Asset decumulation: optimising income needs for retirement

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Introduction

Decumulation is the use of financial assets accumulated during one's working life in such a way as to provide a more or less regular payment stream in retirement. Decumulation may be accomplished by drawing down on capital from time to time, or by purchasing a promise of regular income through annuitisation, using insurance mechanisms.

The questions considered here then are: in regard to retirement financial assets, what approaches might be taken to structure decumulation of those assets in order to optimise one's income over the period of one's retirement? Can market failure be identified? And if so, what government interventions may be needed?

The focus here is solely on arrangements for providing income in retirement based on individual property rights. Some groups in New Zealand have a culture in which intergenerational income is pooled within the family or whanau. These latter arrangements, while important, are outside the scope of this work - although the extent to which they exist does affect possible responses to the policy issues discussed in this paper. Additionally, the diversification effects which arise from wealth and income sharing between couples are not investigated, although these are also important. The focus on individual rights is simply for the purpose of bringing the basic issues into starker relief.

Background

There are two primary observations underpinning consideration of provision for retirement income:

1. Most working age people, in modern industrial societies, principally manage their finances by reference to their direct and regular income from labour;
2. Nobody knows when they will die.

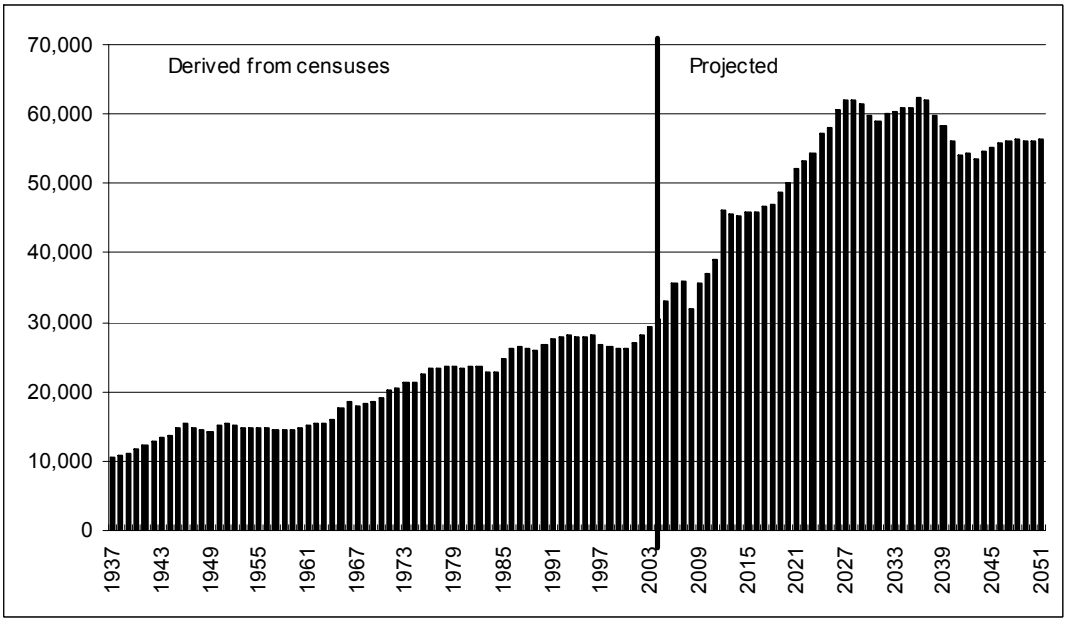
The first observation suggests that most (but not all) people would be most comfortable having a significant degree of regular income continuing on into retirement, preferably commensurate with their income pre-retirement. Absent pension entitlements from occupational superannuation, *a priori* one would expect

(depending on circumstances) significant demand for conversion of at least part of asset-holdings built up pre-retirement into a regular form of post-retirement income, to give greater overall comfort and utility.

The second observation however suggests that the uncertainty as to when death will occur leads to significant difficulties in determining what actually will be the optimal strategy to achieve that objective.

What is the size of the issue? Looking forward in NZ, the number of people reaching retirement age is projected to roughly double over the next 20 years. The figure below, taken from Statistics NZ past population figures and medium future projections, shows the number of persons attaining age 65 from 1938 to 2051.

Figure 1 Increase in population aged 65 by year, New Zealand 1937-2051



This indicates the extent to which decumulation, if not already a matter of policy interest, is likely to become one as the baby-boomers make their way into retirement.

How much pension provision might people need?

As a crude rule of thumb, it is often stated that people wanting to maintain living standards into retirement should plan to have income in retirement at a level of 70-75% of their pre-retirement income, reflecting lower costs (such as not needing to travel to work, having acquired durables or provided for their future purchase, etc)[1]. Meaningful discussion on such replacement rates needs to take into account such matters as living arrangements (particularly whether partnered or living alone) and housing arrangements (particularly whether mortgage free or paying rent).

[1] See for example Munnell and Soto (2005). These are in respect of gross incomes.

A crude indication of the adequacy of New Zealand Superannuation is given by considering median and average income figures from the NZ Income Survey (Statistics NZ, 2006b). The median annualised income for a person aged 50 to 65 in paid employment is $37,900. The single living alone gross rate of New Zealand Superannuation is currently $16,647 pa, which is around 44% of the median for the 50-65 pre-retirement group.

For couples, the New Zealand Superannuation rate is higher, $25,278 pa gross. However, the NZ Income Survey figure for the average couple income, over all family types, is $61,830 pa. This is over all ages, and the average for the pre-retirement ages could be lower than this by 10% or more, from looking at comparable single rates. Taking it to be 10% less, the replacement rate is about 45% for this average.

It is reasonably clear therefore that New Zealand Superannuation on its own will fall short for many people in meeting a 70-75% replacement rate target.

How much non-NZS pension provision do people currently have?

Since 1989, when a favourable tax treatment was removed from pension schemes, there has been no financial incentive for superannuation benefits to be paid in pension form. The largest pension-paying scheme, the Government Superannuation Fund (GSF) for public servants, was closed to new entrants from June 1992. Many other schemes either wound up, or if they continued, closed to new entrants and (unlike the GSF) also stopped the accrual of further pension benefits.

A significant legacy of pension entitlements continues, but will diminish in time. Its size can be estimated from figures for payments from the GSF as provided in the annual Government Actuary actuarial valuation reports, and figures for annuities in force with NZ life insurance companies from quarterly reports of the Investment Savings and Insurance Association NZ. Aggregate figures for pension payments made by registered superannuation schemes other than the GSF can be obtained from the Government Actuary's annual reports.

From that data, current pension payments by age are estimated as in table 1 below. The right hand column shows what proportion these are of private incomes[2] as derived from the 2004 Household Economic Survey data (Statistics NZ, 2004).

Table 1 Estimate of pensions in payment by age group ($millions pa).

	GSF			Other	Total	As % of
Age group	Male	Female	All	All	All	HES 04
65-69	83	18	101	57	158	12.5%
70-74	80	26	106	60	166	19.0%

[2] ie excluding State income such as New Zealand Superannuation

75+	165	83	248	140	388	30.3%
Total	328	127	455	257	712	20.9%
Total 70+	245	109	354	200	554	25.7%

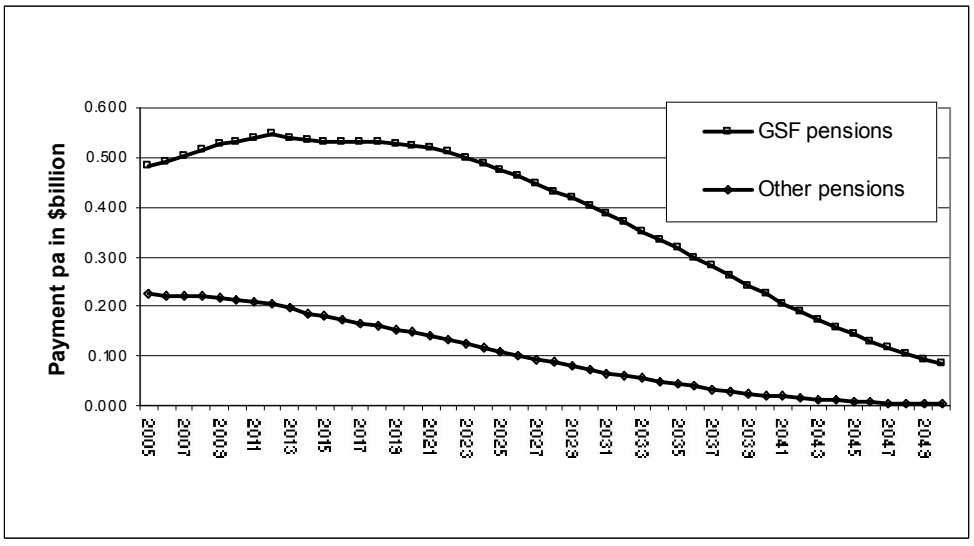
(1) GSF figures from 2004 valuation report. Age 65-69 values taken as one half of 60-69 values.
(2) Other figures taken from GA 2004 report, ISI December 2004 statistics.

Since some of those aged 65 to 74 will be still earning labour market income, lowering the proportion that pension income represents, we need to look further for trends.

Future benefit payments from the GSF are projected by the Government Actuary and are contained in the Treasury Long Term Forecast Model (Treasury, 2006b). These benefit projections include lump sums and resignation benefits as well as pensions, but the proportion that represents pension payments is steadily increasing and can be expected to be very close to 100% by 2021. Similarly, while currently 25% of pensions go to those under 65, it may reasonably be expected this will decrease and be effectively nil no later than 2038.

There is no similar projection of non-GSF private pension arrangements, but given the static levels in past years, it is reasonable to assume that the outgo will follow a similar but rather flatter trajectory than the GSF. Figure 2 below shows estimates of pension payments up to 2050 in current dollar values, discounting at 2% pa.

Figure 2 Projected private pension payments to the 65+ population, in 2004 $



Source: GSF benefit payments, Treasury Long Term Fiscal Model and own calculations

A not unreasonable conclusion, bearing in mind that the number in the 65+ population is increasing while the amount of pension payments look likely to fall from 2013 onwards, is that an increasingly smaller proportion of older people will have annuities or occupational pensions and a significantly larger proportion will have none.

What problems are presented by "draw down" methods?

An alternative to annuity purchase is **draw down**. This describes the process whereby assets are released in a structured fashion, ignoring the uncertainty as to when death may occur. One strategy for example employed by financial planners working with a client is first to identify what assets are to be set aside to be preserved for precautionary reasons, and/or as definite bequests to family or others. Having identified the remaining assets then available for draw down, a fixed period is chosen, and amounts calculated for release over that period so as to provide regular payments, taking into account expected investment return on the capital remaining from time to time[3]. Effectively the process is the same as paying off a mortgage.

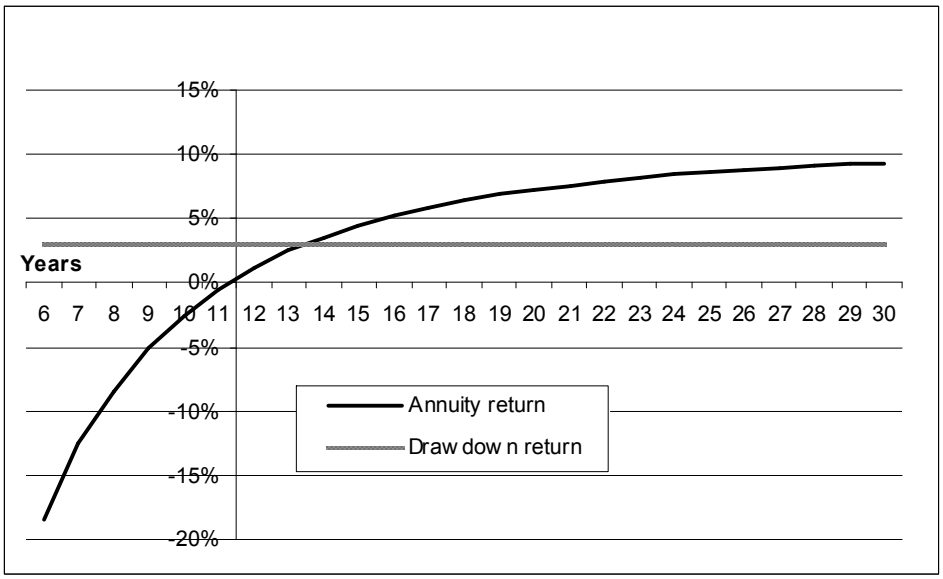
Ignoring the uncertainty of death under draw down causes two immediately obvious difficulties. There is the risk that one may die before the end of the draw down period, with the result that one has not obtained full value from what has been set aside. And there is the converse risk that one may live past the fixed period of time, and hence run out of income. (Certainly one can adjust one's drawings downwards as time goes by, in order to not run out completely, but this is hardly assuring oneself of regular income.)

For comparison of draw down with purchase of an annuity, suppose a sum of $200,000 is applied to purchase of an annuity priced on the following assumptions: the person to receive the payments is a male, aged 65; mortality is as per all-population NZ Life Tables 2000-2002 (NZLT02)[4]; the average return on investment is 5% pa after tax and expenses; payments are made monthly and increase at the end of each year in line with price inflation over the year, assumed to be 2% pa.

The increasing average annual payment for life, under pooling of the longevity risk, can then be calculated as starting at $16,024 pa. That is, for a payment of $200,000, the insured would receive $16,024 each year, increasing 2% compound at the end of each year. For a survivor, the annualised return on investment at the end of each year from year 6 onwards is shown in Figure 3 below[5].

[3] These payments may be planned to be level, or alternatively increasing with some index such as price inflation.
[4] Note the expectation of life is 17 years in this case.
[5] Note that returns shown are real, ie the excess over the assumed 2% pa increase in cost of living.

Figure 3 Comparison of annualised real return from draw down and annuity



On death within the first 11 years, the annuity purchaser receives a negative return on their investment. At 13 years, however, some four years before the median expected period of survival, the annualised return matches that for the draw down, and an increasing return is obtained thereafter for each further year of survival. The initial negative return may appear unattractive; but if one has died, this is of little consequence, while if one survives, the higher return is clearly attractive.

Aside from the structural problem of lack of efficiency, draw down also exposes the user to individual investment risk, transaction costs (particularly if use is made of a financial adviser, as will frequently need to be the case), and family pressure and potential fraud (because of the liquidity). For further analysis of the weaknesses of draw down, refer Wakeling & Yang (2000).

Why is annuitisation unpopular?

The traditional life office annuity product has problems on both the supply side and the demand side. Many of these are replicated for occupational pensions.

On the **supply** side, the problems can be summarised as:

- there are now levels of uncertainty about future patterns of longevity that were not present a number of years ago, due to improvement in mortality continuing to be higher than projected; accordingly while it continues to be practicable to insure against **idiosyncratic** longevity risk (variation of outcomes between individuals within a reasonably well-founded probability distribution), it is currently problematic to insure against **systemic** longevity risk (uncertain changes in the probability distribution going forward)

- there are limits on the availability of matching assets to minimise investment risk, particularly in the case of New Zealand
- there may be mis-alignment of taxation incidence - the tax rules for life office annuity products are opaque
- lack of demand is putting pressure on expense loadings particularly where economies of scale are needed
- increased attention to prudential reserve requirements by regulators (not unreasonably) in conjunction with shareholder demands for appropriate return on at-risk capital is putting pressure on pricing.

Taken together, it is hardly surprising that traditional annuity products are harder to find, and that competition is becoming less effective at holding prices. While in general it has proved possible for providers of many insurance products to adapt to changes in conditions, the problems facing annuity providers are potentially intractable.

In addition, occupational pensions are fading away, as employers (including Government) discard their guarantee role and devolve risk onto employees through lump sum-based defined contribution arrangements. The new KiwiSaver scheme, for example, places all investment and longevity risk onto individuals.

On the **demand** side, there are also problems, which may be summarised as follows:

- precautionary savings may be felt necessary, with uncertainty as to what levels are required, and a sense that existing levels of income being received (including NZS) are insufficient for further savings to be established
- there may be a wish to have the ability to make bequests (although there may be some expectation of receipt as well)
- in addition to the above, there may be a wish to have control and to not hand money over to unknown and/or mistrusted financial service providers
- annuities may be seen as poor value for money, due to unrealistically low expectation of life, poor implicit returns, low levels of regulation (in NZ), and a perception of high charges
- a perception of poor value for money will also be the case where one has knowledge that one has poorer or even average longevity prospects, and appropriate terms are not available in such cases

- the need to actually plan to buy an annuity leads one directly to contemplate one's death, which may be anxiety provoking (and hence become utility-maximising not to plan!)
- there will be a disinclination to take a lower CPI indexed pension compared to a higher fixed pension, despite its probably better fit
- the greater visibility of annuity income may make it unattractive if there is some real possibility of otherwise qualifying for means tested benefits
- NZS and/or family support may be perceived as mitigating the need for longevity insurance.

There are solutions to at least some of these objections, but the NZ market has shown little sign of delivering them to date. This may or may not be because other objections require non-market solutions.

What are the public good issues?

The public good issues which arise through not having a market which delivers a viable combination of asset management and longevity insurance could be listed as:

- the significant economic inefficiency identified earlier in respect of draw down in the absence of longevity insurance, requiring people to have to hold higher than necessary assets, or have lower incomes in retirement than they could have were longevity insurance available
- the potential, under draw down or other individual wealth management approaches, to "waste" savings through short-term attitudes to consumption, high transaction costs and exposure to fraudulent behaviours; remembering that managing income rather than financial assets is what people are mostly used to
- the perverse incentive to spend assets early in order to avoid income-testing of welfare benefits such as disability payments, accommodation supplement, the residential care subsidy, and the like, increasing the risk of inadequate financial support later in life placing pressure on the State
- the behavioural issues in getting people to do what would, on a reasonable assessment, optimise their welfare.

Longevity insurance issues require some amplification.

Firstly, differentiation of longevity risk is not occurring in New Zealand, and indeed is not that well-developed elsewhere. This leads to annuity products only being good

value for those who have well above average longevity prospects, and tends to price others out of the market. Compulsory annuitisation facilitates pricing based on averages to a greater extent, but because of heterogeneity of the population, still represents poor value for money for a significant number.

Secondly, and more importantly, the uncertainty as to future longevity improvement makes traditional annuity pricing difficult, if not impossible. Cohort effects have been detected, but the drivers are not as yet understood[6]. Other things being equal, the people for whom longevity insurance is useful are not only likely to have longevity higher than population averages, but are probably more likely to be able to afford medical interventions that will enhance their lifespan. Hence, it is quite possible that with increasing wider disparity of income in the population, there will be corresponding wider disparity of life expectancy. This adds to the difficulties of pricing.

Possible market solutions to the problems of insurance of systemic longevity risk have been discussed; see for example Antolin and Blommestein (2007), Blake, Cairns and Dowd (2006). However, at the present time, longevity bond issues have not been successful, and reinsurance companies have not been keen to offer annuitant cover because of the uncertainty as to future mortality patterns, despite some opportunity to offset against life insurance risk. Also, employers, including Government in New Zealand, are increasingly reluctant to carry longevity risk for their employees through financially backing the longevity risks inherent in pension paying schemes, particularly when they are unable to adequately quantify this risk.

A further difficulty that flows through from increased uncertainty is the extent to which provision needs to be made by an insurer for poorer outcomes than expected. To the extent that this leads to additional capital being required to ensure the benefit promise can be met, annuity provision becomes even more highly priced, and hence less likely to be utilised regardless of its merits.

Thirdly, the State is already providing longevity insurance through the state pension system. In New Zealand this is significant for those on lower incomes, although rather less so for the middle and higher income groups. This suggests that further State provision might be aimed more towards facilitating self insurance or acting as an insurer of the last resort, rather than taking the risk directly. For example, in the Swedish state old age pension system each cohort of retirees has an up-to-date risk assessment made, but the State then acts as guarantor from that point forward.

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[6] For a full description of New Zealand cohort mortality, refer Statistics New Zealand 2006a

Fourthly, there is the perception that insurance is poor value for money. Given apparent consistent underestimation of mortality by individuals, allied to a "one size fits all" approach to pricing by traditional insurers, this perception is not surprising and may be well-founded. However, there may also be an element of not wishing to contemplate the inevitability of death by making use of a product that requires this to be more obvious.

Taken together, these problems suggest that relying on market provision of longevity insurance is problematic, to say the least. Even were there to be greater education as to the perils of not insuring longevity risk, it is unlikely that insurance companies would be able to provide annuities at a price that would be perceived as acceptable. Some employers might consider reverting to taking on some longevity risk for their employees and underwriting pensions, but this seems only likely if there are sound labour market reasons for doing so.

What are the options?

One can identify three main policy responses to the annuitisation problems outlined above. These are:

1. do nothing, noting that New Zealand Superannuation provides a certain amount of longevity insurance, and that the greater savings resulting from the KiwiSaver initiative may possibly lead to a market solution emerging without government involvement;
2. at the other extreme, have the state establish a not-for profit annuity fund offering CPI-indexed annuities[7]
3. as an intermediate position, take steps to facilitate the introduction of annuitised funds, under which participants pool their risk on a collective basis, but with the state providing some reinsurance against "excess" loss, ie limiting the extent of potential loss, in return for sharing in "excess" profit if such occurs.

The principal difference between option 1 on the one hand and options 2 and 3 on the other is that option 1 requires private solvency capital, whereas options 2 and 3 have the state providing the prudential guarantee to a greater or lesser extent. If the argument is accepted that systemic longevity risk is not currently hedgeable, nor likely to become so in the near future, then a viable private annuity market under option 1 is unlikely.

[7] Some might suggest indexing to net wage increases, as is done for New Zealand Superannuation; however pricing of such annuities is highly problematic, if not impossible.

This argument becomes stronger when the disparity in expected mortality conditioned on such factors as income, gender, education, family history of mortality, smoking, etc, is taken into account (refer next section). Effectively the potential population has not the conventional two risk dimensions (ie male or female) but a number of dimensions, implying a greater number of smaller risk pools. With a population the size of New Zealand, any expectation of being able to hedge systemic longevity risk through private markets then becomes extremely small.

Allied to other matters touched upon, particularly the absence of instruments for the private market to hedge investment risk, then options 2 and 3 would seem the most promising if New Zealanders are to have viable access to annuity products.

Why does differential mortality need to be taken into account?

The extensive literature on annuitisation has mostly focused on a "whole of population" mortality. The so-called "annuity puzzle", relating to what appears to be a higher price for annuities than would be expected by reference to population mortality, is in fact explained by the fact that those who voluntarily purchase annuities generally expect to have better than average mortality - and life insurance companies price their products accordingly.

Research within New Zealand and elsewhere has shown that mortality rates differ according to socioeconomic factors such as education, income, etc; refer Blakely, Fawcett, Atkinson, Tobias and Cheung (2003).

It follows that it will be necessary, in an environment where annuity purchase is not mandatory, to develop differential pricing for annuities if the market is seen to be fair. Indeed, in countries such as the UK where annuity purchase is mandatory, a market is developing in what is termed impaired lives. However, from a public policy perspective, such a development in NZ could be many years away if left to the market, precisely because there is no mandatory requirement to purchase an annuity here.

In the next sections, option 3 above - the annuitised fund - is developed in greater detail, on the grounds that current policy settings are unlikely to support option 2, establishment by the state of a publicly owned annuity fund. The issues discussed for the risk-sharing model would, however, for the most part also need to be considered under option 2. In illustrating its workings, particular attention is paid to the need to underwrite - ie, assess risk - on a fair basis if such funds are seen to be good value.

What is the annuitised fund?

The basic features of annuitised funds are:

- self-pooling of longevity risk
- self-pooling of investment risk

For a fuller discussion, refer Daykin (2004) and Pigott, Valdez and Detzel (2004).

For the model examined here it is assumed each fund begins with a cohort of new entrants under a specified pricing basis incorporating a mortality table, expected future net of tax investment return, expected transaction costs, and indexing basis to apply for the duration of membership. There are likely to be different risk classes and hence different mortality tables within a cohort; the issues around this are explored later.

A re-pricing model is assumed, in that at each balance date after commencement, each surviving cohort member would have an asset share calculated, being the asset share at the start of the year, decreased by payments and the share of expenses, and increased by the share of investment return and "fall-in" from deceased cohort members, which would represent their share of fund assets at that time. The initial asset share is of course the purchase price. Tax paid on investment earnings would be allocated according to asset shares, and available as an imputation credit against personal income tax.

Rather than use a **re-pricing** approach, assuming the asset share is used to re-calculate the pension at each subsequent balance date using the pricing assumptions, one could instead use an **indexing** approach, increasing the pension by CPI regardless of investment and mortality experience. Under re-pricing, the pension may diverge from that expected; under indexing, the funds may accumulate a deficit or surplus in relation to the liabilities calculated on the initial pricing basis. However, investigation of the indexing approach showed the speed with which the difference between assets and liabilities increased was such as to rule it out as a sensible approach to follow under collectivised risk sharing.

The assigned cohort mortality table is a projection of future mortality, appropriate to members' date of birth, and assuming longevity improvement appropriate to that cohort. The projection will be based on the best demographic analysis available as a "best estimate", without margins.

The initial pension according to the amount invested is calculated according to the pricing assumptions. Note that for pricing, the relationship between assumed

investment return after tax and indexing rate, ie the real net investment return, is relevant, not the components, and may be expected to be more stable than those separate components.

While some variation in outcomes may occur through excess fluctuation in idiosyncratic longevity risk (and hence be insurable), other variation may result from systemic longevity risk, which is currently non-hedgeable and would have to be borne by the state if any form of annuity is to be viable (refer Antolin). Hence some form of state-backed stop loss insurance may be needed, triggered when the number of deaths diverged outside specified limits. In the event deaths were less than expected, the state would supply a subsidy; and where more than expected, a payment would be made to the state. The mortality and risk-assessment basis would therefore have to be state-approved - an incentive for best-estimate pricing. (Note there would be no reinsurance of investment risk.)

Note that the state in such a case is providing protection against extreme volatility on a basis which, all other things being equal, should be cost-neutral[8]. Excess losses will be prevented, but similarly excess profits will be constrained.

What would it look like in practice?

The difficult issue for consumer acceptance is a potential perception of "unfairness" or "lack of value for money" depending on the extent of likely and predictable variation of longevity between individuals within a cohort. For example, as it is known that lives that experience Māori mortality die earlier on average than lives which experience Pakeha mortality do, some Māori may consider that they would not get good value from participating in a annuitised fund that had predominantly Pakeha participation[9]. On the same basis men might feel that they would not get good value if the annuitised fund had a significant number of women.

More broadly, those who have reasonable cause to expect that they will have lesser length of life will be concerned about equitable treatment. The critical feature for an annuitised fund then is the out-working of the longevity risk.

To investigate the longevity differential issues, a simplified model has been used wherein it is assumed:

- new entrants are all age 65

[8] Clearly however getting the mortality assumption correct is vital.

[9] This would be less of an issue if in time existing disparity between Māori and Pakeha mortality was expected to narrow.

- all contribute an initial $100,000[10]
- the assumed indexing for pricing and re-pricing is 2% pa[11]
- the assumed investment return for pricing and re-pricing is 6.5% pa after tax, with all cohort members having the same rate of income tax[12]
- that in practice, the assumed investment return is in fact achieved[13]

There are in effect two questions concerning longevity: what outcomes might one get if the risk of death is relatively homogeneous, ie there is no a priori reason to suppose any cohort member more likely to die earlier or later than another; and what happens if some members do have characteristics which, *a priori*, suggest mortality better or worse than average?

To explore these points further, results are modelled for an annuitised fund under the structure described, making a number of simplifying assumptions so as to focus on longevity issues. By using stochastic methods to simulate variation in mortality outcomes under different assumptions as to the underlying mortality, issues around longevity differentials can be brought into greater focus.

A population of 1000 joiners is assumed for each run. The run output is the pension payable for each year, under the re-pricing approach.

The base mortality table used here is the All Males (AM) group, New Zealand Life tables 2000-2002 published by the New Zealand Department of Statistics. This is a period table; that is, the rates reflect current mortality rates by age.

To make a broad allowance for potential cohort effects, the period table values are adjusted to allow for improved cohort mortality by assuming the probability of death for a person aged x in year t from now is given by the period table probability for age x decreased by 0.33% compound for t years. For a 65 year-old, this gives an increase in life expectancy of about 2 years every 10 years over the next 30 years, which is broadly in line with observed cohort improvements (although no attempt has been made to relate improvement rates to age with this approach). This table is denoted as AM(C).

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[10] The assumption of a level purchase price is a simplification, since in general having a higher sum to invest is correlated with lower mortality.

[11] The indexing follows the centre of the Reserve Bank 1-3% inflation target.

[12] Investment return is based on the projected return of the NZSF, 8.65% pa, less 25% as an allowance for tax.

[13] A more detailed examination would look at the effect of variation in investment return, but that is not pursued here.

To investigate the effects of lower mortality (ie higher longevity), a low mortality table has been constructed by assuming a 33% reduction in period table mortality; this is denoted as AM(L). A high mortality table has been constructed by increasing period mortality rates by 55%; this is denoted AM(H). The effect in each case is broadly to add or subtract 3 years from the life expectancy of a 65 year old based on period mortality.

Table 2 below sets out the **initial** pension that would be payable under each mortality table with the other pricing constraints as set out above, ie age 65, 2% pa indexing, 6.5% net investment return, $100,000 purchase price. As well as All Males, results are shown for the other NZLT 2000-2002 tables.

Table 2 Pension amounts according to different mortality assumptions

	Mortality table			
Initial pension per $100,000 purchase price	Basic period table	Lower mortality (L)	Higher mortality (H)	Cohort improvement (C)
All Males (AM)	$9,053 pa	$8,063 pa	$10,514 pa	$8,954 pa
Non-Māori Males (NM)	$8,949 pa	$7,996 pa	$10,347 pa	$8,853 pa
Māori Males (MM)	$11,167 pa	$9,516 pa	$13,737 pa	$11,040 pa
All Females (AF)	$7,975 pa	$7,282 pa	$8,982 pa	$7,894 pa
Non-Māori Females (NF)	$7,882 pa	$7,221 pa	$8,831 pa	$7,802 pa
Māori Females (MF)	$9,868 pa	$8,572 pa	$11,895 pa	$9,756 pa

These figures could also be recast as the purchase price required for a given level of pension. The results would show that for the same pension, someone classified as having higher longevity would pay a higher price than someone classified as having lower longevity.

Although the pension for a purchase price of $100,000 may not seem to give a great deal of income, in the context that incomes as shown in the 2004 Household Expenditure Survey (Statistics NZ, 2004) have a median value for the 65 and over of only $780 pa excluding New Zealand Superannuation, then even a more modest purchase price applied to purchase a pension could have a dramatic effect on retirement income.

It will be noted from table 2 that the higher mortality of Māori lives, as reported in NZLT 2000-2002, consistently gives rise to a higher pension than for non-Māori mortality, as one would expect. The difference between all population and non-Māori is small, reflecting the small number of older Māori currently in the population.

Secondly, assuming lower or higher mortality has a marked effect on the pension afforded. A male who could be taken as having life expectancy some 3 years less than the population average should expect to start with broadly $1,500 pa more,

whereas a male whose expectation is 3 years better than the average should start with broadly $1,000 less.

Finally, the effect of assumed cohort improvement is not high – about 1% less in all cases. This reflects that at age 65, the bulk of payments will occur before the improvement starts to show up significantly. However, the principle that improvement should be allowed for is important, as it ensures that adequate provision is made for those who do, in fact, live longer than the average.

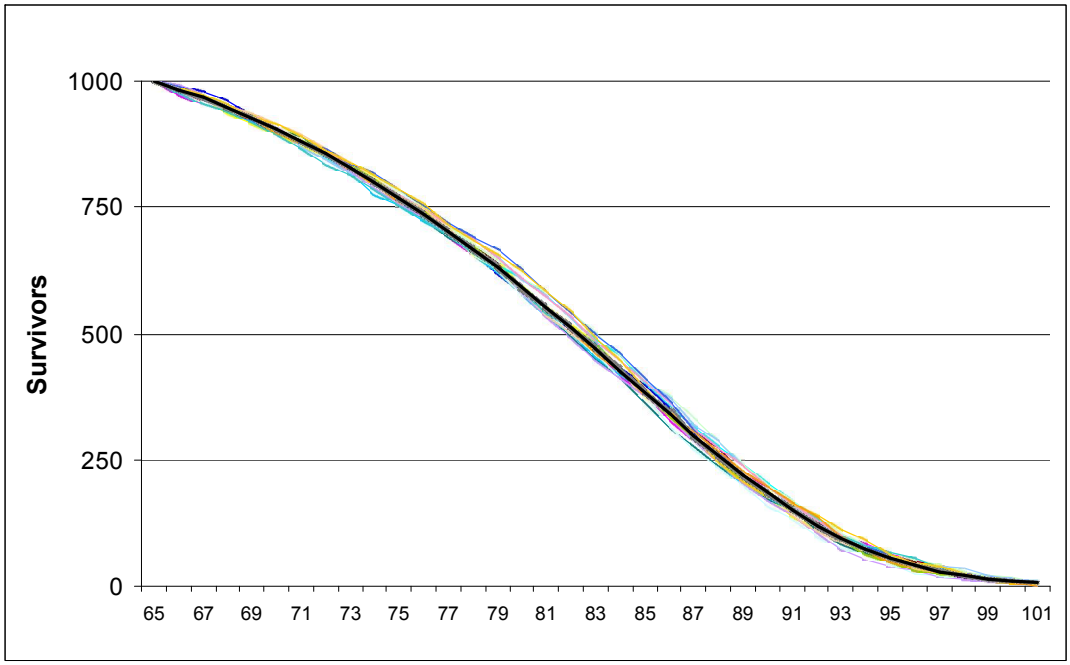
The next two sections examine firstly the homogeneous mortality case, to explore the effects of random fluctuations, and secondly the heterogeneous mortality case, to explore the effects of incorrectly assuming homogeneity.

Homogeneous case

Assuming firstly that all participants are appropriately underwritten and allocated to homogeneous risk groups, the question becomes how much variation might one expect from random fluctuations in mortality outcomes.

Clearly the number of participants is the dominant factor. Focusing on the AM group, figure 4 below shows the result of 20 stochastic simulations of the experience of 1,000 new entrants aged 65.

Figure 4 Fund participants by age, 20 simulations of 1000 entrants, table AM(C)



By age 90, on average less than 200 of the original starters remain, and less than 60 by age 95. While the variation from the average (shown as the heavy line) does not appear high, it is of course more significant as overall numbers drop, as table 3 below indicates. This shows the dispersion from the simulations according to

survivors at specific ages, and demonstrates how dispersion measured as a percentage of the average widens as age increases.

Table 3 **Dispersion of simulation results: participant numbers at selected ages from 1,000 entrants at age 65, 20 simulations**

Age	80	85	90	95
Average	594	386	185	56
Highest	627	410	204	67
Lowest	579	360	159	40
Highest, % of average	105.6%	106.2%	110.4%	119.7%
Lowest, % of average	97.5%	93.7%	86.0%	71.5%

The progress of the asset share under re-pricing – that is, each participant's notional share of the fund – at the same ages of 80, 85, 90 and 95 is shown in figure 5 below. The downward trend in the average (the heavy line) shows that asset shares will decrease but, in the light of the original $100,000 purchase, shows also that value in nominal terms persists for some time. There is however an appreciable increase in the relative volatility of the outcomes as age increases, particularly after age 90.

Figure 5 **Asset shares under re-pricing at ages 80, 85, 90 and 95, 20 simulations of 1000 entrants, table AM(C)**

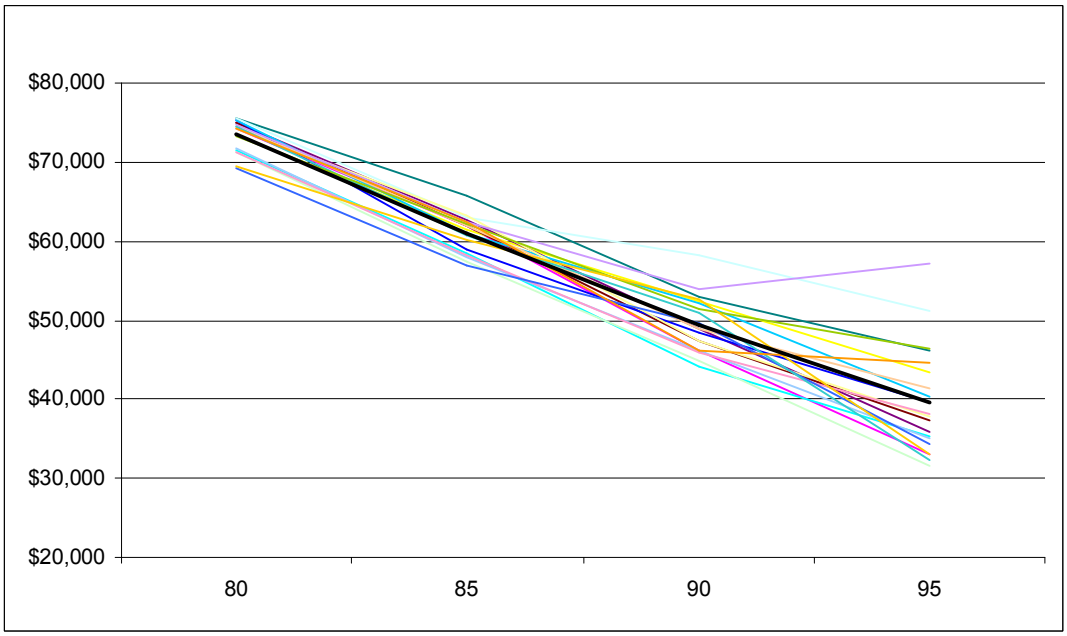
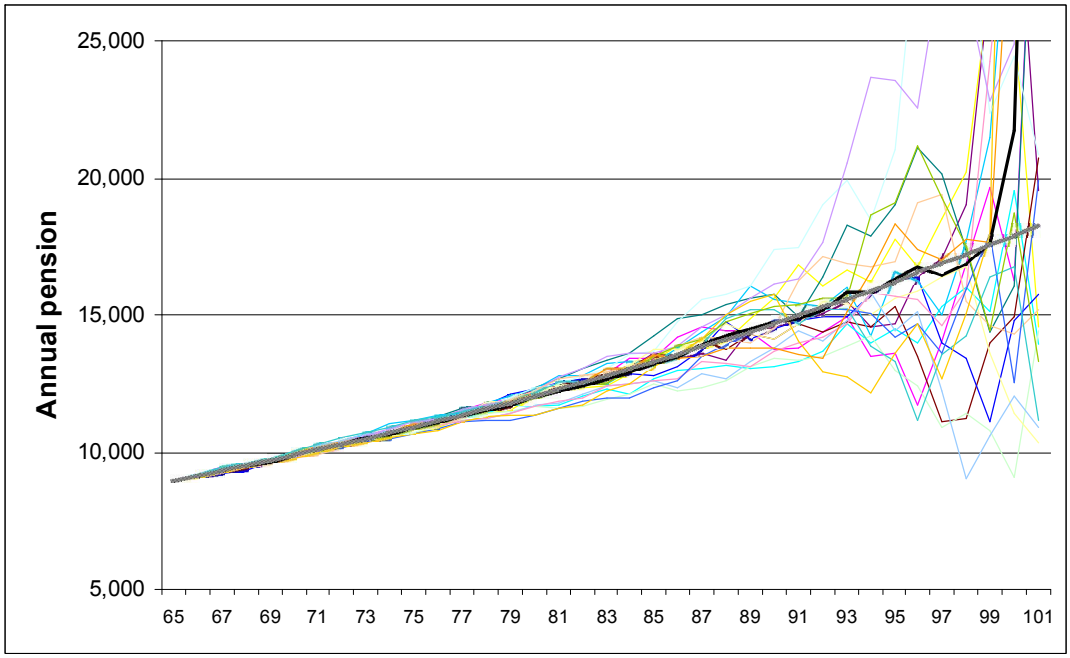


Figure 6 below shows simulations of the amount of pension payable each year.

Figure 6 **Pension amounts by attained age, 20 simulations of 1000 entrants, table AM(C)**



There is a reasonable degree of closeness of outcome over the first 10-15 years, but then results become more variable as the number of survivors fall. After 25 years, from age 90, results become quite variable. In this example no pension actually falls until around age 87, but around half have increases less than the assumed inflation rate.

The heavy black line shows the average over the simulations, and the heavy grey line the expected result. In this example it will be seen that over these 20 simulations the average is close to the expected until very near the end, after age 98.

Heterogeneous case

Assuming cohorts entering an annuitised fund established on the basis of an assumed mortality probability as above, what are the implications for people who may be assessed as having materially higher or lower longevity prospects?

Consider first the case where a prospective participant has materially better longevity prospects than the other participants. If they were instead participating in a fund with people of the same mortality characteristics as themselves, their pension would be lower for the same investment because pensions would, on average, have to be paid for longer. So by participating in a fund with pricing based on higher mortality, they will get a higher pension, at least initially.

The converse case is where a prospective participant has materially poorer longevity prospects. In this instance, participating in a fund where the pricing is based on

everyone having higher longevity, they will get a lower initial pension than they would if the pricing was based on their own expected longevity.

To explore this further, the simulation runs have been carried out using mixed mortality and results compared with uniform mortality.

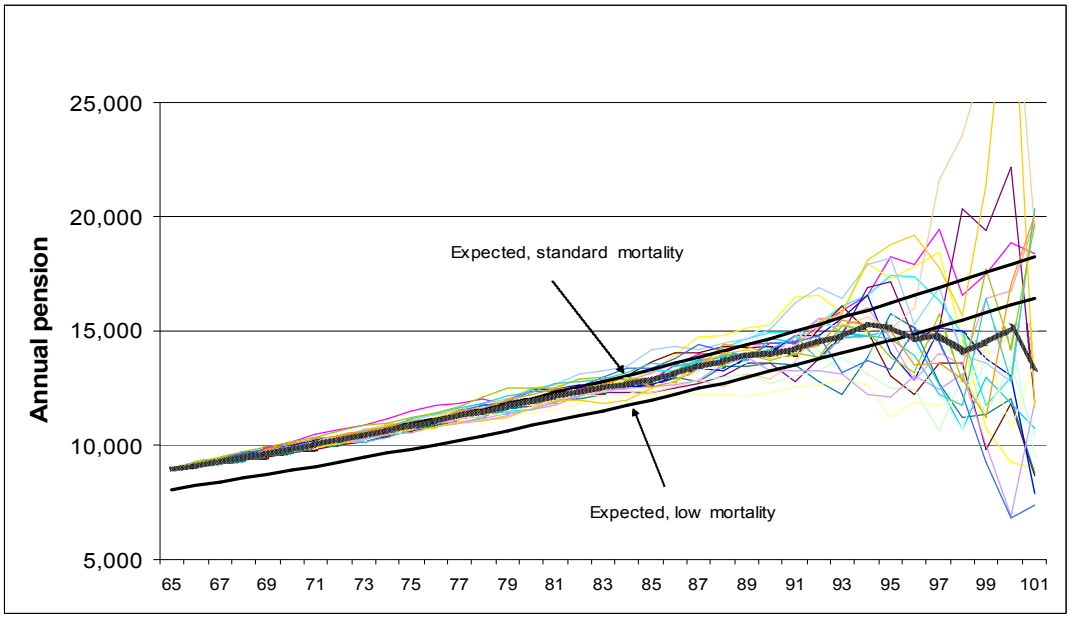
Figure 7 below shows the results of 20 runs under the re-pricing approach of 1000 lives where it is assumed:

- 90% have the assumed AM(C) mortality, on which pricing and re-pricing is based;
- 10% have lower mortality (higher longevity) as per AM(L).

It will be seen that results initially do not depart greatly from that expected assuming all were AM(C). However, after 5-10 years the average starts to fall, reflecting the presence of some low mortality participants who, as a result of not dying as quickly as the assumed AM(C) group, cause asset shares to fall (since there are more survivors amongst whom the fund must be shared) and consequently lower pension amounts declared.

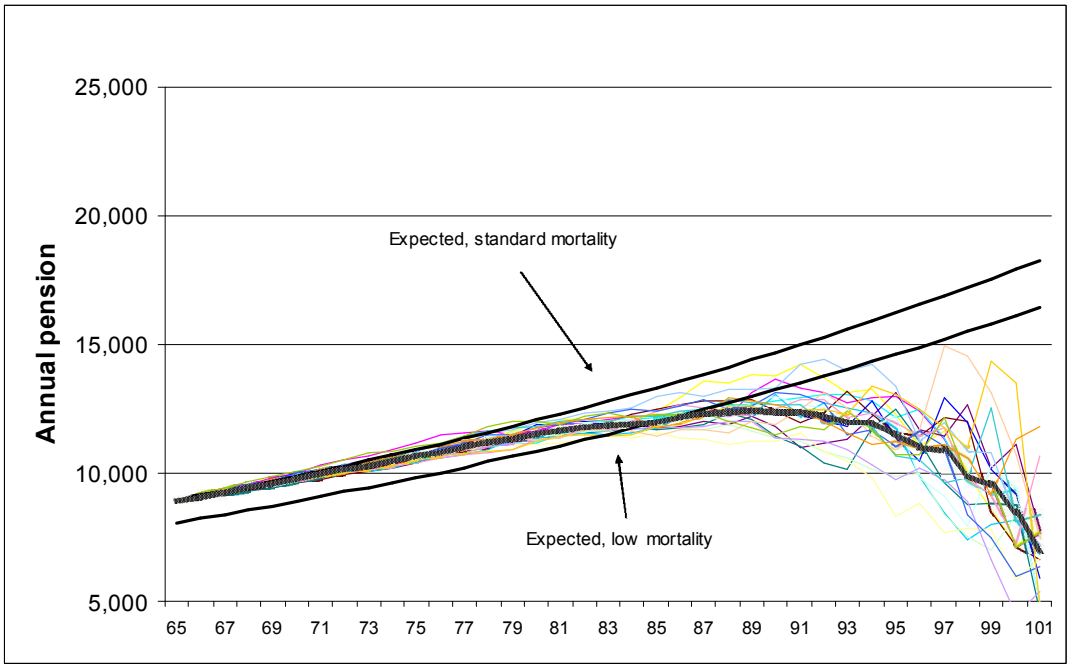
It still takes some 30 years in this simulation for the average pension to fall to the level the low mortality participants would have had if pricing had been on their mortality from outset, indicating the extent it will be to the advantage of low mortality groups to "infiltrate" higher mortality groups. Note also that eventually the average falls even below the expected level for lower mortality pricing; this is because the higher mortality pricing gives too high a pension and erodes the fund.

Figure 7 **Pension amounts by attained age, 20 simulations of 1000 entrants, table AM(C) mixed with 10% low mortality**



The effect is more pronounced with a higher proportion of low mortality participants included in a groups with a higher mortality pricing basis. Figure 8 below shows the results where 30% of the initial participants are assumed to have lower mortality.

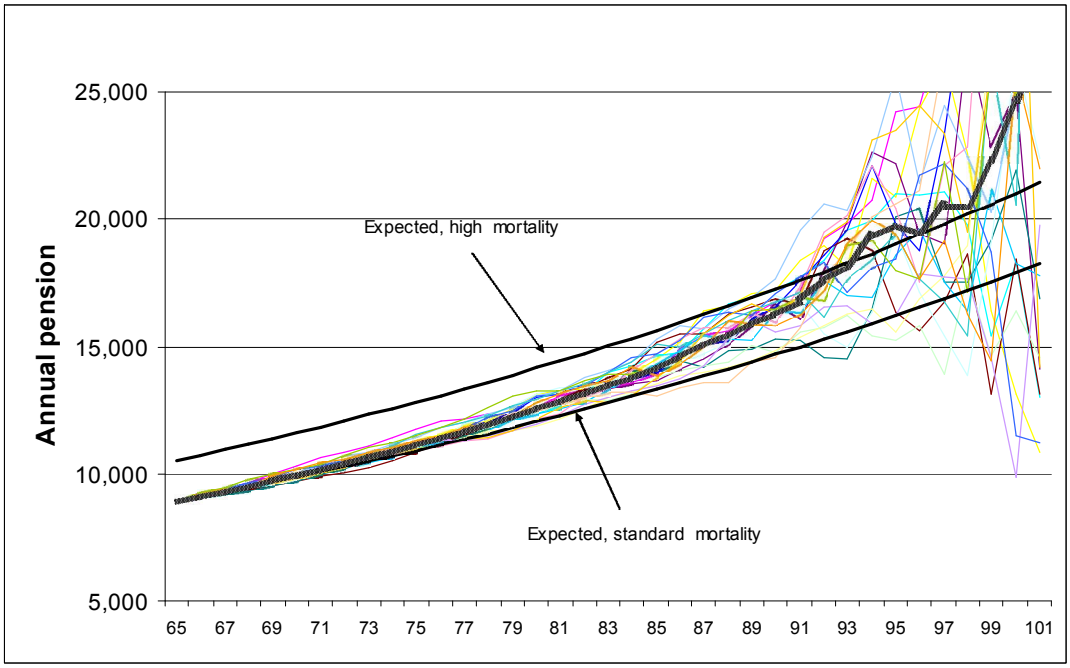
Figure 8 **Pension amounts by attained age, 20 simulations of 1000 entrants, table AM(C) mixed with 30% low mortality**



Here the effect of over-provisioning – that is, re-pricing on the basis of mortality higher than would be expected by 30% of participants – is rather more marked, with the average falling faster. Note that the low mortality group still benefit from participating, but will suffer erosion of the size of their pensions from age 85 unless the mortality pricing assumption is changed.

Turning to the other example, when the minority participants have high mortality and hence lower longevity than the standard assumed for the operation of the fund, the results with a 10% high mortality group is set out in figure 9 below.

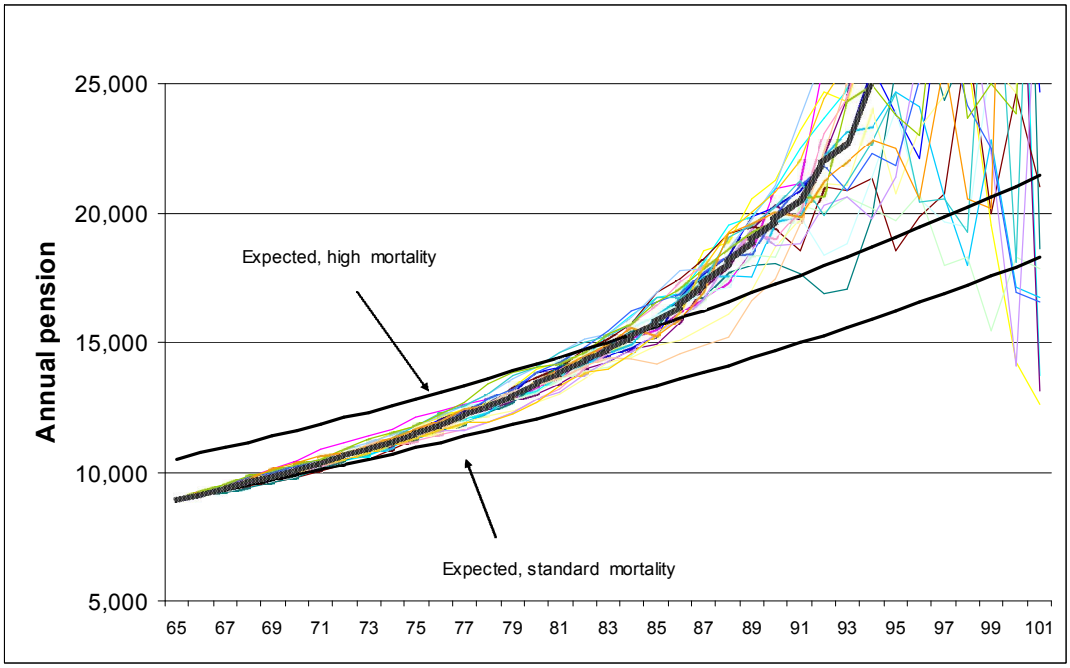
Figure 9 **Pension amounts by attained age, 20 simulations of 1000 entrants, table AM(C) mixed with 10% high mortality**



In this case, the pension levels are only a little better than expected in the initial period, but after 10 years the effect of having more people than expected die causes the available funds to increase and higher pensions to become payable. The profits are eventually such, in this simulation, that survivors at the end receive pensions commensurate with what would have been payable under the high mortality assumption. Note however that actual high mortality participants will have had lower pensions than they would have expected for nearly 20 years.

Figure 10 below repeats the above with 30% of participants having higher mortality than the assumed standard.

Figure 10 Pension amounts by attained age, 20 simulations of 1000 entrants, table AM(C) mixed with 30% high mortality



Unsurprisingly, the impact of having a larger group of participants with higher mortality than assumed for the pricing leads to pension levels rising rather more sharply. The period for which the higher mortality participants receive less than actuarially fair pensions is reduced to 15 years, but the actual numbers surviving past that time will of course be relatively few.

What conclusions may be drawn from the simulation exercise?

Firstly, the likely variability of outcomes is demonstrated with as many as 1000 initial participants in a risk cohort, even assuming all participants have homogeneous risk, just through random fluctuations. Secondly, it shows how heterogeneity in risk will be likely to lead to what may well be perceived to be unfair results. This second point emphasises the results reported in some of the literature, that annuitisation which does not reflect reasonable perceptions of one's mortality risk will be seen as unfair and hence not utilised.

Random fluctuations may require some form of stop loss insurance, if participant numbers are low; and in any case, once ages move beyond 90 or later, it may be desirable to cancel the annuitised funds and distribute the asset shares, rather than run the risk of tontine-like results. Whether this could be tied to provision of long term care may be worth investigating.

The second point can only be dealt with satisfactorily by some form of risk classification. This could be reasonably broad, eg average, above average, below average, since there is a trade-off between finer subdivision and administrative

complexity. The basis on which one could in practice classify risk would need to be considered carefully; the approach taken for some forms of car insurance, where a number of factors are assessed and a weighted result used to determine the risk classification, may be appropriate. In the New Zealand context, this might allow one to concentrate on socio-economic and life experience factors rather than ethnic differences.

Summary

In this paper the importance of methods of providing wealth management facilities in retirement in conjunction with longevity insurance to provide assured income have been discussed. The drawbacks of draw down mechanisms, which do not include longevity insurance, have been demonstrated; these include economic inefficiency in terms of the mechanism itself, as well as high transaction costs and other risks.

On the other hand, the drawbacks discussed here of the traditional form of longevity insurance, the life insurance office annuity, are considerable both in relation to supply and to demand. Pension provision through occupational schemes is in long term decline, and is not high in any case. There is therefore a strong argument for asserting market failure has occurred in the provision of longevity insurance.

This failure looks to become more acute with the increased numbers approaching retirement, and the continued decay of pension provision through defined benefit occupational superannuation schemes.

How important is this failure? I am indebted to a reader of an earlier draft of this paper, Andrei Andreianov, for the following schematic which summarises the differences between draw down and longevity insurance in terms of where interests may lie.

Table 4 Contrast of longevity insurance and drawdown

	Early death	Prolonged life
Longevity insurance	Benefit goes to other participants in the insured pool	Participant benefits through maintained income
Draw down	Benefit goes to the heirs	Family or children needed to provide support

This demonstrates that maintenance of an assured level of income (or equivalent goods and services) is possible under draw down if there is an effective contract between the retired person and their heirs that, on early death, the heirs benefit through a bequest; but if life is prolonged, the heirs are obliged to find resources to

continue support. Effectively, the heirs are taking on the longevity risk in an informal (and legally unenforceable) fashion[14].

For those however for whom such a contract is not possible, or appears too risky, the absence of a functional longevity insurance market would seem an important issue. In its absence, they are unable to make the most efficient use of their savings. For some, this may lead them to question the usefulness of making savings, and could lead to significant pressure for Government to increase New Zealand Superannuation to a higher level, or to underwrite earnings-related pensions as occurs in many other OECD countries

The option of the annuitised fund, becoming an increased subject of interest in the actuarial literature, is put forward here as having many features which make it a suitable mechanism for delivering effective asset management in conjunction with longevity insurance. For annuitised funds to become practicable, however, certain forms of government intervention will be necessary.

The interventions proposed include or imply:

- investigating an appropriate basis of risk classification to enable the setting of differential mortality for population sub-groups, under the appropriate constraints given by the Human Rights Act
- an agency established to
    - set, on an annual basis, appropriate mortality tables in accordance with the determined risk classification basis
    - accept initial lump sums from participants and calculate and pay pensions
    - carry out other administration functions such as processing applications for withdrawal, winding up of cohorts, etc
    - calculate variations in experience and determine, in accordance with agreed guidelines, whether a contribution is required to support a fund or whether there is an excess in the fund which may be transferred to Government, in terms of the stop loss agreement
- regulation of out-sourced administration and investment services provided by the private sector to ensure that a high level of trust and confidence is created.

The Demography Unit of Statistics NZ would be the logical source of the technical advice required. The office of the Government Actuary would appear the most

[14] Pigott et al (2004) refer to a paper by Hayashi, F., Altonji, J, and Kotlikoff, L. 1996: "*Risk-sharing between and within families*", Econometrica 64:261-294, that shows risk-sharing through transfers is limited even within families.

appropriate for regulation, utilising powers similar to those that it presently has for supervising defined benefit superannuation schemes. The importance of strict regulation and firm operational rules is emphasised, since trust is a vital ingredient if ordinary consumers are to make use of sophisticated financial services.

As well as the importance of appropriate mortality risk classification for annuitised funds, the paper illustrates the financial implications of differential mortality in the population at large. A policy implication here is that there is arguably some lack of equity in a fixed age of eligibility for New Zealand Superannuation. In the light of recent comment as to the possibility of raising the age of eligibility consequent on average improvements in longevity[15], it may be that differential mortality considerations should be extended to set different eligibility ages for New Zealand Superannuation according to risk classification of individuals.

What else?

There are a significant number of "matters arising" in respect of the material covered in this paper. An important omission is a discussion of the longevity pooling effect that couples can provide each other, referred to in the literature. As noted at the beginning of the paper, consideration of the individual case allows the principles to be established, and that has been the focus here. Nonetheless, it would be useful to discuss how couples could be treated within the annuitised fund arrangement and then extend the simulations to that case.

The role that home equity release could play in annuitised fund development has not been discussed. The extent to which residential property might be an asset class of an annuitised fund is a worthy subject for consideration.

The difficult issue of whether or not one would wish to distinguish between male and female mortality, and how one would do that, has also been sidestepped here. In some respects it can be described as "the elephant in the room" in this context, as many writers on the economics of annuities do not explore the social implications of the statistically observed mortality difference. Any movement towards practical solutions does however have to take it into account, but I suggest it is a topic in its own right.

Finally, the question of replacement rates – that is, target ratios of income pre-retirement to income post-retirement – was touched on at the beginning. As noted, living arrangements and housing situation are two aspects that prevent simplistic

[15] See for example Treasury (2006a) where changes to the eligibility age for New Zealand Superannuation are discussed in the context of improving longevity.

approaches being useful. Further investigation would however appear a fruitful area of research.

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