75 to 84	85+
Secondary cost ($m)	114	309	341	398	485	194	96	186
Pop. ('000)	286	544	510	1090	719	241	138	41
No. hospital admissions ('000)	94.1	25.7	57.4	119.2	68.1	55.3	48.3	17.9

Clearly within each age group, only a portion are ever admitted to hospital in a given year. This is ignoring the possibility of multiple admissions of the same individual, which would deceptively, increase the numbers admitted. Furthermore the cost of a person's hospital admissions varies through a large spectrum of values. While there are large numbers of routine procedures, there is also a small number of exceedingly expensive admissions.

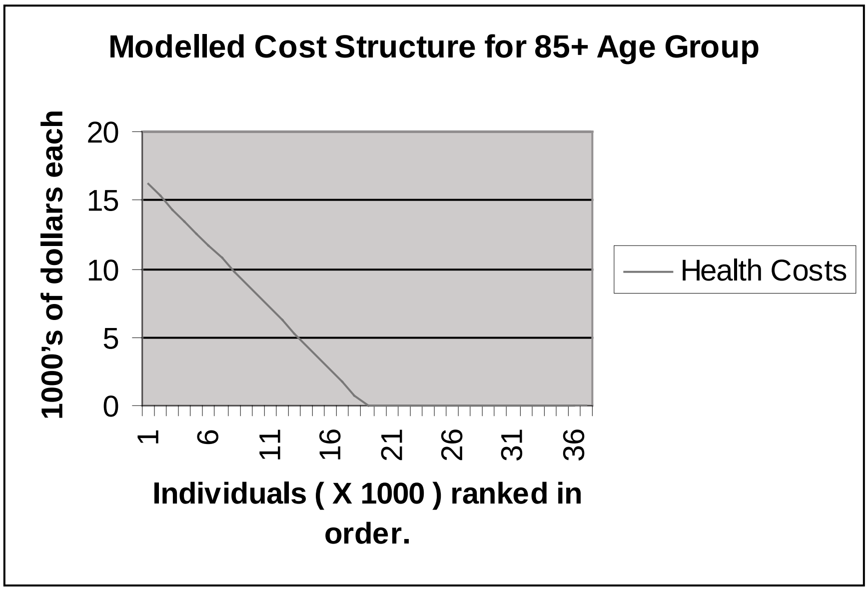
Concentration curves have the general form of a Pareto or negative exponential distribution. However, for the only two instances we could readily discover of concentration curves – for French and American data[8] – these distributions failed to produce a sufficiently good fit.

As an alternative approach, a stepped quartic polynomial was fitted to the French data. Judgement of individual coefficients led to rejection of the cubic and quartic terms. The resulting quadratic had a positive coefficient on the linear term and a negative one on the squared term. When this quadratic is

[8] "Financing and Delivering Health Care: A Comparative Analysis of OECD Countries", *OECD Social Policy Studies*, No 4, 1984.

differentiated it then produces a negatively sloped linear function (with a step) for the distribution secondary health costs.

We therefore adopted a linear step function for the New Zealand data. Whilst it can be expected to be a useful approximation, it is nonetheless likely to understate the most extreme high health costs and overstate the most extreme low costs. Reproduced below is an example of a linear step model of secondary health costs, (principally hospital admissions) for persons in the 85 and over category.



Note that the X-axis runs from 0 to 41,000 because there are 41,000 people in New Zealand aged 85 or more. When ranked in order of the secondary health costs they incur in a given year, all those over rank of 17,850 (the number of hospital admissions) have zero secondary cost, because they are assumed to never go to hospital. The cost of those who are admitted is assumed to follow a linear function. The Y intercept is determined endogenously from the knowledge that the total secondary costs of this age group are $186m, and this must equal the area of the triangle.

The amalgamation of these models into a concentration curve is slightly more complex. A program was written which first constructs a family of these functions for each of the eight age groups, and automatically solves for their slopes, and X and Y intercepts. The algorithm then draws a horizontal line through the Y-axes at a very high value. It then moves this line down each triangle simultaneously in small increments, each position of the line representing a given admission cost, i.e. all operations which cost $9,000 to $10,000. For each position, which is progressively lowered, the program integrates across all the age groups the number of persons in New Zealand who experienced health costs within that bandwidth, and what those total costs actually were. Hence when the program first looks only for those whose treatment cost more than 45,000 few will be counted. But once it lowers its range to costs of 2000 or more, large numbers of individuals are being accumulated in the summation.

The amalgamated concentration curve obtained by this integrating program looked very similar to the curve based on the French data, providing some additional support for our adoption of the linear model and its underlying assumptions.

Appendix 7.2 ISI Members

American International Assurance
AMP Society
Armstrong Jones NZ Ltd
Bank of New Zealand
BT Funds Management Ltd
Cologne Life Reinsurance Co
Colonial
Countrywide Life Ltd
Equitable Life Insurance Co Ltd
Equitilink Australia Ltd
Farmers' Mutual Group
Fidelity Life Assurance Co Ltd
Gerling Global Reinsurance
Guardian Assurance Ltd
Hannover Life Re of Australasia Ltd
Jardine Flemming NZ Ltd
Medical Assurance Society NZ Ltd
Munich Reinsurance Co of Australia Ltd
National Bank of New Zealand Ltd
National Mutual Life
Norwich Union Holdings (NZ) Ltd
Pacific Life Ltd
Prudential Assurance NZ Ltd
Public Trust Office
Reouf Asset Management Ltd
Royal SunAlliance Life Ltd
Soverign Assurance Co Ltd
Swill Re Life & Health Australia Ltd
Wetspac Trust Financial Services NZ Ltd

Associate Members
Bell Gully Buddle Weir
Burrowes & Co
Chapman Tripp Sheffield Young
Coopers & Lybrand
Deloitte Touche tohamatsu
Ernst & Young
FPG Research Ltd
IPAC Securities NZ Ltd
Kensington Swan
KPMG Peat Marwick
Melville Jessup Weaver
Phillips Fox
Price Waterhouse
Russell McVeagh McKenzie Bartleet & Co
State Street NZ Ltd