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Financing New Zealand Superannuation

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Abstract

The New Zealand Superannuation Fund is being established as a means of smoothing out the impact on the rest of the Crown's finances of the transition that will take place over the next fifty years to a permanently higher proportion of the population being eligible for New Zealand Superannuation, the universal pension paid to New Zealanders over the age of 65. This paper discusses the financial issues surrounding the determination of the contributions that the Government would be required to make to the Fund over time in order to meet this objective. The calculation of the required contribution rate is derived as a function of future expected entitlement payments, future expected nominal GDP, future expected investment returns, and the Fund balance. Estimation issues are discussed and the implications of volatility in investment returns are examined. Some issues in assessing long-term expected returns are addressed in an appendix.

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Introduction

The New Zealand Superannuation Fund is being established as a means of smoothing out the impact on the rest of the Crown's finances of the transition that will take place over the next fifty years to a permanently higher proportion of the population eligible for New Zealand Superannuation. This paper discusses the financial issues surrounding the determination of the contributions that the Government would be required to make to the Fund over time in order to meet this objective.

The next section provides an overview of the policy underlying the establishment of the Fund. This is to set the scene for the subsequent sections that address the calculation of the contribution rate and its practical estimation. An appendix to this paper summarizes the range of approaches taken and views put forward regarding the levels of returns to expect from financial markets in the long-term. Frances and McCulloch (2001) provides a more general and detailed description and analysis of the whole policy underlying the establishment of the Fund.

Pre-Funding New Zealand Superannuation: Policy Overview

Like that of many countries, New Zealand's population is ageing. Figure 1 illustrates how the proportion of the population over the age of sixty-five is expected to increase from 12% to 27% over the next fifty years. This is partly due to the 'baby boom' generation passing through life, but the increase also reflects the effects of increasing longevity, falling fertility and later child-bearing. As a result, it is expected that this will be a permanent shift to an older population structure. A related feature of the demographics is that the working age population falls from 65% to 59% over this time period.[1] So, loosely speaking, while there are about five workers per retiree now, there will be about two workers per retiree by 2050. The implied dependency ratio is not without historical precedent. The total dependency ratio ([retired + youth]/working-age) increases from 50% now to 70% by 2050, which is about the same as it was in the 1950s when the youth

[1] "Working age" is defined for this analysis as ages 15 to 64 to be consistent with typical international analyses. Other age ranges give a similar overall picture.

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population included the baby boomers. The difference is that the forthcoming increase appears to be a permanent change in the population age structure, rather than a transitory peak.

New Zealand Superannuation is a universal pension paid to all eligible New Zealanders over the age of sixty-five. The level of payment is based on the national average earnings level and is not subject to individual means-testing.[2] Figure 2 shows the expected track of New Zealand Superannuation payments, under current policy, as a proportion of New Zealand nominal Gross Domestic Product (GDP).[3] Reflecting these demographic changes, it increases from around 4% now to over 9% by 2050. The purpose of establishing the New Zealand Superannuation Fund is to help the Crown's finances to adjust to this permanently higher proportion of national income that is expected to be devoted to New Zealand Superannuation payments. The Government would be required to make contributions each year to a Fund managed on a commercial basis by an independent board. For the first few decades, the contributions would need to be enough to cover the annual cost of New Zealand Superannuation, along with an additional annual capital contribution to build up the Fund to help finance the transition to the higher future cost of New Zealand Superannuation. This is illustrated in Figure 3.

The level of required contribution for the next year would be calculated annually by the Treasury during the Budget process, following the legislated formula, which is examined further below. In the normal course of events, this would be the amount the Government would actually contribute to the Fund in the following year. Like the Government's fiscal objectives regarding debt levels and the operating surplus, the required contribution rate becomes another constraint on Budget decision-making. In the same way that any departures from the fiscal objectives are subject to the transparency provisions of the Fiscal Responsibility Act 1994, failure to meet the required contributions to the New Zealand Superannuation Fund will require full public disclosure and explanation. The analyses underlying the 2000 and 2001 Budgets indicated that the fiscal objectives would continue to be met for the foreseeable future after the introduction of the Fund.

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[2] Although it is not subject to means-testing of individuals, the payment rate does vary slightly, depending on individual domestic arrangements (married, single living alone, single sharing accommodation). Further, the payments are treated as taxable income so are taxed according to the progressive income tax scale. Additional means-tested benefits are provided, but these are generally not age-related and they are not financed through the Fund.

[3] The GDP projections referred to throughout this paper are on a nominal basis. The illustrations use projections of GDP extracted from the Treasury's Long-Term Fiscal Model. Woods (2000) describes the methodology underlying the projections.

Calculation of the Annual Contribution Rate

The smoothing algorithm stated in the legislation for the rate of contribution to the Fund is to annually set the required contribution for the next year at the level that, if that same proportion of forecast nominal GDP was made to the Fund each year for the succeeding forty years, the Fund balance plus accumulated returns would be expected to be sufficient to meet entitlement payments over those forty years.[4]

When the rate is reviewed each year, the same calculation would apply, but the forecasts of entitlements and GDP would roll along to reflect the moving time horizon (with any adjustments required to reflect changes in expectations about future GDP, entitlement payments and Fund returns), and the fund balance is updated to reflect actual investment performance over the past year. So, if we seek to calculate what the required contribution rate is expected to be in *j* years' time, it is necessary to solve the following equation for k_j:

$$E_0\left[B_{j-1}\prod_{t=1}^{H}(1+r_{j+t-1})+\sum_{t=1}^{H}k_jG_{j+t-1}(1+f_{j+t-1})\prod_{i=t+1}^{H}(1+r_{j+i-1})-\sum_{t=1}^{H}P_{j+t-1}(1+g_{j+t-1})\prod_{i=t+1}^{H}(1+r_{j+i-1})\right]=0 \quad (1)$$

where

$E_0[\ldots]$ = expected value given information available at the beginning of year 1.

B_{j-1} = Fund balance at the beginning of year *j*.

H = time horizon for the calculation. This is set at forty years.

r_t = rate of return on the Fund in year *t*.

k_j = contribution rate as a proportion of GDP.

G_t = nominal GDP for year *t*.

P_t = forecast entitlement payments in year *t*.

g_t = annualised return on the Fund in year *t* to reflect the fact that entitlement payments are made in fortnightly instalments. If it is assumed that expected returns accrue evenly over the year, then:

$$(1+g_t)=\frac{1}{26}\sum_{i=0}^{25}(1+r_t)^{i/26} = r_t \Big/ 26\left((1+r_t)^{1/26}-1\right)$$

f_t = annualised return on the Fund in year *t* to reflect the pattern in which contributions are received by the Fund during the year. If (as currently anticipated) contributions are made in fortnightly instalments in line with entitlement payments, then $f_t = g_t$.

[4] The use of forty years in the legislation is essentially arbitrary. The choice affects the extent to which the funding of entitlement payments is smoothed over time (see Figure 4). At its limits, a time horizon of one year would be equivalent to continuing the existing pay-as-you-go scheme and no Fund would build up, while an infinite time horizon would result in a constant contribution rate approaching 7% of GDP.

In words, Equation *(1)* specifies that, for the contribution rate that is expected to apply to year j (k_j), the expected value of:

- the opening Fund balance at the start of year j (end of year j-1), with returns compounded over the time horizon: $B_{j-1}\prod_{t=1}^{H}\left(1+r_{j+t-1}\right)$;

plus

- the contribution receipts in each year of the time horizon (H years starting from year j) at a constant contribution rate of k_j, taking into account the within-year payment pattern and compounded for the remainder of the time horizon: $\sum_{t=1}^{H}k_j G_{j+t-1}\left(1+f_{j+t-1}\right)\prod_{i=t+1}^{H}\left(1+r_{j+i-1}\right)$

minus

- the entitlement payments in each year of that time horizon, taking into account the within-year disbursement pattern and compounded for the remainder of the time horizon: $\sum_{t=1}^{H}P_{j+t-1}\left(1+g_{j+t-1}\right)\prod_{i=t+1}^{H}\left(1+r_{j+i-1}\right)$

equals zero.

The estimated level of the total contribution in year j would be k_jG_j and the Fund would be meeting P_j in entitlement payments, so the estimated required capital contribution (or withdrawal, if negative) would be equal to k_jG_j *minus* P_j.

Assumptions

Two main assumptions are required in order to solve Equation *(1)* to give an expression for the expected value of k_j:

- Future GDP and future entitlement payments are both uncorrelated with returns on the Fund.
- Returns on the Fund are serially uncorrelated.

Neither of these assumptions needs to hold perfectly in order to solve Equation *(1)*. However, the discussion of each below indicates that they are at least approximately true.

Expected returns not correlated with GDP and demographics

First, future GDP and future entitlement payments (that is, the series for which G_t and P_t are the expected values) are both assumed to be uncorrelated with the returns on the Fund (r_t). Consider first the relation between GDP and returns on the Fund. The returns on the Fund will be driven by world capital market returns. While New Zealand GDP is clearly not independent of the global economy, there is no obvious relation between world annual capital market returns and the level of New Zealand's annual GDP that would give rise to a material statistical correlation (neither contemporaneaous nor lagged). Such a correlation would only arise if the product of unexpected world returns (that is, the deviation from expected returns for a year) and unexpected New Zealand GDP (that is, the deviation from expected GDP for a year) is expected to be significantly different from zero. This is not observed empirically, as indicated by the poor performance of such macroeconomic variables in multifactor asset pricing models (Chan, Karceski & Lakonishok, 1998).[5]

Turning to future entitlement payments, these are a function of national average earnings (which are closely related to GDP and hence not expected to give rise to a correlation for the same reason as above) and the size of the population entitled to receive New Zealand Superannuation. There is some debate as to whether capital market returns are affected by changes in population age structure (for example, see Brooks, 2000). However, to the extent that such relationships are predictable, it would be reasonable to believe that market *expected* returns would reflect this. Accordingly, a significant correlation (which relates to *unexpected* movements) between these variables would not be expected.

The projections of future GDP and future entitlement payments (that is, the series of G_t and P_t) are assumed to be the expected values of these variables.[6]

Fund returns are serially uncorrelated

Second, it is assumed that returns on the Fund are serially uncorrelated (that is, that the unexpected return in one year is independent of the rates of return realised in prior years). This is a standard market efficiency assumption.[7]

[5] Further, note that GDP (as opposed to Gross *National* Product, GNP) reflects domestic production and does not include returns on overseas investment by New Zealanders.
[6] Although the forecasts that are used are intended to be central estimates, the actual distributions of these variables are unknown. Their estimation is discussed below.
[7] It is easy to show that markets cannot be entirely efficient in equilibrium (for example, see Shiller, 1984) and there is some evidence of autocorrelation in returns (Poterba and Summers, 1988). However, the pertinent assumption being made in this paper of random-walk price behaviour cannot be rejected at conventional statistical significance levels.

Solution

Given the above assumptions, Equation *(1)* can be solved for $E_0[k_j]$ as follows:

$$E_0\left[k_j\right]=\frac{\sum_{t=1}^{H} P_{j+t-1}\left(1+n_{j+t-1}\right)\prod_{i=1}^{t}\left(1+m_{i+j-1}\right)^{-1}-E_0\left[B_{j-1}\right]}{\sum_{t=1}^{H} G_{j+t-1}\left(1+w_{j+t-1}\right)\prod_{i=1}^{t}\left(1+m_{i+j-1}\right)^{-1}} \qquad (2)$$

where

m_t = $E_0[r_t]$, the expected annual rate of return on the Fund in year t.

n_t = $E_0[g_t]$. Entitlement payments are made in fortnightly instalments so, assuming that $(1+r_t)$ is distributed lognormally[8] with mean $(1+m_t)$ and variance s_t^2:

$$\left(1+n_t\right)=\frac{1}{26}\sum_{i=0}^{25}\left[\left(1+m_t\right)^{i/26}\left(1+\frac{s_t^{\,2}}{\left(1+m_t\right)^2}\right)^{\frac{1}{2}\left(\left(i/26\right)^2-1\right)}\right].$$

w_t = $E_0[f_t]$. If contributions are received fortnightly, then $w_t=n_t$.

$E_0[B_{j-1}]$ = the Fund balance that is expected (as at the end of year *0*) for the beginning of year j.

$$E_0\left[B_{j-1}\right]=B_0\prod_{t=1}^{j-1}\left(1+m_t\right)+\sum_{t=1}^{j-1}A_t\left(1+w_t\right)\prod_{i=t+1}^{j-1}\left(1+m_i\right)-\sum_{t=1}^{j-1}P_t\left(1+n_t\right)\prod_{i=t+1}^{j-1}\left(1+m_i\right) \qquad (3)$$

where

A_t = the actual contributions expected (as at the end of year *0*) to be made in year t.

In the normal course of events, A_t would equal k_tG_t. However, it may be anticipated that, in some years, there will be deviations from the required contribution level. For example, there might be additional capital contributions, or other fiscal priorities might require a lower contribution level, or the Government might establish policies that prescribe minimum and/or maximum levels for the contribution to the Fund. To the extent that these are predictable at year *0*, A_t would differ from k_tG_t.

Equation *(2)* can be described in words as the present value of entitlement payments over the time horizon minus the opening Fund balance, all divided by the present value of GDP over the time horizon, with discounting of entitlements and GDP being at the expected

[8] The assumption that $(1+r_t)$ is lognormally distributed is based on the central limit theorem and the independence of daily returns.

rate of return on the Fund.[9]

Application

The level of contribution to be made to the Fund would be required to be recalculated each year. So, each year, Equation *(2)* is to be calculated with *j=1*:

$$k_1 = \frac{\sum_{t=1}^{H} P_t (1+n_t) \prod_{i=1}^{t} (1+m_i)^{-1} - B_0}{\sum_{t=1}^{H} G_t (1+w_t) \prod_{i=1}^{t} (1+m_i)^{-1}} \qquad (4)$$

The Treasury would be required to report the amount of the required annual capital contribution for the next year (that is, the amount $k_1 G_1$ *minus* P_1) in the Budget Economic and Fiscal Update that is required to be produced under the Fiscal Responsibility Act 1994 at the time of the Budget (that is, immediately before the start of the financial year).[10]

In addition, it is useful for fiscal planning to make projections of future contribution rates, using Equation *(2)* with *j>1*. However, these are simply projections given current expectations about entitlement payments, GDP, and Fund investment returns. They do not determine future contribution levels beyond the one year and, like any projections involving uncertainty, there would be widening confidence intervals around the expected levels as the projection period increases to reflect the uncertainty surrounding future levels of GDP, entitlement payments and Fund returns. Projections of the Fund balance (based on Equation *(3)*) are also subject to uncertainty regarding future contribution rates, entitlement payment levels and Fund returns. The effects of uncertainty on the projections of contribution rates and Fund balance are analysed further in the next section.

[9] The use of the expected return on the Fund for discounting the projected entitlement payments and projected GDP is a mathematical result of deriving Equation *(2)* from Equation *(1)*. It is therefore appropriate for this rate calculation. However, this does not imply that it would be appropriate to use the Fund's expected rate of return to value the projected entitlement and projected GDP cashflow streams individually. In that case, the discount rates chosen should reflect the risks inherent in those cashflow streams, independently of the investment strategy adopted for the Fund.

[10] In practice, the time line for preparation of the Budget would require the calculation to be carried out, and the contribution level finalised, two or three months before the start of the year. The opening Fund balance (B_0) will not be known with certainty at that time, but it ought to be able to be estimated with reasonable accuracy from the year-to-date results and short-term forecasts of returns for the remainder of the year.

Estimation

Estimation of future contribution levels requires long-term forecasts of future nominal GDP, entitlement payments and Fund returns. The assessment of the required capital contribution for the next year that the Treasury would be required to state in the Budget Economic and Fiscal Update requires forty-year projected series of each of these variables. If projections of future contribution levels are to be made, even longer series are required. For example, to project contribution levels over the next sixty years requires one hundred year projected series of GDP, entitlement payments and Fund returns. Such long-dated projections, even the forty years needed just to determine next year's contribution level, require bold assumptions to be made. However, the fact that the contribution level is routinely reassessed each year means that the actual contribution levels will continually adjust to reflect changes in expectations about the long-term future.

GDP

Projections of future GDP are made routinely by the Treasury as part of the Budget process (Woods, 2000). The Budget Economic and Fiscal Update prepared by the Treasury includes detailed forecasts for the next four years. The Budget Fiscal Strategy Report produced for the Government extends the assumptions to produce ten-year "progress outlooks" and indicative fifty-year "scenarios", in which nominal GDP is assumed to grow in line with labour productivity, projected changes in the labour force, and inflation. For projections beyond the fifty years, the fifty-year assumptions are assumed to continue. The projections of GDP are made as central estimates.[11]

Entitlement Payments

Total annual payments of New Zealand Superannuation are influenced by demographic trends and nominal wage levels. The demographic trends are based on Statistics New Zealand population projections with medium fertility, medium mortality and net migration of 5,000 per year. The demographic projections span one hundred years. Nominal wage levels are projected as a function of labour productivity and inflation. The demographic and wage level assumptions used are the same as those adopted throughout the Budget

[11] The 2000 Budget Fiscal Strategy Report also included some analyses using a scenario of lower annual growth in GDP.

(Woods, 2000).[12]

The projections are based on currently legislated policies for entitlement payments continuing into the future. The projections are therefore conditional on continuation of existing policy.[13] This is an unavoidable feature of Budget-related projections. While it is inconsistent with the dynamic nature of policy evolution over time, it has the advantage of making clear the implications for future government finances of continuing with existing policies, and it provides a basis for evaluating the implications of policy changes (for example, alternative entitlement parameters).

The contribution rate calculation is made as a proportion of GDP. As a result, the absolute levels of projected GDP and entitlement payments are not as critical as their relative levels. Since nominal wage growth is closely related to nominal GDP growth, changes in the relative levels of GDP and entitlement payments are driven primarily by demographic trends and, in particular, by the projected number of people eligible for New Zealand Superannuation. Since all of the people who will be eligible for New Zealand Superannuation over the next sixty-five years have already been born,[14] their numbers can be predicted relatively accurately.

Expected Fund Returns

The net returns obtained on the investment of the Fund balance will depend on the investment strategy adopted by the Board, long-term returns in the asset classes adopted, management expenses and income tax paid. These are discussed further below.

Investment Strategy and Long-Term Returns

The Board of the New Zealand Superannuation Fund would be required to “invest the

[12] Where a longer series of entitlement projections than 100 years is required (for example, to illustrate the path of future contribution rates beyond sixty years into the future), entitlement payments are presumed to become a constant proportion of GDP. Of course, in reality it will not be exactly constant. If nothing else, there would be some autoregressive ripples as the baby boomers’ offspring age. However, this is over a century away and a whole range of events could occur in the meantime so this assumption is as good as any.

[13] If the legislation provided for specific change over time (for example, to change the age of eligibility gradually over a number of future years), this would be treated as ‘existing policy’ (that is, the eligibility age would be assumed to follow the legislated track, rather than be assumed to stay at its current level). In this way, the effects of current policy decisions that affect future entitlement levels do feed immediately into current contribution levels.

[14] This is assuming that the eligibility age stays at 65. With life expectancy now in the mid-70s and increasing, most of the recipients of New Zealand Superannuation over the next century are already alive. If the eligibility age were to be raised, or if immigration were to increase markedly, the “now-alive” would be an even larger proportion of future recipients.

Fund on a prudent, commercial basis and, in doing so, must manage and administer the Fund in a manner consistent with best-practice portfolio management; and maximising return without undue risk to the Fund as a whole; and avoiding prejudice to New Zealand's reputation as a responsible member of the world community." (New Zealand Superannuation Bill, clause 58(2))

Given this mandate, and given the long-term nature of the Fund, it is reasonable to expect that the Board would establish an investment portfolio that is widely diversified across world capital markets. However, regardless of the actual investment strategy that is adopted, what levels of returns can be expected in world capital markets many decades out into the future is the subject of significant debate. Issues arise surrounding the relevance of past historical returns for predicting the future, the effects of evolution and innovation in capital markets, consistency between expectations about capital market returns and expectations about the rate of long-term economic growth, and the effects of the demographic changes on capital markets. These issues are discussed in more detail in the appendix to this paper. While the balance of opinion seems to be that long-term returns in world equity and bond markets will be somewhat lower than those experienced in the recent past, there is no general consensus about the levels of expected future returns more than a few years ahead. Private-sector forecasters rarely make projections of market returns more than ten years ahead and typically not much beyond five years.

Management Expenses

Management of the Fund's investments would involve management expenses that will reduce the net returns of the Fund and so need to be taken into account when projecting the required contribution levels. The levels and types of fees would depend on the investment strategy adopted and the management approach (for example, active versus passive management).

Tax

The Fund is subject to tax on its investment income.[15] This tax is paid to the Crown. This means that the Crown as a whole benefits from the gross investment returns (after management expenses) of the Fund, applying part of it (that is, the tax receipts from the Fund) to the rest of the Budget in the year the investment income is earned, and effectively reinvesting the remainder in the Fund until a capital withdrawal is made to help finance entitlement payments. As a result, any analysis of the implications of policies for the Crown as a whole (for example, the merits of alternative investment strategies for the Crown as a whole, or indeed the existence of the Fund at all) needs to take into account total returns (after management expenses), including tax receipts from the Fund.

Although the Crown as a whole benefits from the gross investment income, the Fund only retains the after-tax returns. This means that the contribution level required to finance New Zealand Superannuation through the Fund needs to be based on the after-tax returns of the Fund. The effective tax rate will depend on how different income sources are taxed (for example: dividends versus capital gains; and local income versus overseas income which may have been subject to taxation in another jurisdiction). This would be determined over time following the same law that applies to other taxpayers.

In the illustrations given below, the tax rate is assumed to be 33%, which is the current corporate tax rate in New Zealand, and it is assumed to apply in the year the returns are earned. Depending on the investment strategy adopted by the board, the average tax rate will most likely be less than this and there would be some deferral of tax to later years.

Results

Figure 3 illustrates the projected path of contributions to the Fund using the projections of New Zealand Superannuation from Figure 2 and assuming an internationally diversified portfolio for the Fund with an expected annual pre-tax nominal return of 9.1% after management fees.[16] This example should be treated as an illustration and not as a particular view about the long-term expected returns of the Fund.[17] The Board of the Fund will determine its investment policy, and there is also significant uncertainty regarding how market rates of return in the various asset classes will evolve in the long-term future. Nonetheless, this level of expected annual returns is within the ballpark of likely expected returns and it provides a characterisation of the effects of the Fund that

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[15] The Fund will be subject to the same tax rules as other investors. Should the tax regime change in the future, such changes would be expected to apply equally to the Fund.

[16] This is the average annual return. Assuming that returns are distributed lognormally, the expected compounded long-term return would be lower than this. For example, assuming an annual standard deviation of 6.75%, a 9.1% annual return implies an expected compound return over 40 years of 8.86% per year.

[17] Further, it is not necessary to assume that expected returns are stationary over time (μ_t in Equation *(2)* is a function of time so can vary). The expected return could be modelled as changing over time to reflect factors such as a yield curve or predictable changes in the Fund's asset allocation over time. However, the same general picture emerges.

applies across a wide range of levels of expected return.

Figure 5 illustrates the effect on the path of contribution rates if different assumptions are made about expected returns. If a lower [higher] expected annual rate of return was to be assumed, the total required contribution (k_j) line would shift up [down] slightly and its slope would be marginally lower [higher], but still converging eventually on the payments line. The cross-over from retaining capital contributions in the Fund to making capital withdrawals would occur slightly later [earlier].

Regardless of the assumption that is made about the level of expected returns, the path of total annual contributions to the Fund (that is, current year New Zealand Superannuation payments plus [minus] the retained capital contribution [capital withdrawal]) starts at a higher level than New Zealand Superannuation payments alone and it is upward-sloping.[18] Until the mid to late 2020s, there is a positive, but declining, annual capital contribution required to be retained to build up the Fund. After that time, the Fund starts to be drawn upon to help finance the annual cost of New Zealand Superannuation payments. Eventually, possibly sometime next century, the upward-sloping line converges on the path of New Zealand Superannuation payments as the Fund is drawn down to zero and the system reverts to pay-as-you go. This highlights the fact that this is not an ongoing pension scheme.[19] Rather, it is a financing mechanism designed to smooth out the effect of the cost of New Zealand Superannuation on the rest of the Crown's finances over time and, in particular, to ease the transition to a permanently higher level of expense.

The overall result from the existence of the Fund is that the transition to the higher long-term cost of New Zealand Superannuation is smoothed over time. Instead of more than doubling from current levels of around 4% of GDP to around 9% of GDP over the next fifty years, the Fund requires a higher start of around 6% of GDP which then only increases by a third to 8% of GDP in that time.

Effects of Uncertainty

Projections of future levels of contributions and of the size of the Fund over time rely on

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[18] It is upward-sloping because the rolling forty-year moving-average of New Zealand Superannuation payments steadily increases.

[19] While not infinitely lived, this Fund could last for over a century. If a fully perpetual fund was intended, it would be equivalent to setting the rolling horizon for this Fund infinitely large. This would have the effect of moving immediately to the long-run average cost of New Zealand Superannuation which, under current policy, would be in the region of 9% of GDP per year.

expectations about future GDP, future entitlements and future Fund returns. Sensible use of these projections requires some understanding of the uncertainty surrounding the expected values that are calculated. Over long projection horizons, this uncertainty would be substantial.

Projections of future New Zealand GDP and future New Zealand Superannuation entitlements do not have measures of volatility associated with them.[20] However, as noted above, the relative levels of these series are more important than their absolute levels. The relative levels are primarily determined by demographic trends in the relative size of the population eligible for New Zealand Superannuation. This can be predicted reasonably accurately over long periods. As a result, the focus of attention on uncertainty can be placed on the volatility of the other main variable that affects the projections: investment returns to the Fund.

Forecasting the volatility in annual investment returns many years into the future suffers from some of the same estimation problems as discussed above for expected returns, albeit to a lesser extent. Nonetheless, estimates of volatility and of the shape of the distribution of returns[21] can be made drawing on empirical finance.

The required contribution rate for a year depends partly on the Fund balance at the start of that year. In turn, that Fund balance depends on past investment outcomes, past levels of contribution and past entitlement payments. These complex interactions mean that an analytical expression that describes the distributions of future contribution rates or future fund balances cannot be derived. However, given the distribution of returns for each year of the projection period, it is relatively straightforward to simulate the evolution of the Fund over time.[22]

Figure 6 provides an illustration of confidence intervals surrounding the projected contribution rates over time. It assumes that the Fund is invested in a market portfolio with expected pre-tax return after management expenses of 9.1% in each year and an

[20] Measures of uncertainty in relation to demographic and social security projections in the United States have been developed. See Holmer (2001), Lee and Tuljapurkar (1998), Meyerson and Sabelhaus (2000). Application to the New Zealand context is a possibility for future analysis.
[21] The central limit theorem can be used to show that, if daily returns are independent, annual returns (1+r) follow the lognormal distribution. This is a relatively robust result.
[22] The simulation results presented here were produced using the Treasury's Excel spreadsheet of the Fund (available from www.treasury.govt.nz) along with *@Risk* (a simulation add-in for Excel from www.palisade.com). The results graphed were based on 2,000 simulation runs.

annual standard deviation of 6.75%.[23] The distribution of the projected contribution rate does widen over time but stays relatively narrow. This is because the contribution rate is recalculated each year taking account of past experience. The confidence intervals actually become narrower toward the end of the century. This is because the Fund balance is declining so the level of investment return (and hence its volatility) has a diminishing effect on the rate calculation. Figure 7 presents the same information, highlighting the capital contributions to, and capital withdrawals from, the Fund.

Figure 8 illustrates confidence intervals surrounding the projected Fund balance over time for the same return assumptions. The Fund balance is subject to relatively wide confidence intervals. Although the Fund is expected to peak at about 50% of GDP, a peak as high as 60% or as low as 40% is quite conceivable under these return assumptions. The distribution widens over time because small deviations from expected returns compound quickly to have a dramatic effect on the wealth of the Fund. This is not immediately offset by corresponding change in the contribution rate because that calculation is on the basis of a forty-year rolling horizon.

There are some important caveats surrounding the illustrations presented in this paper:

- First, as noted above, the assumptions made about expected returns and volatility are intended simply to illustrate the general way the Fund will work. The same qualitative effects are obtained across the range of plausible values for these variables.

- Second, the expected returns and volatility of returns of the Fund will depend to a large extent on the asset allocation strategy adopted by the board of the Fund, who had not been appointed when this paper was written. The assumptions made for the purpose of the illustrations in this paper should not be regarded in any way as presenting a view about the Government's expectations about future returns on the Fund or its asset allocation strategy.

- Third, expected returns and volatility are unobservable, and there is a variety of views about they will evolve in the future, especially in the long-term. When it comes to calculating the contributions that actually will have to be made into the Fund, a robust process will be required to determine each year the forty-year series

[23] These numbers for expected return and volatility have been chosen for illustrative purposes, reflecting a broadly diversified investment portfolio. The effect of making different assumptions about expected returns is illustrated in Figure 5.

of future expected returns on the Fund to use in the calculation.

- Fourth, expectations will change over time as new information comes to hand and as the future becomes closer. This makes the actual confidence intervals wider than in the illustrations given here, which assume that the parameters (means and volatilities) of the returns distributions of future periods years are known with certainty.

- Fifth, as noted above, only the volatility in Fund returns has been modelled. There is also volatility in the other parameters, GDP and New Zealand Superannuation payments, that has not been modelled.

- Sixth, also as noted above, the illustrations are made on the basis of no changes in policy. If the rules for New Zealand Superannuation are changed in the future (for example, the eligibility age, the eligibility criteria, the payment rate, the indexation to wages), the contribution rate calculation will then reflect the changed expectations about future expenditure.

- Seventh, the illustrations assume that, after the first three years of transition, exactly the full levels of contribution are made. If the fiscal conditions for the Government were such that it decided to contribute less [more] than the calculated required rate in one year, then all future years' required contributions would be higher [lower].

Smoothing Return Volatility

The purpose of the establishment of the Fund is to smooth out over time the effect on the rest of the Crown's finances of change in the level of annual New Zealand Superannuation expense. Using the forty-year rolling horizon algorithm of Equation *(1)* produces a calculation of the contribution rate that is a function of the opening Fund balance and, hence, of volatile past returns (see Equation *(4)*, noting that $B_0=B_{-1}(1+r_0)$). As a result, if actual returns for the year are lower [higher] than expected returns (so that B_0 is lower [higher] than $E_{-1}[B_0]$), then the contribution for the next year will need to be set at a slightly higher [lower] level than had been forecast (that is, k_1 would need to be higher [lower] than $E_{-1}[k_1]$).

One possible response would be to smooth over time the effect of return volatility on the contribution rate. For example, this could be achieved by replacing the actual opening balance (B_0) of Equation *(4)* with the expected balance ($E_{-1}[B_0]$) plus an averaged proportion of past deviations from expected returns. This is referred to by some as an "actuarial smoothing" approach. An approach like this has not been adopted for two reasons.

First, the effect of unexpected returns on the contribution rate is already relatively small. To see this, consider the sensitivity of the contribution rate to unexpected returns:[24]

$$\frac{d\left(k_1 - E_{-1}[k_1]\right)}{d\left(r_0 - m_0\right)} = \frac{B_{-1}}{PV[G_{1\ldots H}]} \qquad (5)$$

The accumulated present value of the next H years' annual GDP, $PV[G_{1\ldots H}]$, is a relatively large number. Even when the Fund is at its height, maybe in the region of 50% of annual GDP, this translates into something in the region of only 2% of $PV[G_{1\ldots 40}]$ at that time. At that rate, a deviation from annual expected return of as much as 1,000 basis points would imply a deviation from the (one-year-ahead) expected contribution rate of only 0.2% of GDP.

The second reason for not adopting this response is that, while it might reduce the one-year-ahead volatility in the contribution rate to some extent, it also introduces additional autocorrelation to the contribution rate series so that the contribution rate is slower to respond to changes in Fund wealth. The effect of this is that confidence intervals around future contribution rates are much the same as without the actuarial smoothing, meaning that the long-term effectiveness of the Fund in smoothing the cost of New Zealand Superannuation is unchanged. This can be seen by comparing Figure 7 with Figure 9, which has been prepared with the same assumptions as for Figure 7, except that deviations from expected returns are "smoothed" over five years in the contribution rate calculation.[25] The confidence bands are essentially the same.

Conclusion

This paper discussed the principles and issues surrounding the determination of the contributions that the Government would be required to make to the proposed New Zealand Superannuation Fund. The level of contribution is required to be recalculated

[24] $PV[G_{1\ldots H}]$ is the sum of the present value of G_t, $t=1\ldots H$, the denominator in Equation *(4)*. The time horizon, H, being used is forty years.

[25] To implement the smoothing, an autoregressive procedure was adopted, in which the deviations from expected returns are credited to an "actuarial smoothing account". Instead of the actual opening Fund balance, the rate calculation uses the expected Fund balance ($E_{-1}[B_0]$) plus one-fifth of the accumulated value of that account. The "one-fifth" fraction was chosen arbitrarily but apparently is typical.

each year on the basis that, if the same proportion of forecast GDP was made to the Fund each year for the succeeding forty years, the Fund balance plus accumulated returns would be expected to be sufficient to meet entitlement payments over those forty years. The calculation of the required rate is demonstrated and issues in making projections of the contribution rate and the Fund balance are discussed. Making some standard assumptions, an analytical solution for calculating the expected contribution rate resulting from this prescription is presented. It is a function of forecasts of expected GDP, expected payments of New Zealand Superannuation and expected returns on investment of the Fund. Estimation of the paths of future contribution rates and of the size of the Fund over time are illustrated, and the effect of volatility in capital market returns is examined.

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Data Source: The Excel spreadsheet used to produce the results reported in this paper is available from www.treasury.govt.nz/release/super.

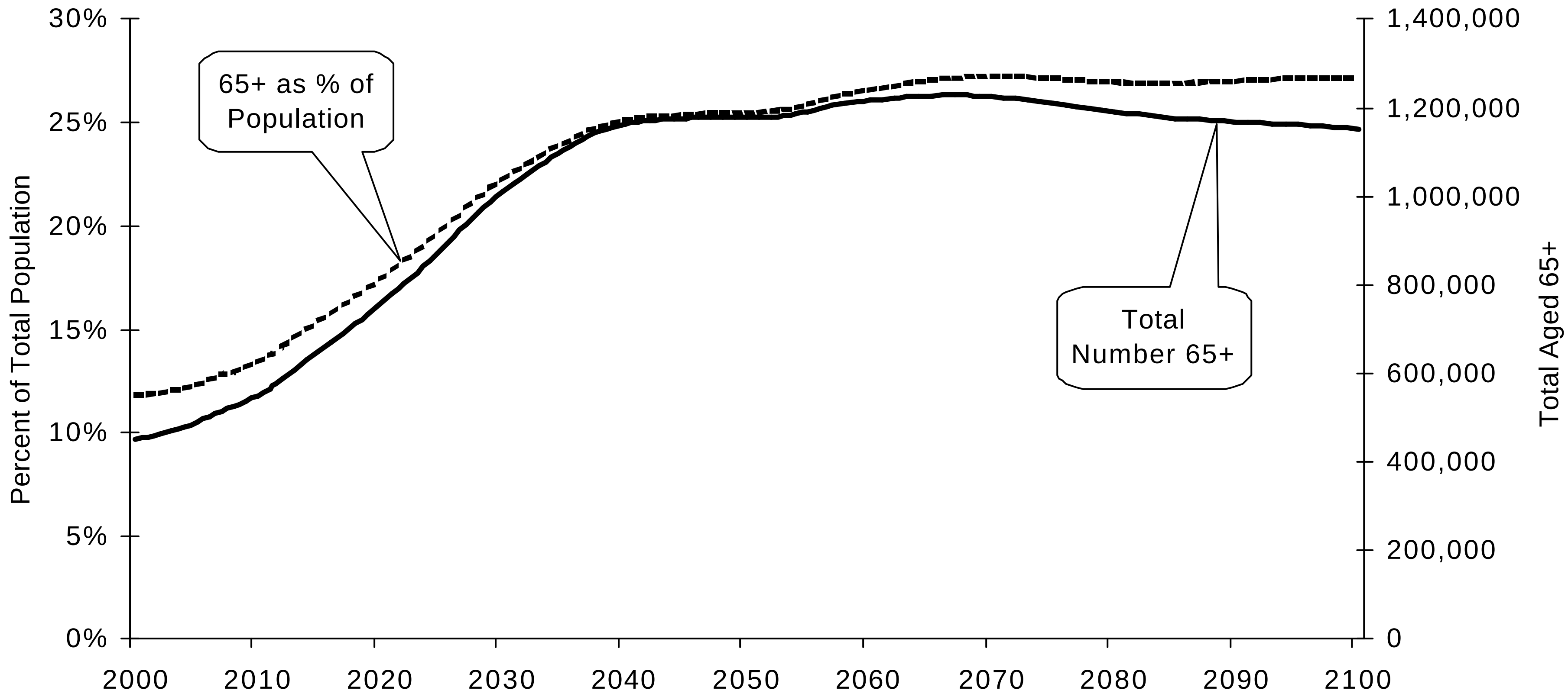


Figure 1: Projections of New Zealand Population Over 65

Source: Statistics New Zealand population projections (1999 base): medium fertility, medium mortality, +5,000 net long-term migration.

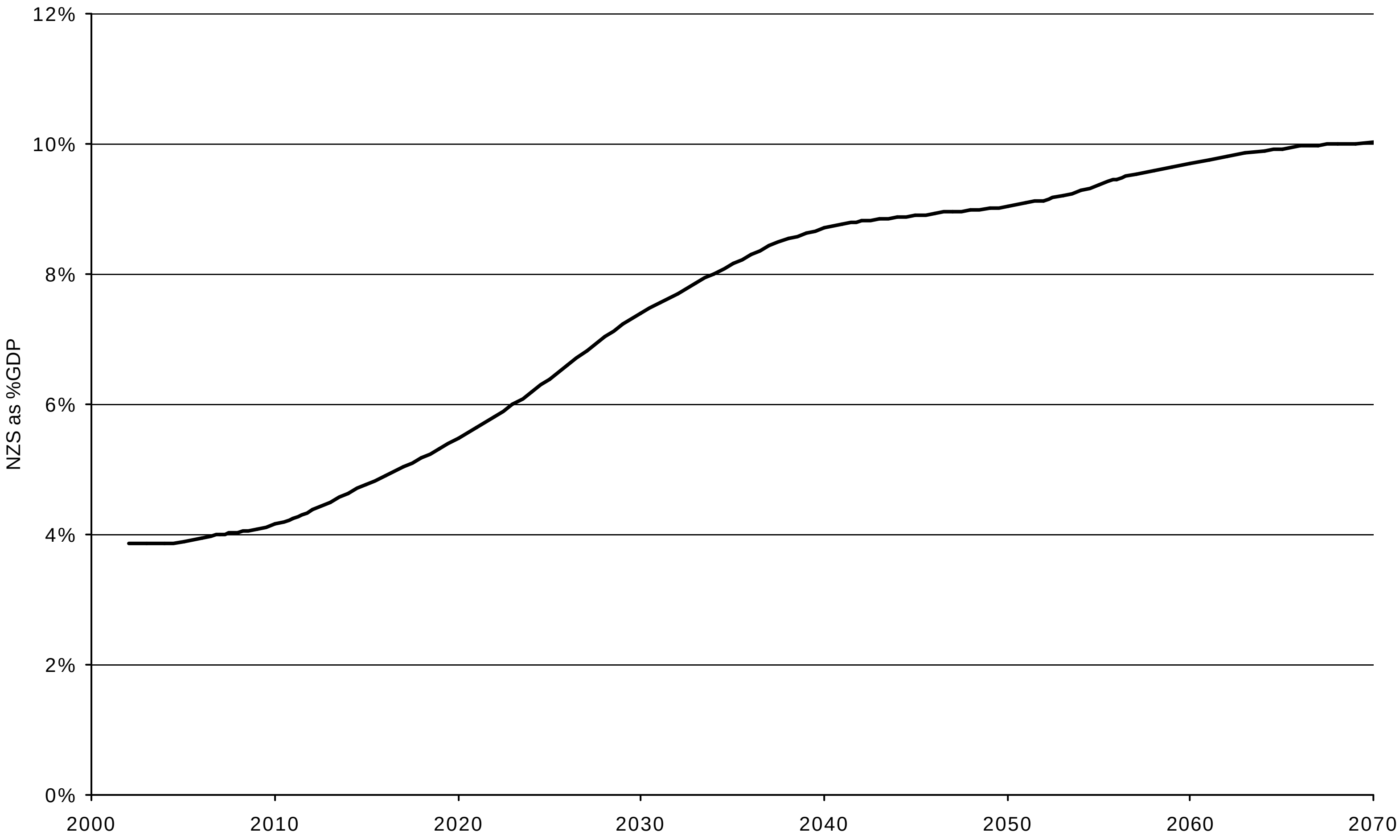


Figure 2: New Zealand Superannuation as a Proportion of GDP

Source: New Zealand Treasury. Based on Statistics New Zealand population projections (see Figure 1) using current entitlement provisions with PAYE tax deducted. GDP projections from Budget 2001.

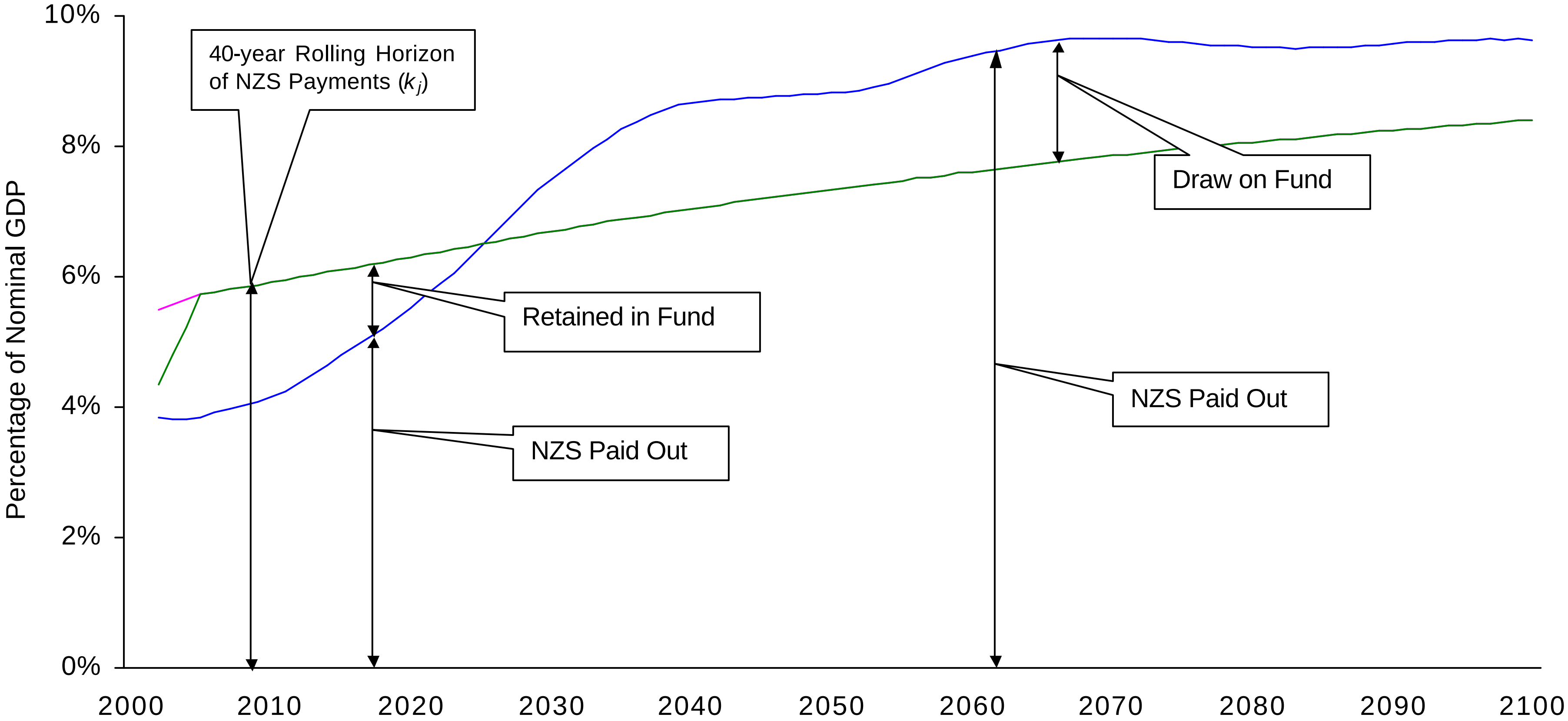


Figure 3: New Zealand Superannuation Fund Projected Contributions

Source: New Zealand Treasury New Zealand Superannuation Fund Model.

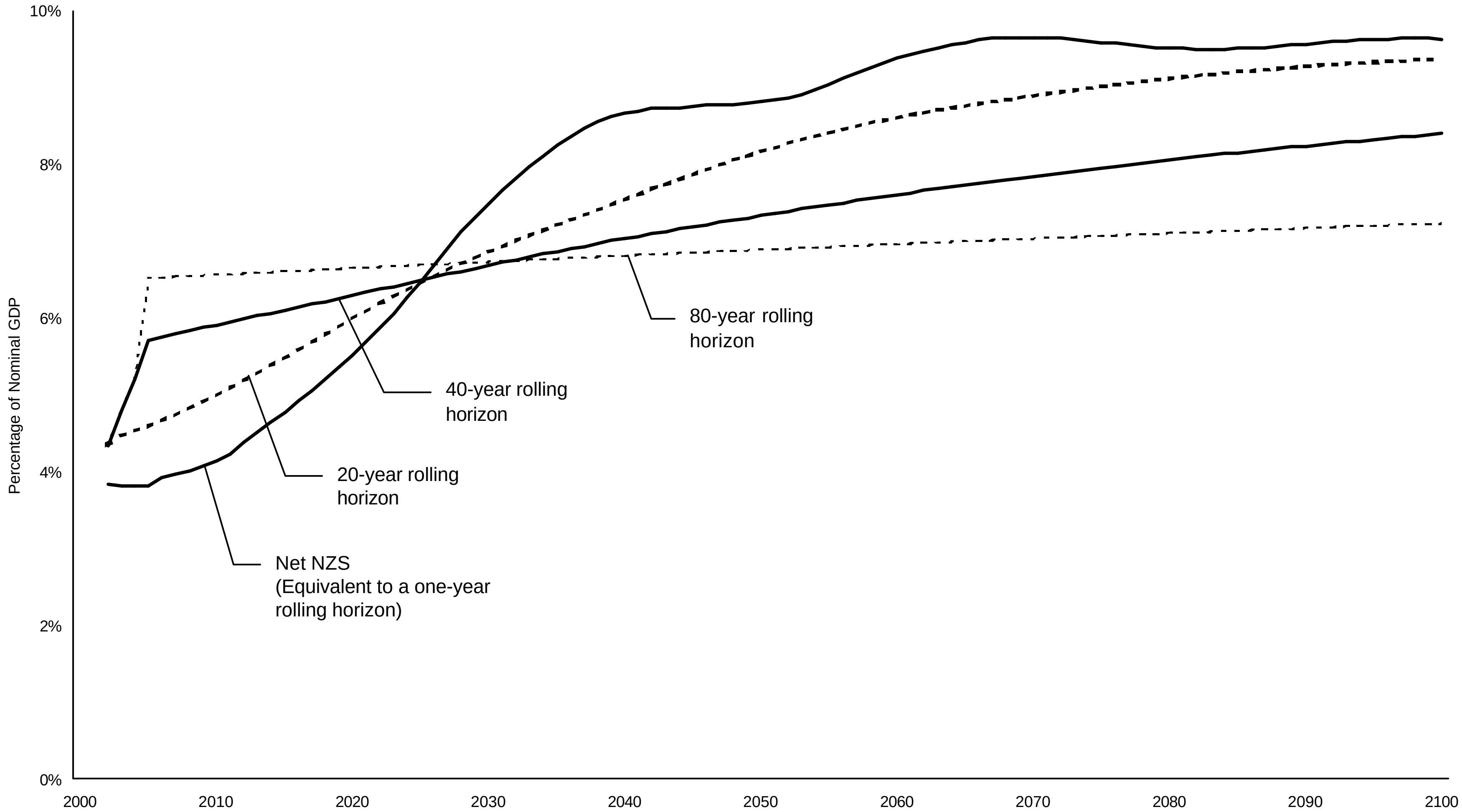


Figure 4: Effect of Alternative Rolling Horizons on the Path of the Contribution Rate (k_j)

Source: New Zealand Treasury New Zealand Superannuation Fund Model.

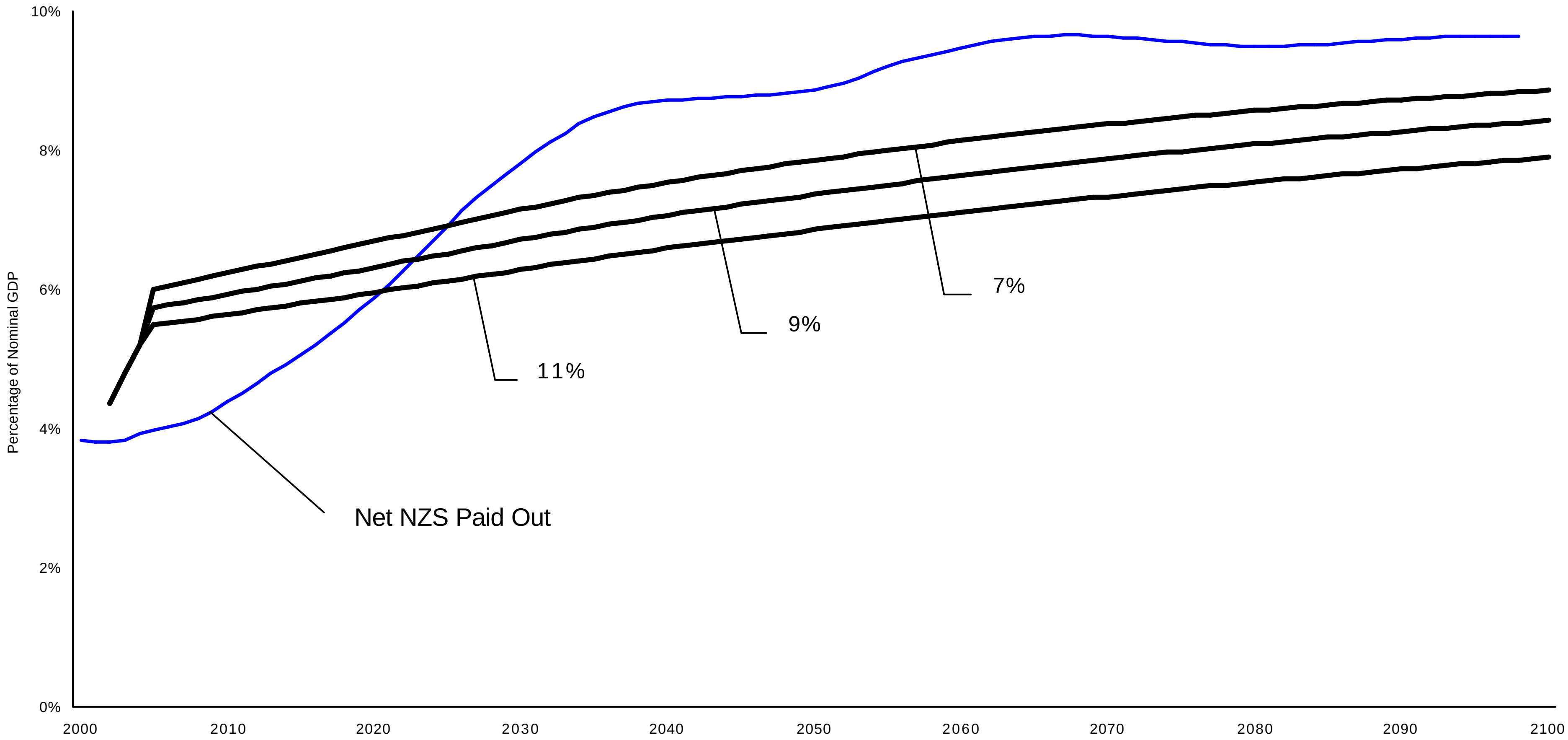


Figure 5: Effect of Different Assumptions About Expected Returns on the Path of the Required Contribution Rate (k_j)

Source: New Zealand Treasury New Zealand Superannuation Fund Model.

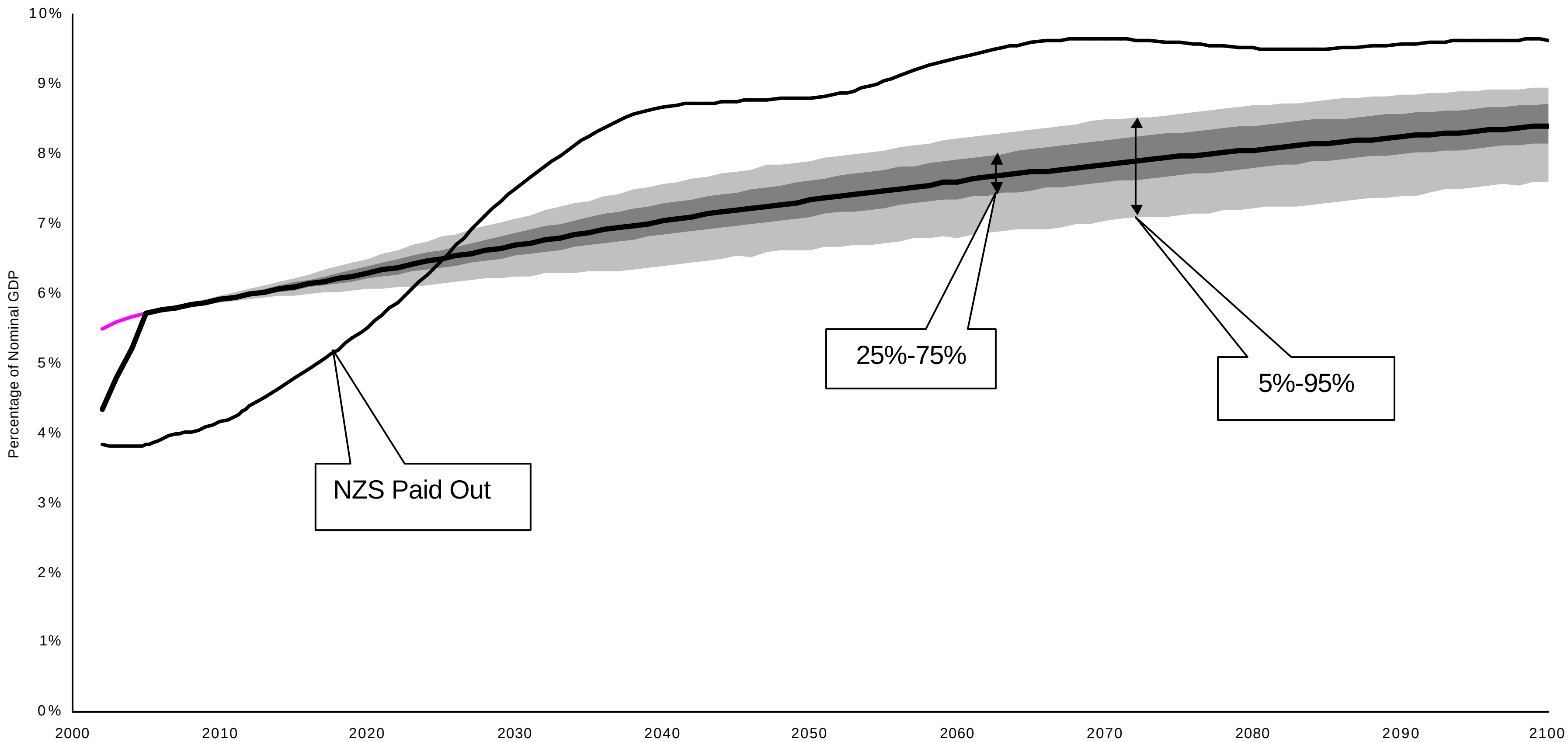


Figure 6: Variability Around the Contribution Rate (*k_j*) Attributable to Volatility in Annual Investment Returns

Source: New Zealand Treasury New Zealand Superannuation Fund Model.

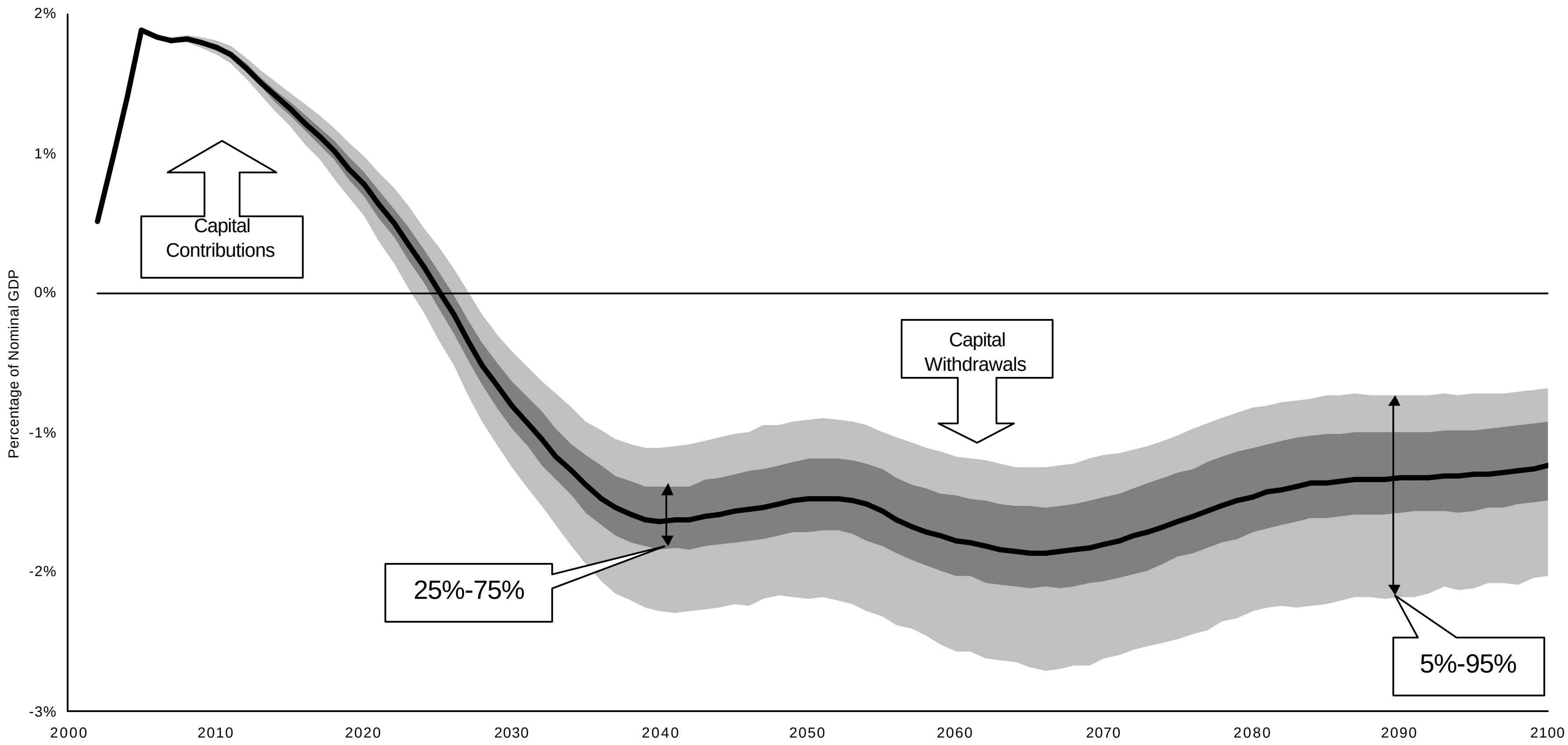


Figure 7: Variability Around Capital Contributions and Withdrawals Attributable to Volatility in Annual Investment Returns

Source: New Zealand Treasury New Zealand Superannuation Fund Model.

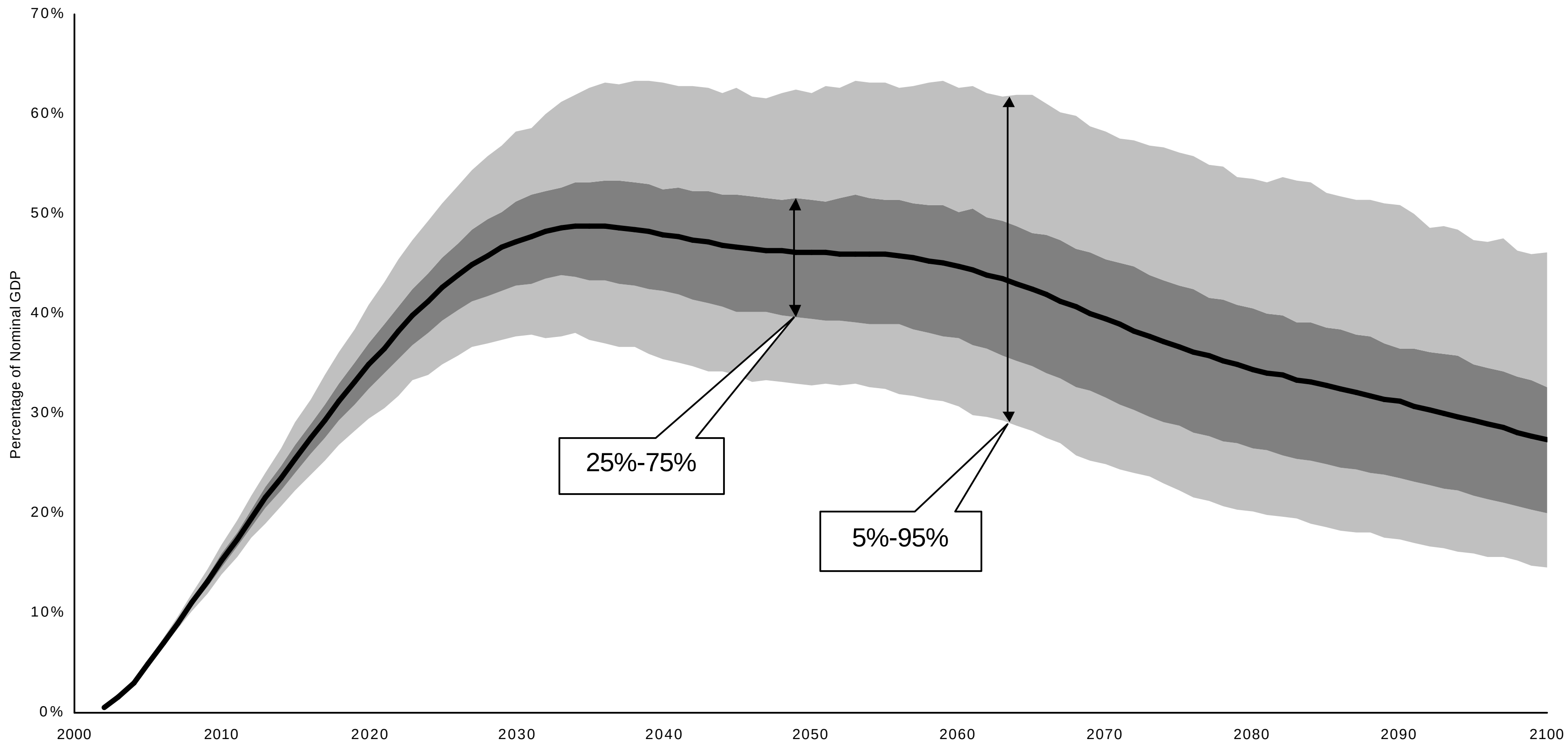


Figure 8: Variability in the Fund Balance Attributable to Volatility in Annual Investment Returns

Source: New Zealand Treasury New Zealand Superannuation Fund Model.

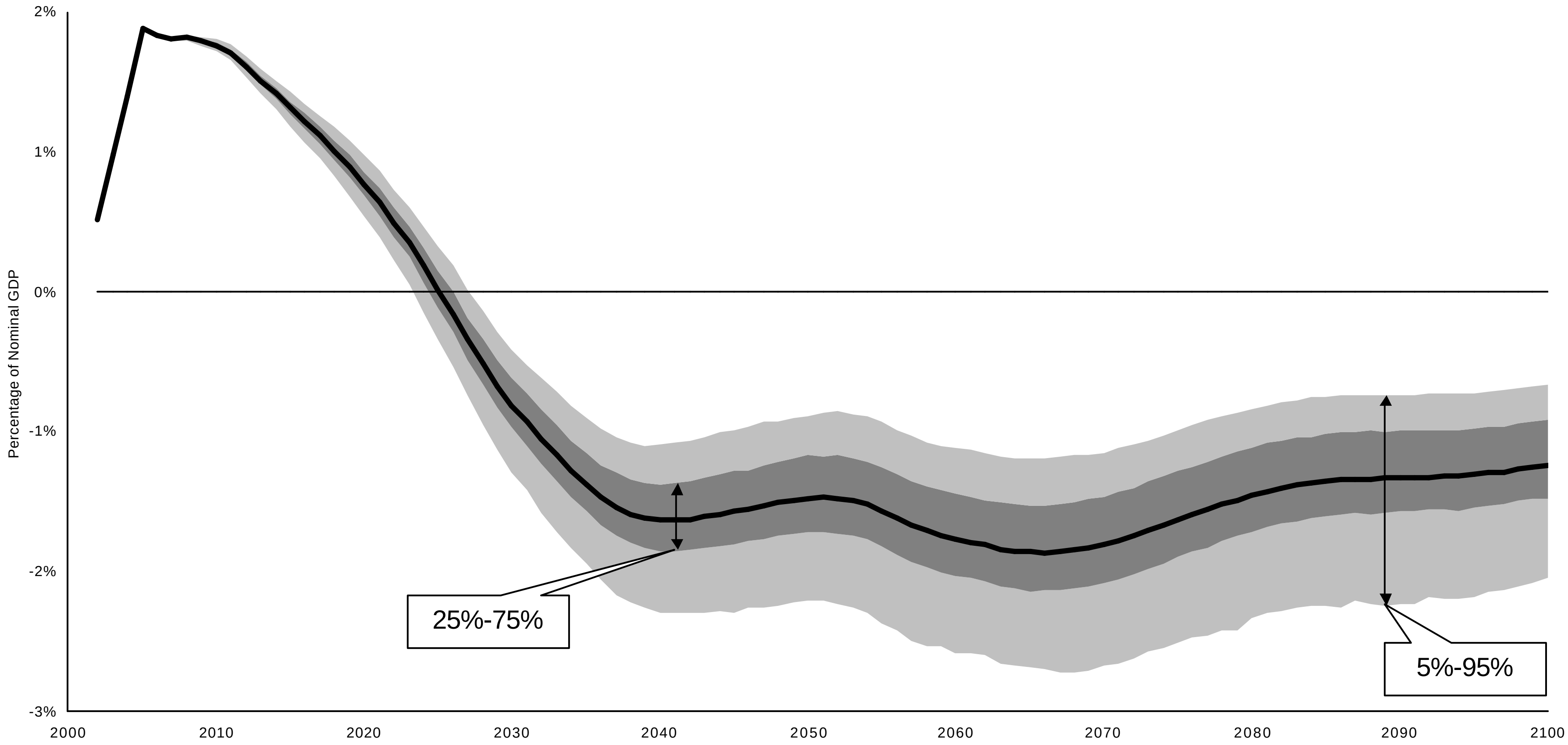


Figure 9: Variability Around Capital Contributions and Withdrawals with Actuarial Smoothing

Source: New Zealand Treasury New Zealand Superannuation Fund Model adapted to incorporate actuarial smoothing.

Appendix: Long-Term Returns

Introduction

The characteristics of financial asset and liability returns are becoming increasingly salient in fiscal and economic policy work. Long-term fiscal modelling and policies that have long-term financial implications, such as the New Zealand Superannuation Fund, require assessments to be made about what financial returns we should expect decades out into the future. However, there is a range of popular views about the likely state of financial markets in the long-term. What effect will the ageing baby-boomers have? Are current high market values supported by fundamentals? Is history any guide?

This appendix summarizes the range of approaches taken and views put forward on this issue. Its purpose is to provide a basis for thinking about how these could be developed to the stage that useful conclusions can be drawn for application to long-term modelling and policy analysis.

The next section examines the historical record of asset returns and the issues that arise in using these as a basis for extrapolating future returns. Section 3 considers what the relations between current market values and other economic variables signal about future prices and returns. Section 4 examines developments and trends in capital markets that could affect long-term returns and section 5 examines the effect of the future macroeconomy on prices and returns. Section 6 analyses the implications of changing demographics. Finally, section 7 makes some concluding observations.

Historical Record

Analysis of the historical record on returns to financial instruments focuses primarily on US data because this has provided the most long-lived continuous capital market.[1] The following table provides rates of return over the past 200 years.

[1] Lally (2000) examines the relationship between the real cost of capital in New Zealand, Australia and the United States.

Table 1: Compound Annual Real Returns (percent)
U.S. Data, 1802-1998

Period	Stocks	Bonds	Bills	Gold	Inflation
1802-1998	7.0	3.5	2.9	-0.1	1.3
1802-1870	7.0	4.8	5.1	0.2	0.1
1871-1925	6.6	3.7	3.2	-0.8	0.6
1926-1998	7.4	2.2	0.7	0.2	3.1
1946-1998	7.8	1.3	0.6	-0.7	4.2

Source: Jeremy J. Siegel, "The Shrinking Equity Premium: Historical Facts and Future Forecasts."

Equity returns have remained reasonably steady, while bond and bill returns have declined over time. The equity premium has thus increased over time, as shown in the following table.

Table 2: Equity Premia—Differences in Annual Rates of Return between Stocks and Fixed Income Assets (percent)
U.S. Data, 1802-1998

Period	Equity Premium with Bonds	Equity Premium with Bills
1802-1998	3.5	5.1
1802-1870	2.2	1.9
1871-1925	2.9	3.4
1926-1998	5.2	6.7
1946-1998	6.5	7.2

Source: Jeremy J. Siegel, "The Shrinking Equity Premium: Historical Facts and Future Forecasts."

However, there are several difficulties with simply extrapolating this past series out to the future, especially the long-term future. These difficulties include issues of nonstationarity, survivorship bias, degrees of freedom required for long-term return estimation, the "equity premium puzzle", and the distinction between expected returns and realized returns.

Nonstationarity

The above tables illustrate that average long-term returns have varied over time. A prediction of future expected returns therefore will depend heavily on which past time period is used to form the prediction and the changes over time are not well understood (Siegel, 1999). More recent data might be considered to be more relevant for future expectations, but a longer time series might be considered to be more representative of long-term returns.

Survivorship Bias

While it is convenient to focus on the US markets because of the long time series they provide, it does introduce the possibility of survivorship bias. Survivorship bias occurs when a sample is not representative of a population because it only includes observations from entities which provide a complete time series over the sample period. In this case, the US market happens to have survived over time while other countries' capital markets have foundered. Jorion and Goetzmann (1999) report that over the period 1921 to 1996, US equities had the highest real return among the 39 markets that go back to the 1920s, at 4.3 percent compared to a median of 0.8 percent for other countries. They conclude that the high equity premium in the US has been an exception rather than the rule.

Degrees of Freedom

While a two hundred year series may seem like a healthy-sized sample for making projections of future expected returns, it is actually relatively short for projecting long-term returns. For example, for projecting average returns over the next fifty years, it only provides only four independent past observations. Of course, it is possible to take rolling averages through time (1901-50, 1902-51, 1903-52, etc.) but these are highly statistically dependent because they include so many overlapping years.

An alternative approach would be to undertake the analysis based on the distribution of returns (even though these would inevitably have to be estimated on the basis of history), rather than on the actual historical returns. Jones and Wilson (1999) adopt this approach to illustrate how the traditional wisdom based on historical returns is likely to overstate future investment performance.

Equity Premium Puzzle

The above table shows that the equity risk premium in the past 75 years has averaged 5 to 7 percent. The prevailing view seems to be that these levels will continue into the future. A 1999 survey of over 200 US economists found that most estimate the equity premium at 5 to 6 percent over the next thirty years (Welch, 1999, quoted in Siegel, 1999).

The "equity premium puzzle" is that these levels of risk premium are too high to be explained by the standard models of risk and return without invoking unreasonably high levels of risk aversion. Mehra and Prescott initially presented this finding in 1985. In the intervening fifteen years various explanations have been attempted but none has been completely satisfactory. This leaves some doubt as to whether the risk premium will stay at these historical levels, or will be somewhat lower, as suggested by Fama and French (2000). Indeed, there is some evidence that the equity premium has already declined (Jagannathan, McGrattan and Scherbina, 2001).

Expected Returns versus Realized Returns

Expected returns are not directly measurable. As a result, realized returns are invariably used as a proxy for expected returns. This is based on an assumption that arbitrage will result in "surprises" (deviations between expected returns and realized returns) being zero-mean and unpredictable, in which case realized returns would provide an unbiased estimate of expected returns.

However, this relationship does not hold well. Elton (1999) illustrates this: "In the recent past, the United States has had stock market returns of higher than 30 percent per year while Asian markets have had negative returns. Does anyone honestly believe that this is because this was the riskiest period in history for the United States and the safest for Asia?" He also points to lengthy periods in history when equity returns and long-term bonds returns averaged less than risk-free rates.

Later in this appendix, we discuss various developments that could lead to changes in return expectations in the future. If a change occurred that resulted in investors requiring a smaller risk premium to invest in equities (for example, aggregate risk aversion drops, or transaction costs fall, or risk is shared more widely), the required rate of return on equities would fall. The immediate effect of this would be that individuals would be more prepared to invest in equities, bidding the price up until the expected return fell to meet the required return. However, in the meantime, the increase in price means that a higher realized return is observed.

On this basis, the recent high growth in market prices (and hence high realized returns), as indicated in the graphs below, could well be quite consistent with low expected returns for the future.

Current Market Values

Current US stock prices are high relative to various indicators. This section examines the relations with earnings and with national income.

Price-Earnings Ratio

Average past earnings provide a measure of firms' past ability to generate wealth, while stock prices reflect the market's expectations about future earnings. The price-earnings ratio therefore provides an indication of the match between past performance and expectations about the future.

Figure 1.2 from Shiller (2000), reproduced below, shows the price-earnings ratio for the S&P Composite Stock Price Index over the past 120 years. The graph shows that the current high level of this ratio is well outside its historic range. This is primarily due to price increase: earnings have followed a steady trend growth rate. This has led various commentators to predict that prices are likely to scale back in future, resulting in low or negative returns, either with a sharp correction, as in 1929, or with a slow slide like the twenty years following 1901. For example, see Campbell and Shiller (1998) and Philips (1999).

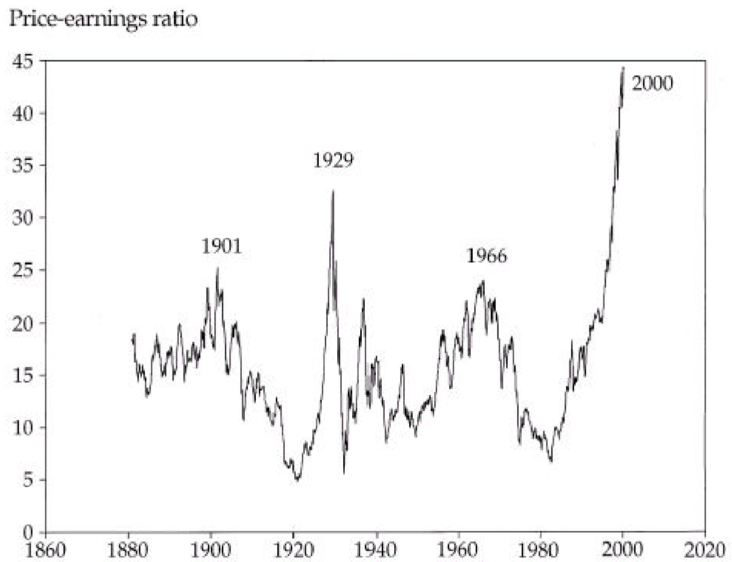


Figure 1.2

Price-Earnings Ratio, 1881–2000

Price-earnings ratio, monthly, January 1881 to January 2000. Numerator: real (inflation-corrected) S&P Composite Stock Price Index, January. Denominator: moving average over preceding ten years of real S&P Composite earnings. Years of peaks are indicated. *Source:* Author's calculations using data from sources given in Figure 1.1. See also note 2.

There are most likely several factors that have combined to produce the increasing prices. Shiller (2000) lists twelve factors that he believes have contributed to a self-fulfilling psychology of a roaring stock market:

- the arrival of the Internet coincidental with a time of solid earnings growth;
- triumphalism and the decline of foreign economic rivals;
- cultural changes favouring business success or the appearance thereof;
- a Republican Congress and capital gains tax cuts;
- the baby boom and its perceived effects on the market;
- an expansion of media reporting of business news;
- analysts' increasingly optimistic forecasts;
- the expansion of defined contribution pension plans;
- the growth of mutual funds;
- the decline of inflation and the effects of money illusion;
- expansion of the volume of trade: discount brokers, day traders, and twenty-four-hour trading; and
- the rise of gambling opportunities.

A further factor leading to increasing price-earnings ratios over time is that the reporting of earnings has become more conservative over time (Givoly & Hayn, 2000). As a result, a simple focus on the ratio time-series, as in the graph above, may overstate the growth in share price relative to the underlying income-generating capacity of firms.

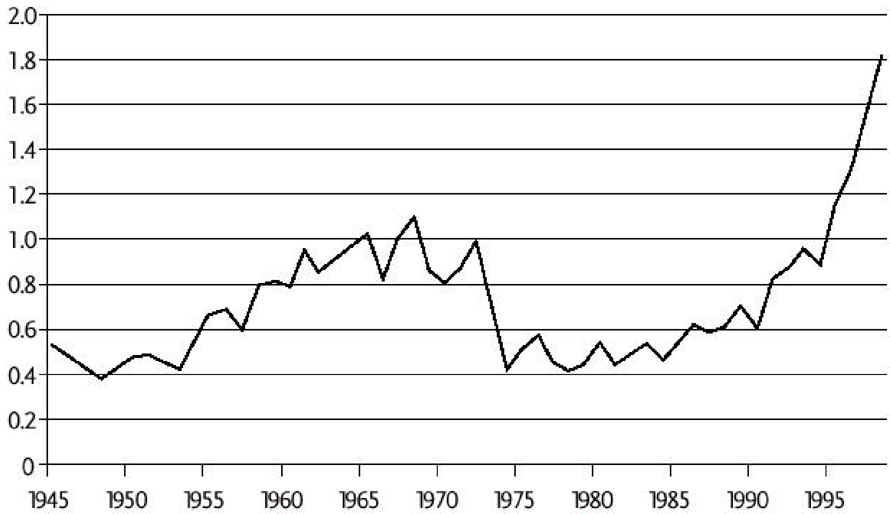
National Income

Gross domestic product provides a measure of the production in the economy. A significant proportion of that production is attributable to firms. It is therefore reasonable to expect that expectations about future production, as reflected in aggregate asset prices, would bear some relationship to gross domestic product.

Figure 2 from Diamond (1999), reproduced below, shows the ratio of market value of US stocks to US gross domestic product over the last seventy years. Like the price-earnings ratio, it is now well outside its historic range. One possible explanation is that there has been a fundamental change in technology so that the marginal product of capital is permanently higher than its past series. This is reflected in talk about the “knowledge economy” and a “new era” of technology-driven innovation. The alternative explanation is that the market is experiencing an “irrational exuberance”, Alan Greenspan called it, that is bound to be corrected in future.

However, McGrattan and Prescott (2001) cast doubt on whether the market for equity is overvalued. They show that the market value of productive assets is roughly in line with the market value of equity.

Figure 2: Market Value of Stocks to Gross Domestic Product Ratio, 1929-1998



Capital Market Developments

Capital markets are not static. They are continually evolving. This section examines some trends that may affect future required rates of return.

New Institutions

A major development in investment has been the establishment of mutual funds, in which investors pool their resources to acquire a more diversified portfolio at lower cost by taking advantage of economies of scale. Because this reduces the price to individual investors of investing in risky assets (otherwise they presumably would not do it), it has been suggested that this should lead to a lower equity risk premium in the future. However, although mutual funds have grown significantly in recent years, they still own a relatively small proportion of the market (less than 20% of the US market in 1999) and the cost savings do not apply to large investors who have always enjoyed lower charges.

Declining Transaction Costs

Another trend in capital markets is a decline in transaction costs as trading technology, especially over the internet, has developed and deregulation has taken place.[2] This applies to both stocks and bonds, but possibly more to stocks, suggesting that both the total expected return and the equity risk premium might decline. Again, however, large institutional investors, who make up the bulk of the market, already enjoy low charges so this trend would not be likely to have a significant effect on future returns.

Widening Pool of Investors

Heaton and Lucas (1999) document the increasing participation rates in the US stock market over the last decade. This increase is partly attributed to "baby boomers" entering their peak saving years, and also to developments in tax law, pension provision and globalisation of capital markets. Like the other capital market developments discussed above, the risk spreading resulting from this greater participation suggests that both the total expected return and the equity risk premium might be reduced but, again, the increase is primarily for small investors who do not own a large proportion of the market. Nonetheless, Siegel (1999) suggests that declining transaction costs and increased diversification could have had an effect as great as one to two percentage points on expected net returns.

Investor Time Horizons

Another possible change in capital markets out into the future is that investors' time horizons might change, in aggregate. How investment horizon should affect risk preference is an issue of some debate (see Thorley (1995) for a review. Bodie (1995) provides an analysis using options theory). However, it is generally observed that, as people age, their financial portfolios shift toward less volatile assets. With a more aged population this suggests that there might be generally higher observed risk aversion and hence higher equity risk premia in the future. However, the increase in institutional investment might have lengthened the average time horizon. In short, it is not clear how investor time horizons in aggregate might change in future, nor how returns might be consequentially affected.

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[2] Prior to 1975, brokerage commissions on trading individual stocks was set by the New York Stock Exchange, and were substantially higher than they are today (Seigel, 1999).

Economic Developments

Low inflation environment

After an analysis of 34 years data for 20 countries, Lindh and Malmberg (2000) find a pattern of inflation effects consistent with the hypothesis that increases in the population of net savers dampen inflation, whereas especially the younger retirees fan inflation as they start consuming out of accumulated pension claims. If this result has any predictive power, it suggests that inflation would be higher over the next few decades. This would be reflected in expected nominal rates of return.

However, others believe that we are entering a permanent low-inflation environment that is different from historical experience, and with significant implications for pensions and other products that are priced on the basis of expected long-term returns (Meredith et al., 2000).

Future GDP growth

Labour force growth is expected to slow over the next few decades as the population ages. With a constant or declining labour productivity, this implies that economic growth will be lower in future than now.

This lower economic growth may or may not flow through to a lower marginal product of capital and lower returns. Diamond (1999) uses a standard (Solow) model of economic growth to show that slower long-run economic growth with a constant savings rate will yield a lower marginal product of capital. However, he also notes that savings and growth are related, with slower economic growth resulting in lower savings, which could preserve stability in the rate of return since in his Solow model, low savings increase the marginal product of capital.

Globalisation

As globalisation of markets, particularly capital markets, gathers pace, country-specific effects will be increasingly dominated by worldwide trends. As a result, the specific conditions in a particular country, for example its demographic structure, will come to have less of an effect on investment returns in, and to, that country than would the global demographic trend.

Demographics

Anecdotal accounts from the US of the effect of the "baby boom" generation on house prices in the late 1970s and early 1980s as they moved through their "home-buying years", and more recently on stock market values as they move through their "peak saving years", have led to wide speculation that asset values will decline over the next few decades as the baby boomers start to dis-save to finance their retirement years. Poterba (1988) investigates the empirical association between population age structure and the returns on stocks and bonds using historical data from the US over the past seventy years. He does not find any robust relationship between demographic structure and asset returns. There are several factors that could weaken the relationship between age structure and asset returns:

- Changes in age structure could affect asset demand, and thereby asset returns, but these might be too small to be detected amongst other shocks to asset markets. Strong serial dependence in age structures also limits the power of statistical tests.
- The development of financial markets in currently "emerging markets" might dilute the effect of changing age structures. Seigel (1998, p. 41) states: "The developing world emerges as the answer to the age mismatch of the industrialized economies. If their progress continues, they will sell goods to the baby boomers and thereby acquire the buying power to purchase their assets." However, a World Bank study (Holzmann, 2000) concludes that investments in emerging markets might help at the margin but are unlikely to be a major factor.
- Changes in government social policy, particularly retirement income provision and health insurance, could affect saving rates across age cohorts. For example, Poterba (1998) suggests: "If government provision of retirement income declines, this may stimulate saving among younger workers, thereby changing the current age-wealth accumulation profile."
- If the market is made by investors with rational expectations, any predictable effect of a changing age structure should already be incorporated in the prices of financial instruments, at least to some extent.
- Individuals tend to shift from investments in equities to investments in less risky financial assets, such as government bonds, as they age.[3] This might lead to depressed returns for the baby boom generation as they sell their equities all at once to a smaller follow-on generation. Brooks (2000) demonstrates this effect in theory using a neo-classical growth model with three overlapping generations (children, working parents and retired). However, this effect is mollified in the existence of publicly-funded pay-as-you-go income provision. The real-world effect would also be expected to be weaker because there are more than three overlapping generations trading with each other and wealth is not evenly distributed

[3] The usual explanation for this, that people become more risk averse as they age, is not very satisfactory and has led to a long debate about the merits of time-diversification. A more satisfactory explanation is that individuals run down their implicit holding of a non-traded asset, human capital, over their life cycle, so the move toward bonds is a rebalancing of their overall portfolio (Viceira, 1999).

within cohorts.

Another feature of the demographic forecasts is that a permanent change in the age structure of the population in developed countries is expected to take place this century. It is not simply a case of a post-war “baby boom” generation going through life. Fertility has declined, parents are having children later in life, and longevity has increased. Together, these factors signal a permanent shift to an older population in future. It is not obvious what effect these changes will have on investment returns, particularly as these effects will vary across socio-economic groups. For example, increased longevity might increase incentives to save in anticipation of a longer retirement period (thus decreasing required rates of return), however this might have little effect on the wealthy (to whom the bulk of private saving can be attributed) if they are already saving more than enough to meet their lifetime needs.

Conclusion to Appendix

Small differences in expected returns can have significant effects on long-term wealth as returns compound over many years. This appendix has reviewed a range of approaches that have been taken to assessing likely future expected returns.

While there seems to be a consensus that returns in future in both bond and equity markets are expected to be lower than in the recent past, there is not a unanimous view as to how much lower they will be, nor what will be the main drivers of expected returns over the long-term.