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Long-term fiscal projections and their relationship with the intertemporal budget constraint: An application to New Zealand

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Long-term fiscal projections and their relationship with the intertemporal budget constraint: An application to New Zealand

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Abstract

The fiscal gap calculates the change in fiscal policy settings needed to achieve a particular debt target at some point in the future. This working paper calculates fiscal gaps for New Zealand under a range of scenarios, including alternative spending growth, debt targets and interest rates. A positive (negative) fiscal gap indicates that a permanent increase (decrease) in the primary surplus is required to achieve a selected debt target in a particular terminal year. The scenarios suggest that under a range of alternative assumptions the fiscal gap out to 2051 is positive. These results are in accord with previous long-term fiscal projections, which, unlike the fiscal gap, have not been explicit about the nature of long-term fiscal imbalances. The analysis provides a platform for the further examination of potential long-term fiscal imbalances under a wider range of assumptions (e.g., around demographics, labour force participation, health spending) as well as alternative modelling techniques that allow for uncertainty.

JEL CLASSIFICATION E62 Fiscal Policy; Public Expenditures, Investment, and Finance; Taxation,

H60 General

KEYWORDS Long-term fiscal imbalance, intertemporal budget constraint

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1 Introduction

Developments in fiscal policy and theory over recent years have increasingly taken on a longer-term focus. For example, in a recent summary article, John Taylor acknowledges the role of automatic fiscal stabilisers influencing short-run business cycle fluctuations and suggests that the focus of discretionary fiscal policy should be on longer-term issues (Taylor, 2001). David Romer's recent text on macroeconomics starts its chapter on budget deficits and fiscal policy with an explicit consideration of the government's budget constraint through time (Romer, 2001). The longer-term metric for evaluating fiscal policy is typically the government's intertemporal budget constraint (IBC). The IBC is based around the notion that all government spending must eventually be financed, either in the current period through taxes or over time through interest on debt.

The 1990s saw the development of a variety of fiscal policy frameworks internationally that recognise the importance of longer-term implications of current fiscal policies and tend to focus on the paths of deficits and debt through time. Examples include the "Code for Fiscal Stability" in the United Kingdom; the "Charter of Budget Honesty" in Australia; the "Maastricht Treaty" and "Stability and Growth Pact" in Europe. In New Zealand, the Fiscal Responsibility Act 1994 requires the setting of long-term objectives for fiscal balances and stocks, as well as the publication of long-term fiscal projections.

The longer-term fiscal projections required under the Fiscal Responsibility Act provide a guide to the broad requirements for sustainable fiscal policy. For example, an assumed tax reduction (spending increase) without a change to spending (tax) assumptions could see a rising debt profile through time. Although a Government could signal a future reduction in spending (increase in taxes), the requirement to publish projections increases the transparency around the implied policy change. The credibility of fiscal policy is likely to be undermined by projections that indicate fiscal objectives will not be met over a reasonable period of time given plausible economic and policy assumptions.

This paper uses the New Zealand Treasury's long-term fiscal model (LTFM), the model that generates the long-term fiscal projections required under the Fiscal Responsibility Act.[1] The LTFM is also used to generate fiscal "scenarios" over longer time horizons (e.g., 50 years). The LTFM builds in an estimate of the effect of population change on government spending in the future. Since there is a tendency for New Zealand's population to age (in the sense that those aged over 65 will comprise a larger share of the total population), then use of the LTFM builds in the effect of population ageing on fiscal variables (see for example, Polackova, 1997).[2,3]

Long-term fiscal projections need to be interpreted cautiously. The LTFM generates debt as a residual. Over long-time horizons, any "mismatch" between projected revenue and expenses will see an increasing debt-to-output ratio. Such outcomes are unlikely to actually eventuate, as there will be a range of adjustments, both in terms of government policy and by the private sector. The fiscal projections based on the LTFM are therefore likely to over-estimate the deterioration in the fiscal position. The projections are best interpreted as "current policy" projections, where this is an approximation of the current role of government via specific expense and revenue parameters (see Section 5).

Unconstrained debt projections are not particularly useful in terms of communicating the extent of implied policy change. Resolving this issue requires a consideration of the government's intertemporal budget constraint (IBC), which requires that all government spending must eventually be financed, either in the current period through taxes or over time through interest on debt.

There are a number of numerical long-term fiscal indicators based around the concept of an IBC. Generational accounting examines the effect on different generations of alternative ways of satisfying the government's IBC (see Auerbach and Kotlikoff, 1999; Baker, 1999). The concept of Comprehensive Net Worth (CNW) set out by Bradbury, Brumby and Skilling (1999) also centres on the government's IBC. CNW is broader than net worth because it incorporates the present discounted value of all future revenue and expenditure flows.

The fiscal gap is also based around the concept of the government's IBC. The fiscal gap calculates the change in fiscal policy settings needed to achieve a particular debt target at some point in the future (Auerbach, 1994; 1997). This change can be calculated in terms of the adjustment needed now, or what is required in the future if adjustment is delayed. The change in policy can be in the form of adjustments to taxes and/or spending. The US Congressional Budget Office (CBO) regularly publishes estimates of the fiscal gap. Recent work by the OECD on the fiscal implications of population ageing has considered a similar measure (OECD, 2001).

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[1] The LTFM is described in Woods (2000) and at www.treasury.govt.nz/ltfm. Further details on the LTFM structure and assumptions used for the fiscal gap scenarios are available on request from the author.

[2] The projections required under the Fiscal Responsibility Act are termed "Progress Outlooks". They must cover a minimum of 10 years and are included in the Government's annual *Fiscal Strategy Report*. The projections are for the variables specified in the long-term fiscal objectives (e.g., expenses, revenues, operating balance, debt and net worth). The terms "projection" and "scenario" carry a different status to short-term fiscal "forecasts". The projections and scenarios generated by the LTFM involve a higher degree of uncertainty and are based on a relatively small set of key long-run economic, demographic and fiscal assumptions. These assumptions are set out in the text and Appendix.

[3] Fiscal projections of this type became a feature of the retirement income debate during the early 1990s (see Task Force on Private Provision for Retirement, 1992; Briggs, Malcolm, O'Donovan and Vandersyp, 1992; Cook and Savage, 1995).

The fiscal gap calculations in this working paper provide information on the long-term path of budget balances, abstracting from shorter-term influences such as the business cycle. Closing a fiscal gap via a permanent change in policy settings amounts to a long-term "tax smoothing" approach (see Section 2). The long-term budget balances implied by such an approach can be linked with two procedures used by the New Zealand Treasury to assess uncertainty around the budget balance over the short-run. Buckle, Kim and Tam (2001) use a procedure for identifying the *ex ante* fiscal balance required to achieve, with a given probability, a desired *ex post* budget balance for alternative short-term fiscal planning horizons. In their approach, the budget balances implied by the fiscal gap could act as the desired *ex post* target and the probability of realising this target during a specified time horizon can be deduced from the probability of past shocks to the budget balance. In a similar context, the budget balances implied by the fiscal gap are structural and ignore the short-term effects of the business cycle. Tam and Kirkham (2001) set out the Treasury's procedure for estimating the cyclical component of the actual budget balance.

This working paper is structured as follows. Section 2 sets out the analytical framework used to derive the fiscal gap. Sections 3 and 4 discuss the elements involved in calculating the fiscal gap, with reference to overseas applications, particularly for the United States. Section 5 sets outs the structure of the LTFM and key assumptions. Section 6 presents fiscal gap calculations for New Zealand under a range of scenarios. For terminal dates up until around 2030, calculated fiscal gaps are negative under the Baseline assumptions, indicating that the primary surplus could be reduced. However, under the Baseline and other assumptions, the fiscal gap out to 2051 is positive. Section 7 sets out policy issues and caveats and Section 8 concludes.

2 Analytical framework

2.1 The intertemporal budget constraint (IBC)

The framework used here draws on the specification of the IBC used by Buiter (1995, 2001), Wells (1996) and Romer (2001). The specification is stylised in that it excludes capital spending and income from government trading enterprises. The government budget identity is given by:

$$G_t + rB_{t-1} = T_t + (B_t - B_{t-1}) \qquad (1a)$$

where G is current spending on goods, services and transfers, T denotes taxes, and r is the real interest rate. For simplicity, r is assumed to be constant and there is no inflation. B is the end-of-period stock of debt and t denotes a time period (where t would denote a year if G and T represented annual flows). In equation (1a), government current spending, including debt servicing is financed from taxes and changes in debt. Rearrangement gives the equation for the evolution of debt between period t and $t-1$ (i.e., over one year if t denotes a year):

$$B_t = B_{t-1} + rB_{t-1} - T_t + G_t \qquad (1b)$$

The government's primary balance, *PB*, excludes all transactions involving debt and is defined as:

$$PB_t = T_t - G_t \tag{2}$$

A positive value of PB_t indicates a primary surplus arising from the flow of *T* and *G* transactions during the period *t*. The overall fiscal or "operating" balance for period *t* (OB_t) is defined as:

$$OB_t = PB_t - rB_{t-1} \tag{3}$$

The primary balance isolates the underlying spending and tax paths from any dynamics created by the interaction of the interest rate and debt (or financial assets). This is important in the context of the fiscal gap because it is assumed that the fiscal authority can directly influence *T* and/or *G* and change them if necessary to satisfy the IBC.

The IBC is concerned with the future paths of fiscal and economic variables. By repeated substitution, debt at time *N* (i.e., B_N) is a function of its initial value and the entire series of primary balances realised between the initial period and *N*. If the stock of outstanding debt grows at a rate less than *r*, then in the limit, the present discounted value of terminal debt goes to zero as time tends to infinity:

$$\lim_{N \to \infty} \frac{B_N}{(1+r)^N} = 0 \tag{4}$$

If this terminal condition is satisfied, then the government's IBC holds if the excess of primary surpluses over primary deficits, in present value terms (the right-hand-side of equation 5), matches the value of outstanding debt (B_0):

$$B_0 = \sum_{j=1}^{\infty} \frac{PB_j}{(1+r)^j} \tag{5}$$

This expression is sometimes described as the government's present value budget constraint (PVBC). Now let debt and the primary balance be defined as ratios-to-output, *b* and *pb* respectively, where $b_t = B_t / Y_t$, $pb_t = PB_t / Y_t$ and where Y_t is real output in period *t*. Assume that the economy operates with a long-run real interest rate above the long-run real growth rate of output (*g*), where the latter is also assumed to be constant.[4] If:

$$\lim_{N \to \infty} \left(\frac{1+g}{1+r} \right)^N b_N = 0 \tag{6}$$

then an analogous version of equation (5) is given by:

$$b_0 = \sum_{j=1}^{\infty} \left(\frac{1+g}{1+r} \right)^j pb_j \tag{7}$$

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[4] The assumptions imposed to derive the IBC impose a no Ponzi finance condition. A no Ponzi finance condition rules out the possibility of debt being issued at some date and being rolled over forever (see Romer, 2001 Chapter 11). It is also assumed that the real interest rate is exogenous. Section 4 discusses further the relationship between the real interest rate and the real growth rate.

2.2 The fiscal gap

Following Auerbach (1994), the fiscal gap can be defined as the immediate and permanent change in the primary balance (brought about by tax changes and/or spending changes) that, if projections prove accurate, would be needed to bring the debt-to-gross domestic product (GDP) ratio at some date *T* in the future to the level that prevails at some initial date *t* (see Section 3 below for further discussion).

The fiscal gap can be "closed" through changes in taxes (*T*) and/or (non-interest or primary) spending (*G*) that permanently alter the primary balance. Closing a fiscal gap does not imply eliminating any current difference between taxes and primary spending, as the primary balance may be non-zero in the initial year.

Based on Auerbach (1994, p.170), and using the notation from above, the change in the primary balance as a share of GDP (Δpb) required to eliminate the fiscal gap is equal to:

$$\Delta pb = (r-g)\left[b_t + \left(\frac{1}{1+r}\right) \frac{\sum_{s=t}^{T} - pb_s \left(\frac{1+r}{1+g}\right)^{T-s}}{\left(\frac{1+r}{1+g}\right)^{T-t} - 1} \right] \qquad (8)$$

where *T* denotes the terminal year, *t* is the initial year and pb_s is the primary balance as a share of GDP in year *s*. A positive value for Δpb from equation (8) implies that a permanent increase in the primary surplus (or a permanent reduction in the primary deficit) is needed to ensure that the initial debt-to-GDP ratio (b_t) is attained in the terminal year. A negative fiscal gap means that a permanent reduction in the primary balance is consistent with returning to the initial debt-to-GDP ratio in the terminal year. A fiscal gap of zero indicates that the projected path of the primary balance is such that the initial debt-to-GDP ratio is attained in the terminal year.

If the real interest rate exceeds the real growth rate of output (i.e., if $(r - g) > 0$), and there is some initial debt, then $pb_s = 0$ for all periods beyond *t* will imply a non-zero fiscal gap. In these circumstances, expression (8) reduces to $\Delta pb = (r - g)b_t$. A primary balance of zero will see debt servicing add to debt. With $r > g$ debt servicing will add to debt faster than the rate of output growth and the debt ratio will increase. Primary surpluses will be required at some point to stabilise the debt ratio.

The fiscal gap indicator is similar to the "tax gap" set out in Blanchard (1993). The tax gap is the difference between the actual tax rate and a constant tax rate that ensures fiscal sustainability in terms of the IBC.[5] The fiscal gap is also similar to the measure of "Economic Net Worth" (ENW) set out in Wells (1996). ENW is defined by the present value difference between a time–*H* forecast debt ratio and a desired debt ratio. ENW is zero if on unchanged fiscal policy the path of primary surpluses is consistent with the desired debt ratio at the terminal date. The methodology allows calculation of the

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[5] For a further discussion on fiscal sustainability and the construction of relevant indicators (including tax gaps) see the papers in Bank of Italy (2000). Chapters 1 and 2 in Verbon and van Winden (1993) cover similar issues.

proportional change to the sequence of primary balances needed to meet the terminal date debt ratio.

Recent work by the OECD on the fiscal implications of population ageing has considered a similar measure. For a “stylised” OECD country (i.e., one which has the features of the median OECD country) the analysis calculates the change in the primary balance needed to ensure a broadly unchanged debt-to-GDP ratio at the end of the projection period (2050) (see OECD, 2001; Dang, Antolin and Oxley, 2001).

Calculating a fiscal gap using equation (8) requires projections of future primary balances and projections of future interest rates and growth rates. These elements are discussed in Sections 3 and 4 with reference to overseas applications of the methodology.

2.3 The fiscal gap and long-term fiscal policy

Taxes distort behaviour and the costs of these distortions are typically referred to as the deadweight loss of taxation or the excess burden of taxation. Because of the increasing marginal tax burden, an optimal tax regime would have the property that marginal and average tax rates remain broadly constant over time rather than switching between low and high rates. This is why the approach is often termed “tax smoothing” (see Barro, 1979).

Credit Suisse First Boston (1995) analyse these issues given the key characteristics of the New Zealand economy (i.e., small, open, presence of distorting taxes, openness to world capital markets, emigration and local demographics). They conclude that current and capital spending plans should be determined independently of the debt decision, and on the basis of efficiency considerations. Optimal tax policy would plan for a constant average (and marginal) tax rate through all future periods. Under a constant tax rate, this approach will involve budget deficits and surpluses (and so fluctuations in debt) when there are fluctuations in government spending and when there are fluctuations in the tax base (for example, real income). This is in contrast to a “balanced budget” approach, where taxes and/or spending are changed through time so that debt is held constant.

They analyse the case of “unbalanced” growth in government spending (i.e., spending grows faster than GDP). The projected effect of population ageing on future primary spending means this is more relevant than the “balanced” growth case. The IBC would imply a higher immediate and constant tax rate to avoid subsequent tax increases. Assets would be accumulated to finance some portion of future spending out of interest income to meet the higher future government spending arising from population ageing.

Closing a fiscal gap via a one-off permanent change (now or in the future) can be viewed as long-term tax smoothing in a deterministic setting. The fiscal gap is closed either by permanently increasing taxes, or holding taxes constant and permanently changing spending (or some combination). Regardless, debt becomes the residual.

An evaluation of the relative merits of tax smoothing versus balanced-budgets is outside the scope of this paper. For a given unbalanced path of spending, the fiscal gap merely provides a way of quantifying the financing consequences of tax smoothing for fiscal flow and stock variables.

The approach taken to financing a given path of long-term government spending would influence the formulation of long-term fiscal objectives under the Fiscal Responsibility Act

1994. For instance, a policy to smooth taxes given the path of future government spending would mean running sustained operating surpluses, followed by an extended period of operating deficits. This would need to be incorporated into the long-term operating balance, debt and net worth objectives required by the Act. A balanced budget approach, which entails altering, taxes and/or spending would require changes to the long-term objective for expenses.

3 Projecting primary balances

When the terminal date *T* in equation (8) is set at less than infinity the fiscal gap is solving to ensure that the debt-to-GDP ratio returns to the initial ratio in the specified terminal year. Taxes and/or spending are adjusted to generate a path of primary balances that returns the debt ratio to the initial value. (It is possible to specify alternative debt targets.) Although an infinite time horizon seems the most relevant for government, it raises questions about the appropriate "current policy" projection of the primary balance given the uncertainty behind the parameters affecting taxes and spending. Shorter-term, finite horizons are often used to provide a "consistency check".

The US Congressional Budget Office (CBO, 2000) calculates fiscal gaps over a 75-year time horizon (the same time period used by the US Social Security trustees in their projections). In the context of population ageing, Blanchard suggests the application of a "long-term tax gap" for a 50-year period that, at a minimum, should include major transfer programmes and use simple assumptions about other spending programs. In calculating ENW, Wells (1996) sets the time horizon *H* (analogous to *T* above) to match the lifetime applicable to the youngest existing generation (i.e., the generation born in the initial year, which gives *H* = 75 years).

In his application of the fiscal gap to the long-term US fiscal position, Auerbach (1994) considers terminal dates of 2031, 2071 and ∞. Auerbach (1994, 1997) and Auerbach and Gale (1999a) argue that terminal dates set at less than infinity are arbitrary and understate the magnitude of the US fiscal balance because the primary balance is projected to be in deficit in the years approaching 2070 and those that follow.[6] Ongoing primary deficits result from their assumption that taxes to GDP are constant, and Social Security and Medicare maintain their 2070 expenditure shares of GDP in subsequent years as the population structure stabilises. These assumptions allow for the calculation of a "permanent" time horizon measure of the fiscal gap. For the US this will be greater than the fiscal gap calculated for a finite horizon *T.* This is because the primary deficits projected after 2070, which are included in the permanent measure, are larger than those in a typical year up to 2070.

Table 1 summarises a selection of US fiscal gap estimates generated by the CBO and Auerbach and Gale to provide a sense of how estimated fiscal gaps vary according to the choice of *T* and how they change with updated projections of primary balances. Table 1 indicates that including years after 2070 has a considerable impact on the calculation of the size of the US fiscal gap and the calculations of the fiscal gap change through time.

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[6] Auerbach (1994, 1997) and Auerbach and Gale (1999a,b) use the CBO's long-term fiscal projections, with some modifications.

According to the CBO (1997), around two-thirds of the improvement in the fiscal gap from 5.4% in May 1996, to 4.1% in March 1997 comes from changes in their 10-year projections of taxes and spending.

Table 1 – US Fiscal Gaps (% of GDP)

CBO (1997, 1998, 1999)		Auerbach and Gale (1999a,b)	
1996 May	5.4% (t = 1997, T = 2070)		
1997 March	4.1% (t = 1997, T = 2070)		
1998 May	1.6% (t = 1997, T = 2070)		
		1999 March	0.39% (t = 1998, T = 2070) 1.53% (t = 1998, T = ∞)
1999 December	0.5% (t = 1998, T = 2073)	1999 October	1.30% (t = 1998, T = ∞)

Note: The Auerbach and Gale results are not directly comparable to those of the CBO even over a similar time horizon because of methodological differences. These relate mainly to the exclusion of feedback effects in the Auerbach and Gale calculations. The CBO projections include feedbacks between the fiscal position, national saving and investment, and real interest rates. The effect of the fiscal deficit on investment is assumed to be partially offset by increased private saving and foreign borrowing. There are no economic feedbacks from tax rates to labour supply or private saving, or between government investment and private sector output.

Tax and spending assumptions also influence the size of the US fiscal gap. Beyond the first 10-years the CBO projections use “simple rules” reflecting historical patterns. For example, discretionary spending is held constant as a share of GDP so that discretionary programs rise with inflation and real economic growth. If discretionary spending after 2009 is increased only at the rate of inflation (i.e., there is no real growth in spending and so, with real GDP growing this will involve a falling share of GDP), the 75-year CBO fiscal gap falls from 0.5% to *minus* 0.7%.

Auerbach and Gale (1999b) note that the baseline assumption for discretionary spending in the first 10 years sees its share-to-GDP fall from 6.6% in 1998 to 5% in 2009. As a result, more than half of the 10-year surplus is based on this assumption. If discretionary spending were held at its 1999 share of GDP, Auerbach and Gale’s estimate of the (permanent horizon) fiscal gap increases from 1.3% to 3.17%.

The CBO baseline projections assume that tax receipts remain constant as a share of GDP after the first 10-years. Auerbach and Gale (1999b) estimate that somewhere between 79% and 96% of the recent surge in revenue is assumed to be permanent in the 10-year projections.

The CBO (1999) acknowledge that the tax-to-GDP share at the end of the 10-year baseline projection is higher than in any year during the post-WWII period, except 1998. If receipts are assumed to return to the level in the decade preceding 1994 (19.5% of GDP), the fiscal gap increases from 0.5% to 1.6% of GDP.

The assumptions around revenues and expenses in the Treasury’s projections are discussed in Section 5.

4 Projecting interest rates and growth rates

4.1 Economic growth, the golden rule and dynamic efficiency

Consider first the closed economy version of the neoclassical growth model (Solow,1956; Swan,1956). The growth path of output is determined by the growth rates of the labour force (n) and labour-augmenting technical change (μ). Labour augmenting technical change increases the productivity of labour, while allowing factor shares to remain constant for a given capital–output ratio. Growth in *effective* labour is the sum of growth in actual labour and the rate at which it is augmented ($n + \mu$). In steady-state, output per worker and real wages grow at μ. Furthermore, capital grows at the same rate as output and so the capital–output ratio is constant. With output and capital growing at the same rate as the effective labour force (i.e., $n + \mu$), output per effective worker and capital per effective-worker (capital intensity) are constant.[7]

The level of per-worker consumption is maximised at a capital-to-effective labour ratio k_{gold} that is determined by $n + \mu$. This is the so-called "golden rule" of capital accumulation in a closed economy without capital depreciation. At this point the marginal product of capital equals $n + \mu$, and assuming perfect capital markets, this equals the real interest rate r.

Levels of capital intensity above that implied by the golden rule denote a region of dynamic inefficiency. Reducing capital intensity toward k_{gold} requires a fall in the (exogenous) saving ratio, which sees the marginal product of capital rise and r increase to $n + \mu$.

If capital intensity is below the golden rule rate, the economy is in the dynamically efficient region. An increase in capital intensity requires capital accumulation via a higher saving ratio. As capital intensity increases toward k_{gold}, the marginal product of capital falls, as does r, toward $n + \mu$. Based on the above, it is common to see an economy described as dynamically efficient if the real interest rate is equal to, or greater than the real GDP growth rate.

In a closed economy operating in the dynamically efficient region, the decline in the marginal product of capital as adjustment to the golden rule occurs implies a fall in the rate of return on saving. In a small open economy with perfect capital mobility, world capital markets set the real interest rate. The return to saving is set by the exogenous world real interest rate.

Even if the real interest rate is, in the longer run, determined on world capital markets, it will not necessarily be appropriate to assume a constant real interest rate. The chosen profile of the real interest rate may need to reflect worldwide influences, including demographic change. For a small, open economy like New Zealand, the impact of

[7] For details see Wells (1995, Chapter 13) and Barro and Sala-i-Martin (1995, Chapter 1). The LTFM only projects the path of output using labour input projections and exogenous labour productivity growth (see Appendix). See Benge and Wells (2001) for an analysis in the open economy context. Stiroh (1998) provides a useful survey of the growth models used in the fiscal projections of four US government agencies.

domestic demographics and economic growth on interest rates is likely to be minor. Worldwide demographics are likely to be more relevant.

Population ageing is likely to see a slowdown in labour force growth, slower economic growth and falling returns to domestic capital, creating an incentive to invest offshore. Global capital markets may facilitate intergenerational capital shifts in response to differences in rates of population ageing across regions. In an examination of the various issues, Diamond (1999) concludes that on balance, slower projected economic growth may reduce the return on capital (bonds and equities), but the effect is probably considerably less than one-for-one (for a summary of these issues, see the Appendix in McCulloch and Frances, 2001).

4.2 Interest rate and growth rate assumptions used in practice

Long-term fiscal projections generally rely on an assumption of dynamic efficiency, so that $r > g$. For example, in their 50-year fiscal projections for major OECD countries, Chand and Jaeger (1996) project GDP growth on the basis of labour-augmenting technical change and labour inputs (where the latter is influenced by demographic change). They assume real interest rates of 3.5%, which are on average around 2 percentage points in excess of the real GDP growth rates.

Both Auerbach (1994, 1997) and the CBO investigate the effects of different interest rate assumptions on the fiscal gap. Auerbach (1994) finds that reducing the differential between r and g reduces the size of the fiscal gap over time horizons of around 30 and 70 years as the lower cost of debt servicing dominates the calculation. Recall from Section 3 that Auerbach assumes that primary deficits persist beyond 2070. In this case, projected primary deficits over the permanent time horizon tend to dominate the calculation. So, with a lower interest rate, primary deficits in the future, which are larger as a share of GDP, matter more. Over the permanent horizon the fiscal gap increases when the excess of r over g is reduced.

The CBO's 10-year fiscal projections assume that the interest rate on government debt exceeds the growth rate of output. The differential is assumed to increase through time as rising fiscal deficits crowd out investment, interest rates rise and real economic growth slows. (The projections assume that when the government holds assets these pay the same average interest rate as government debt.)

The recent OECD study on the fiscal implications of population ageing utilised national projection models with an agreed set of macroeconomic and demographic assumptions (see OECD, 2001; Dang, Antolin and Oxley, 2001). OECD analysis indicates that a range of factors will affect future real interest rates, including growth across regions and saving and investment balances (see Turner, Giorno, De Serres, Vourc'h and Richardson, 1998). Given the high degree of uncertainty around the real interest variable, the cross-country OECD exercise proposed that countries use a (constant) real risk free interest rate of 4% over the period to 2050.[8]

[8] In their reference scenario, Turner *et. al.* (1998) project a gradual rise in the world real interest rate from 5% to 5.7% by around 2030, followed by a decline to just below 5% by 2100. This rate is calculated as the weighted average of real interest rates (net of any sovereign risk premium) in each region where the

5 The Treasury's long-term fiscal model and fiscal gap calculations

The budget identity of equation (1) and the subsequent fiscal gap of equation (8) are stylised. The formulation of the Treasury's long-term fiscal model (LTFM) captures all the key variables required for the fiscal gap calculation (r, g, b_t, and pb_s). The LTFM can trace out the path of relevant fiscal balance and stock variables under alternative economic, demographic and fiscal assumptions. The model is based on Generally Accepted Accounting Practice (GAAP) and incorporates a fuller set of assumptions around expenses, revenues, assets and liabilities than embodied in equations (1) and (8).

It is important to note the following features embodied in the LTFM when interpreting estimates of the fiscal gap generated using the LTFM. First, although official population and labour force projections are made out to 2101, the LTFM typically does not project fiscal balances and stocks beyond 2051 (year ending June). This is largely because outstanding student loans, which will influence the borrowing requirement, are not currently projected beyond 2051.

Second, the LTFM projections start at the end of a set of short-term economic and fiscal forecasts. The Treasury's short-term forecasts typically assume that the economy is at or close to trend GDP at the end of the forecast period. As a result, the projected long-term fiscal position is structural and ignores the effects of the business cycle.

Third, the LTFM does not incorporate any feedback between the fiscal position and macroeconomic variables such as productivity or interest rates.

Fourth, the LTFM assumes a positive inflation rate and results are generally expressed as ratios-to-nominal GDP. As discussed in Section 5.3 below, the effects of inflation on the tax take (i.e., fiscal drag) are generally excluded.

Finally, the version of the LTFM used here is deterministic in that each input (e.g., labour productivity growth) is given a single value for each year and the model produces a single outcome. Lee and Edwards (2001) use a stochastic approach to modelling the fiscal effects of ageing in the US. They use time series methods to fit stochastic models for input variables such as labour productivity growth, real interest rates and demographics. In most cases they constrain the central path for each input variable (i.e., its long-run mean) to match the assumptions of agencies like Social Security and the CBO. Historical information provides estimates of the variance of the error term around the imposed mean. The stochastic projection uses random draws to assign values to each input in each year. When combined with other components (e.g., cost drivers) these generate a stochastic outcome. The projections are run repeatedly (1000 times) and the frequency distribution for the outcomes is used to generate a probability distribution of outcomes. Recent CBO analysis of the finances of US Social Security uses a similar approach, attaching ranges of uncertainty for inputs such as mortality, unemployment, inflation and the real interest rate (CBO, 2001). Modelling uncertainty around inputs into the Treasury's LTFM using stochastic techniques could complement the more typical "what if?" analysis. The "what if?" analysis generally considers changes to the trend in input variables as well as changes to policy parameters such as the indexation of spending to real wages, or the

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weights reflect the share of each region in world output.

target debt level. Stochastic analysis requires a careful assessment of the interdependence (covariance) of input variables.

5.1 Demographics

Demographic projections are a key input to the LTFM and are summarised in Table 2 (details on the assumptions are in the Appendix).

Table 2 – Demographics (June years)

	Population by age group (000)			Dependency ratio (per 100 people in the age group 15-64)		
	0 - 14	15 -64	65+	Child	Elderly	Total
				0-14	65+	(0-14)+(65+)
				15-64	15-64	15-64
1981	842	1,977	307	43	15	58
1999 (Base)	875	2,490	446	35	18	53
2001	878	2,526	457	35	18	53
2021	775	2,819	781	27	28	55
2041	763	2,709	1,170	28	43	71
2061	737	2,618	1,221	28	47	75
2081	697	2,530	1,190	28	47	75
2101	674	2,413	1,152	28	48	76

Note: 1981 is historical and based on a De Facto population definition. From 1999 the definition is Resident population. Projections are Series 4 (see Appendix for details).
Source: Statistics New Zealand

The elderly dependency ratio embodied in the LTFM increases from around 18 (per 100 people in the age group 15-64) in 2001 to 43 in 2041. The increasing proportion of the population aged over 65 is due partly to the “baby boom” generation passing into higher age groups, and also to the effects of increasing longevity and falling fertility. By 2061 the elderly dependency ratio is projected to reach 47 and there is less change after this point.

The effect of the increase in the elderly dependency ratio on the total dependency ratio is partially offset by the decline in the child dependency ratio. The fall in the child dependency ratio dominated during the 1980 to 2000 period. Thereafter, the increase in the elderly dependency ratio dominates. Nevertheless, the total dependency does not reach the 1981 level until around 2021. However, the composition is quite different.

Raw dependency ratios do not necessarily capture “economic dependence” – some people aged 15-64 are not in employment, some aged over 65 are. The LTFM allows for this by incorporating projections of the labour force that are derived using age group specific labour force participation rates. These labour force projections are combined with assumed long-run rates of unemployment and productivity growth to determine real economic output. In addition, the LTFM builds in the change in the composition of the population and the fact that government spending differs across age groups.

5.2 Expense assumptions

Long-term fiscal scenarios generated by the LTFM use a "bottom-up" approach to expense and tax revenue assumptions.[9] Expenses are projected by functional classification (e.g., social security, health, education, law and order). Some of these classifications are influenced by demographic changes and are projected on an age-related basis. For example, health expenses are influenced by numbers in particular age groups and the amount spent on each age group. Per person expenses for health, education, and social welfare transfers are assumed to increase in pre-specified real per capita terms. This increase generally equals the assumed rate of increase in real wages and hence growth of labour productivity. There are several major items that are sensitive to population projections and are expected to have an important effect on the expenditure profile: New Zealand Superannuation (NZS), Health, Education, and Social welfare.

The projected number of retirees and legislation regarding entitlements determines expenses for public pensions (that is, NZS). Payments of NZS are currently linked to nominal wages and so to real wages and labour productivity.

A number of factors make the projection of health expenses uncertain. The LTFM assumes static cost weights for health spending.[10] There is uncertainty as to whether longer life expectancies will see extended periods of health care at higher age brackets or whether costs will be shifted to later years of life (the "proximity to death" issue). Static age-related spending profiles may overestimate the impact of ageing on health spending. On the other hand, the LTFM assumes that the weights increase in line with real wages and labour productivity. This may underestimate future health costs if the long-term elasticity of health spending to per capita income is greater than one. Although technological advances may work to reduce medical costs for specific procedures, this may result in the procedures being applied to a greater proportion of patients and thereby increasing total costs (see Lee and Skinner, 1999).

Education is the other major expenses area influenced by demographics. Social welfare transfers (e.g., unemployment) are influenced by the rate of "take-up" and grow with wages (so as to avoid a significant decline in benefits-to-wages over the long term). Expenses not directly influenced by demographics, such as core government, law and order, and defence grow at a specified real rate.

Compared to NZS, which has a legislated link to wages and an age of eligibility, the assumptions for other areas are more problematic. There is uncertainty surrounding demographic and economic assumptions, technological change, behavioural responses and the role of future governments in providing particular goods, services and transfers. Given their labour content, and in the absence of major changes to input structure (e.g., capital-labour ratios), health, education and other expenses will in the long-term be influenced by wage growth.

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[9] The use of the bottom-up approach means that fiscal aggregates are not directly comparable to the 10-year projections in *Fiscal Strategy Reports* (see Annex 3 of the *Fiscal Strategy Report 2001* for details).

[10] Health cost weights are estimated for age-by-gender groups (e.g., 0-5 year old females) for seven expense categories. Although the dollar value of the per-person cost rises with inflation and the real growth factor, the weights are unchanged (i.e., the profile across the age structure is assumed to be constant). Dang, Antolin and Oxley (2001) canvas some of the alternative approaches used by countries to model health costs. The issue of long-term health projections is also discussed in detail by the European Commission (2001).

5.3 Tax revenue assumptions

In "bottom-up" mode average effective tax rates are assumed to remain constant. Effects on the tax take arising from the interaction of rising incomes and the progressive tax system are therefore not modelled (i.e., there is no "fiscal drag" or "bracket creep").[11] In the presence of inflation, this assumption is equivalent to assuming labour income tax brackets are inflation-indexed. Possible changes to the tax base are implicitly offset by revenue neutral policy changes (tax scales are implicitly "indexed" because there is inflation).[12]

5.4 Capital, debt and interest rate assumptions

In GAAP, capital expenditure is treated as a financing item that affects debt but is not included in the Statement of Financial Performance (and hence the operating balance), which instead records a non-cash depreciation expense. The LTFM assumes that replacement assets are purchased to maintain depreciating assets (so that non-cash depreciation is neutral in terms of the gross debt calculation). In essence, this shifts the projected operating balance towards a cash balance after investing activities. Over and above this, the LTFM in "bottom-up" mode allows for some increase in physical assets (see Appendix for details).[13]

In the LTFM, fiscal surpluses over and above capital and investing requirements are used to pay back gross debt, specifically New Zealand-dollar debt. (The New Zealand dollar value of foreign-currency debt is held constant at the level of the last year of the fiscal forecasts - with offsetting foreign-currency assets to ensure net foreign-currency debt is around zero). If New Zealand-dollar debt is fully repaid, and the level of foreign-currency debt is held constant, the government starts to accumulate "financial assets arising from debt elimination". Should fiscal deficits re-emerge it is these financial assets that are used to finance the shortfall. Once they are extinguished, gross debt increases through an increase in domestic debt.

The fiscal gap targets a definition of gross debt-to-GDP that allows for these additional financial assets. This target variable becomes negative when additional assets are accumulated (see Figure 4).

Finally, it should be noted that in general the LTFM assumes dynamic efficiency with $r > g$. Various differences between the interest rate and the economic growth rate can be considered as alternative scenarios. Drawing on the discussion in Section 4.2, the

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[11] In a tax system where marginal tax rates exceed average tax rates, changes in GDP will bring about more than proportionate changes in tax revenues. Rising incomes will see an increasing proportion of taxpayers paying the higher tax rate at the margin and those already on the higher rate being taxed at this on an increasing share of their income. The tax-to-GDP ratio will increase under a progressive tax system without full indexing for the growth of per capita income. Both the CBO and the UK Treasury (Miners, 2000) assume a constant tax-to-GDP ratio.

[12] NZS and social welfare transfers are paid on a gross of tax basis, and this is reflected in total expenses and tax revenues (which increases by around one percentage point of GDP over 50 years).

[13] In 2006 this increase amounts to $1 billion (or 0.7% of GDP). This additional capital spending is conceptually equivalent to the capital contingency provision in the short-term fiscal forecasts (although it is allocated solely to physical assets and not to advances or deficit financing). It remains at around 0.6% to 0.7% of GDP over the period to 2051.

Baseline scenario assumes a real interest rate of 5%.[14] Estimates of generational accounts for New Zealand have used real interest rate assumptions of 7%, 5% and 3% (see Baker, 1999 and the discussion in Section 2.4 of Auerbach and Kotlikoff, 1999). Given typical assumptions about labour productivity growth and labour input growth, these rates are above the real GDP growth rate. Wells (1996) also assumes that the economy operates in an efficient region (using r = 5% and g = 3.2%). The LTFM also applies the long-term government bond rate to both debt and "financial assets arising from debt elimination".

6 Fiscal gap calculations

This section presents estimates of the fiscal gap generated using the LTFM. The fiscal gap scenarios are based on assumed paths for revenues and expenses explained in Section 5. There can be a tension between what is assumed and what a particular Government might seek to achieve. Governments always retain the option to adjust both policy settings and financing approaches. The analysis that follows is designed therefore to illustrate the long-term implications for fiscal balances and debt if current policy settings remain unchanged, and the change in policy settings that would be required to satisfy the IBC.

6.1 The unconstrained Baseline scenario

In equation (8) the initial debt ratio is used as the relevant target for time *T*. Given an exogenous track for the primary balance, the approach taken is to calculate the fiscal gap under a target where the gross debt ratio returns to its current level of around 30% of GDP. (The Appendix provides an explanation of the relationship between gross and net debt.) Alternative scenarios examine how the fiscal gap varies with alternative expense growth assumptions, terminal debt targets, real interest rates, productivity, unemployment and net migration. The analysis is assumed to be independent of specific government fiscal objectives and financing approaches. The underlying profiles for tax revenues and non-finance expenses are assumed to be exogenous to the financing choice. Partial pre-funding of New Zealand Superannuation (NZS) through the NZS Fund can be seen as a financing choice.[15] The path of the actual primary balance may differ in the absence of the Fund. So, while the analysis below generally removes the Fund and allocates surpluses to debt reduction, this implies that primary expenses and taxes do not change.

Details of the assumptions for the scenarios are provided in the Appendix. Until 2005, all the scenarios are largely based on the four-year fiscal forecasts in the *Budget Economic and Fiscal Update 2001*. Table 3 sets out the starting position for the key fiscal flows and balances.

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[14] In the LTFM, the level of the long-run real interest rate is set exogenously and the nominal interest rate is determined via a Fisher relationship. In the long-term, Consumer Price Inflation is assumed to average 1.5% per year, as is GDP deflator inflation. The model does not incorporate any relationship between the projected fiscal position and interest rates (say via an increased risk premium).

[15] For details on the financing arrangements created by the Fund, see McCulloch and Frances (2001).

Table 3 – Revenues, expenses and fiscal balances (Forecasts for year ending June 2005)

	$ million	% of GDP
Tax revenues (a)	43,468	32.3
Compulsory fees, fines, penalties and levies (b)	475	0.3
Sales of goods and services, other operational income (c)	893	0.7
Investment income	1,265	0.9
Total revenues	**46,101**	**34.3**
Total expenses	43,410	32.2
Revenues less expenses	2,691	2.0
Net surplus of State-owned Enterprises & Crown Entities	918	0.7
Operating balance	3,609	2.7
Finance costs	2,022	1.5
Non-finance expenses (d)	**41,388**	**30.8**
"Primary" balance (= a + b + c – d)	**3,448**	**2.6**
Memo items		
Depreciation (Physical Assets and State Highways)	926	0.7
Purchase of physical assets	846	0.6
Capital contingency provision	850	0.6
Nominal GDP	134,563	

Note: Totals may not sum due to rounding. Investment income includes dividend income. Adjusted to remove NZS Fund. Purchase of physical assets is net of sales.
Source: Adapted from Budget Economic and Fiscal Update 2001.

Although the primary balance in Table 3 excludes finance costs and investment income, it does not translate directly into changes in debt as per the equations of the text. The LTFM incorporates a range of factors that influence the borrowing requirement (see Appendix). Table 4 below sets out the starting position for the key fiscal stocks.

Table 4 – Assets, liabilities and fiscal stocks (Forecasts for year ending June 2005)

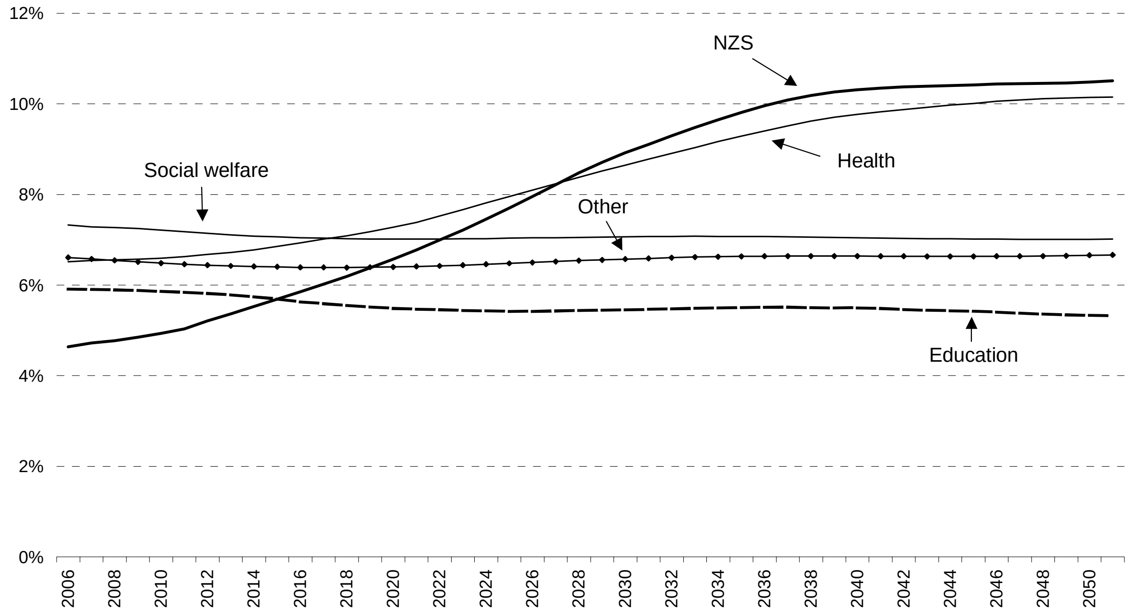
	$million	% of GDP
Financial assets	16,555	12.3
State-owned Enterprises and Crown Entities	18,204	13.5
Physical Assets	18,754	13.9
State Highways	11,410	8.5
Other	5,921	4.4
Total assets	**70,844**	**52.6**
Gross debt	34,181	25.4
Pension liabilities	8,477	6.3
Other	7,110	5.3
Total liabilities	**49,768**	**36.9**
Net worth	**21,076**	**15.7**
Memo items		
New Zealand-dollar debt	26,879	20.0
Foreign-currency debt	7,302	5.4
Nominal GDP	134,563	

Note: Totals may not sum due to rounding. Adjusted to remove NZS Fund. Financial assets include outstanding student loans. State-owned enterprises and Crown entities are combined using the equity method (i.e., amount recorded is net worth). Physical assets include inventories, commercial forests, intangible assets and the cumulated capital contingency. Pension liabilities are the unfunded portion of public sector employee pensions (primarily the Government Superannuation Fund, which is closed to new entrants). The net liability of ACC is included in the State-owned Enterprises and Crown Entities line.
Source: Adapted from Budget Economic and Fiscal Update 2001.

To provide an indication of longer-term fiscal imbalances and their implications for debt, the Baseline scenario is run unconstrained, that is under the expense and tax revenue assumptions outlined in Section 5 above. In the Baseline scenario, NZS is determined by the assumptions detailed above and other demographically influenced expense categories assume real per capita growth of 1.5% per year. This can be thought of as a “wage-indexed” scenario because 1.5% is the labour productivity growth assumption. This, together with other assumptions in the model means that changes in labour productivity growth do not generally alter the share of government spending to GDP. Labour productivity growth enters the numerator (expenses) and the denominator (GDP).

Non-finance expenses are projected to increase from 31% of GDP in 2005 to 40% in 2051. The increase is largely attributable to the effects of population ageing on NZS and Health expenses (refer Figure 1). The cost of NZS is projected to rise from over 4% of GDP currently to over 10% of GDP over the next 50 years. Education declines somewhat as a share of GDP (reflecting the demographics in Table 2) while Social welfare and Other expenses show little change.

Figure 1 – Baseline: Non-finance expenses by functional classification (% of GDP)



This Baseline expense projection combined with the revenue assumptions yields the projected paths for the operating and "primary" balances shown in Figure 2.

Under the Baseline assumptions, "primary" surpluses are maintained for almost two decades and so provide a degree of tax-smoothing as debt-to-GDP continues to fall below initial levels. The difference between the primary balance and the operating balance is attributable to finance costs (which are excluded from the calculation of the primary balance and which decline as debt is reduced) and investment income (which is also excluded from the calculation of the primary balance).

However, primary surpluses switch to primary deficits by the year 2020, and eventually the deficit rises to 5.2% of GDP by 2051. By this time, projected gross debt has increased to around 215% of GDP and finance costs are around 13% of GDP. These changes are reflected in a large operating deficit and negative net worth (the latter reaches minus 154% of GDP in 2051).[16] The eventually larger and continuously rising operating deficit (compared to the primary deficit) reflects the impact of an ongoing rise in debt and debt servicing costs (finance costs). Overall, while projected primary surpluses reduce debt and finance costs initially, the reduction in debt servicing is insufficient to offset the longer-term increase in primary expenses.

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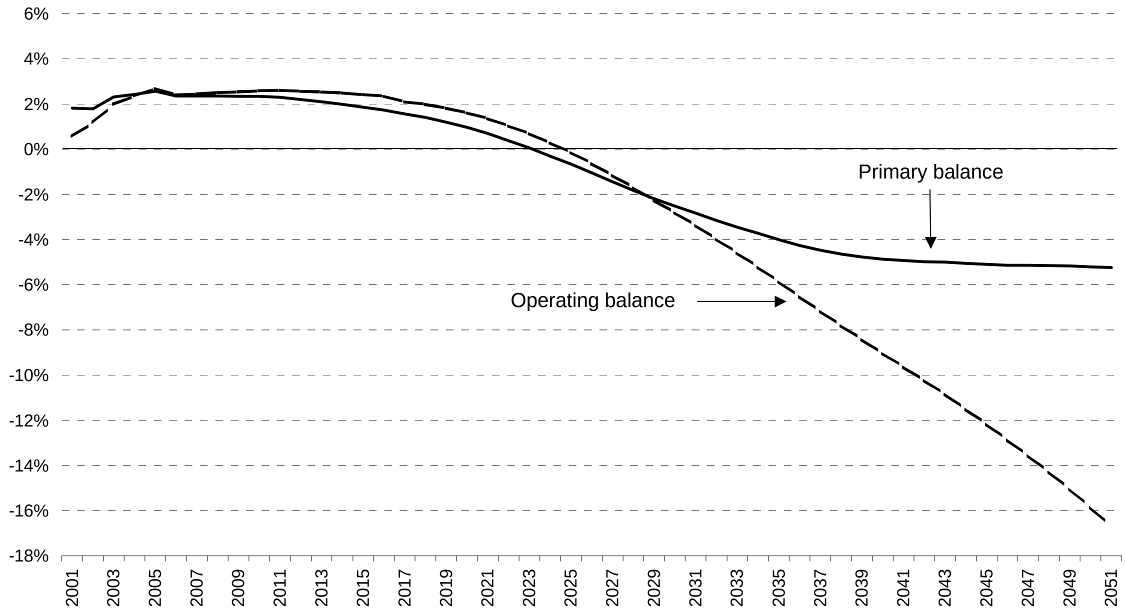
16 Apart from gross debt, the components of net worth are identical across all scenarios (see Appendix). This means that differences in net worth across scenarios simply reflect differences in gross debt. Note that the *levels* of the operating balance and net worth are influenced by the modelling of the Earthquake Commission (EQC). The EQC retains all its operating surplus and no allowance is made for the cost of a major earthquake. The result is an asset growing at a strong compounding rate. Although this is neutral in terms of the debt calculation (see Appendix), the EQC asset grows from around 4% of GDP to 17% of GDP in 2051.

Figure 2 – Unconstrained Baseline: Primary and operating balances (% of GDP)



6.2 Fiscal gap scenarios

The fiscal gap calculates the change in fiscal policy settings needed to achieve a particular debt target at some point in the future. In the following scenario analysis, the initial year for the calculations is 2006 (the first year after the BEFU 2001 forecasts). The calculated fiscal gap is the permanent change in the primary balance needed from 2006 to achieve the target gross debt ratio in the terminal year.

The LTFM calculates the fiscal gap by making a discrete change to taxes to ensure a particular debt-to-GDP target at the end of the projection period (i.e., T). The difference between this new tax-to-GDP ratio and the tax-to-GDP ratio in the unconstrained Baseline projection is the implied change in the primary balance. The change could alternatively be implemented via an equivalent permanent change in the primary expense-to-GDP ratio, or some combination of tax and spending changes.

Table 5 sets out the fiscal gap calculations for the Baseline scenario, together with those for alternative scenarios that incorporate other fiscal and economic assumptions. Each alternative scenario is a complete run of the LTFM with an alternative set of assumptions to the Baseline. The objective is to evaluate what the fiscal gap calculation is sensitive to and where the risks in the calculation process lie.

Table 5 – Fiscal gaps under alternative scenarios, terminal year = 2051 (% of GDP)

Baseline	
"Wage-linked" non-finance expense track (labour productivity growth of 1.5%, Health and Education grow at 1.5% in real per capita terms), real interest rate = 5%, gross debt at 30% of GDP in terminal year	1.57
Lower spending	
Baseline with "Lower spending" non-finance expense track (Health and Education grow at 1% in real per capita terms)	0.42
Higher spending	
Baseline with "Higher spending" non-finance expense track (Health and Education grow at 2% in real per capita terms)	2.88
Lower debt target	
Baseline with zero gross debt-to-GDP in terminal year	1.82
Higher debt target	
Baseline with gross debt at 60% of GDP in terminal year	1.31
Lower interest rate	
Baseline with real interest rate = 3%	1.96
Higher interest rate	
Baseline with real interest rate = 7%	1.21
Lower net migration	
Baseline with zero net migration assumption	1.96
Higher net migration	
Baseline with high net migration assumption	1.04
Delayed adjustment	
Baseline with fiscal gap implemented in 2026	4.24
Lower unemployment	
Baseline with unemployment rate = 5%	1.03
Higher unemployment	
Baseline with unemployment rate = 7%	2.11

Note: In the unconstrained Baseline scenario, tax revenue-to-GDP is 32.3% in 2006 (which is the initial year for all scenarios excepting the delayed adjustment). The fiscal gap is the "% of GDP" added to this ratio.

6.2.1 Baseline scenario

The expense and tax revenue assumptions in the Baseline scenario generate a fiscal gap (Δpb from Equation 8) of 1.57% of GDP, for a 30% gross debt target in 2051. The gap is positive, implying either a permanent increase in taxes-to-GDP and/or reduction in expenses-to-GDP. When interpreting this gap it should be remembered that the implied change is implemented in 2006 and is permanent, so that the required path of primary balances is maintained through to the terminal year. To place the 1.57% in perspective, recall that a zero fiscal gap in the initial year would simply indicate that the Baseline projected primary balances are sufficient to achieve the target debt-to-GDP ratio in the terminal year. For terminal dates up until around 2030, calculated fiscal gaps are negative (see Table 6).

Table 6 – Fiscal gaps under alternative terminal dates (% of GDP)

2011	-1.61
2016	-1.15
2021	-0.80
2026	-0.37
2031	0.14
2036	0.60
2041	1.01
2046	1.33
2051	1.57

The negative fiscal gaps indicate that the projected path of (unconstrained) primary balances (as in Figure 2) are yielding a reduction in debt-to-GDP. Although this would suggest that the primary surplus could be reduced, a longer-term perspective changes this result as population ageing starts to impact.

Figure 3 plots the primary and operating balances under fiscal gap closure (with a terminal year of 2051). In effect, the primary balance has been shifted up by Δpb and the new path of the operating balance reflects the changed paths of finance costs and asset returns. The fiscal gap calculation to 2051 involves significant changes in the path of debt relative to the unconstrained case (that is where fiscal gap is "open"). For example, in the calculation to 2051, (domestic) debt is eliminated and there is a significant, although temporary, accumulation of financial assets (peaking at around 35% of GDP in 2030). Net worth increases from around 16% of GDP in 2005 to a peak of 86%, before declining to 31% as assets are drawn down and gross debt re-emerges.

Figure 3 – Baseline with fiscal gap closure: Primary and operating balances (% of GDP)

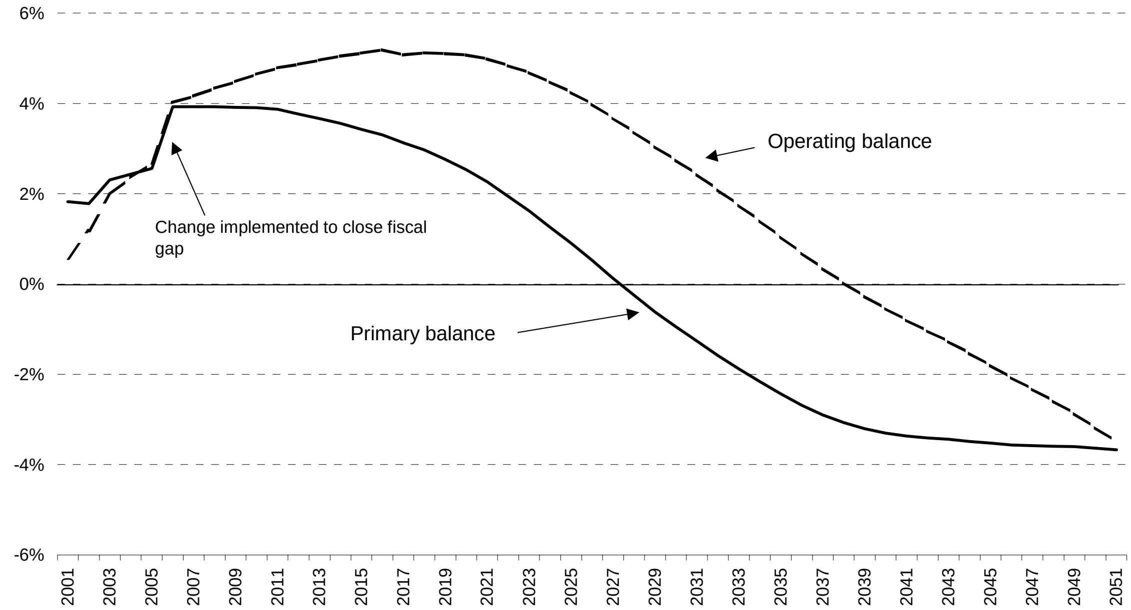


Figure 4 – Baseline with fiscal gap closure: Gross debt (allowing for financial assets from debt elimination) (% of GDP)

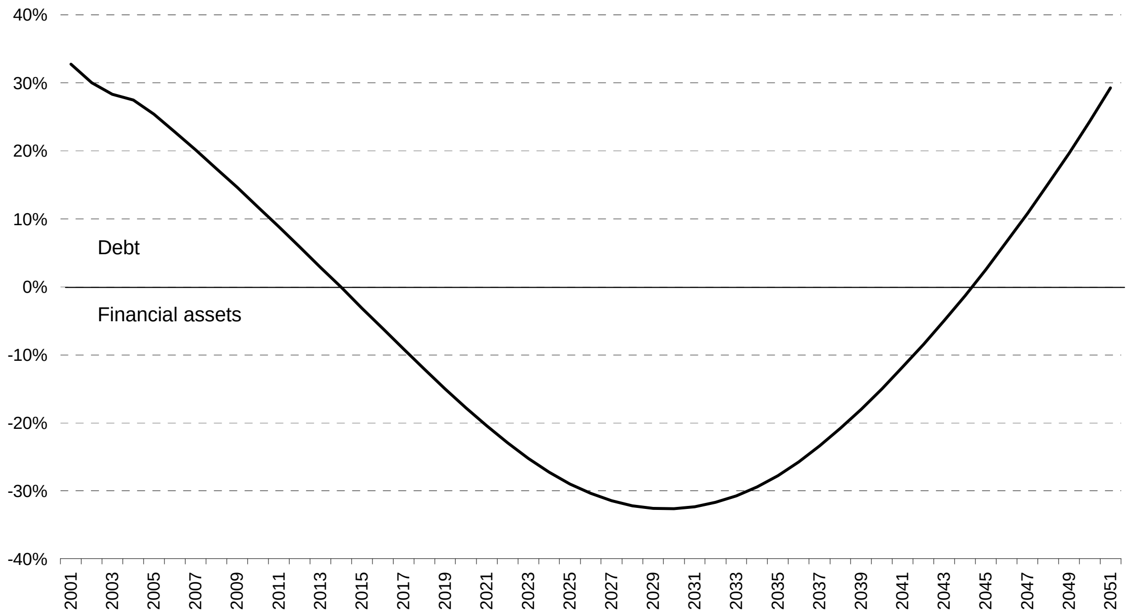


Figure 3 indicates that in the selected terminal year the primary deficit is running at around 3.7% of GDP. Although financial assets have been accumulated, they are drawn down, and by the terminal year the trajectory of debt-GDP is not stable (as illustrated in Figure 4). Because the elderly dependency ratio increases less rapidly after 2051 (refer Table 2), using population projections out to 2101 would see a projected slowdown in non-finance expense growth beyond 2051. Non-finance expenses-to-GDP would tend to stabilise, albeit at a higher level than projected over the next few decades. For a constant tax-to-GDP ratio, this means that primary deficits will also tend to stabilise.

Given that the primary balance is projected to be in deficit in 2051, and assuming it remains in deficit after this date, extending the time horizon will see a larger fiscal gap than that reported in Table 5. Although primary deficits in the distant future are small in present value terms, the assumption that they persist means there are a lot of them. The present value of primary surpluses in the intervening years must be higher than in the case where a shorter time horizon is selected (say T = 2051). As a result, the extent of financial asset accumulation will be larger.

The NZS Fund

If the NZS Fund is included in the LTFM, it is assumed that the primary balance track does not change and projected primary surpluses are effectively channelled into the Fund rather than debt reduction. As a result, gross debt-to-GDP initially increases compared to the case where there is no Fund, although net worth still rises because of increasing Fund assets. Although the drawdown of Fund assets partially covers future NZS expenses, other spending pressures arising from the remaining pay-go element of NZS, as well as health, start to increase primary expenses. By around 2041, gross debt increases to over 100% of GDP. (It is important to note that the Fund is a partial pre-funding device and is not intended to deal with the full extent of projected expense increases – a point recognised in the Fiscal Strategy Report 2000, pages 19 and 24).

The inclusion of the Fund alters the projected path of operating balances and net worth relative to the Baseline case where there is no Fund. This is largely due to the tax paid by the Fund (to the Crown) on its investment income (where that gross return is assumed to exceed the cost of borrowing). The Crown benefits from the tax on gross investment returns in the year the investment income is earned (while the Fund grows by the net return).

Nonetheless, under the Baseline scenario assumptions, the inclusion of the NZS Fund does not alter the underlying mismatch between expenses and revenues. Under a 30% gross debt target in 2051, the fiscal gap is still positive at 1.26% of GDP.

6.2.2 Alternative spending scenarios

There is always a question about what constitutes the current “baseline” policy assumption for long-term scenarios.

In the case of the Lower spending scenario, non-finance expenses rise to 37% of GDP in 2051 and the fiscal gap is 0.42% of GDP. For the Higher spending scenario, non-finance expenses increase to 44% of GDP in 2051 and the fiscal gap is 2.88%. (Recall that non-finance expenses increase to 40% of GDP in the Baseline.)

Although the Lower spending scenario generates a lower fiscal gap, it should be noted that it still implies a sustained period of primary surpluses (although the surpluses are smaller than they otherwise would need to be). In addition, the expense profile may imply policy changes relative to the Baseline. For example, in the Lower spending scenario, real per capita spending on Health and Education grows at 1% per year. This compares to assumed economy-wide productivity (and real wage) growth of 1.5%. Real per capita spending growth of 1% is also below recent historical averages. For example, over the period 1994/95 to 1998/99, real expense growth per capita in Health and Compulsory Education averaged 3.8% and 2.8% respectively (see Table 4 in Woods, 2000).

6.2.3 Alternative debt-to-GDP scenarios

Changing the debt objective has a limited effect on the calculated fiscal gap. Imposing a zero gross debt-to-GDP target sees the fiscal gap increase from 1.57% to 1.82% of GDP. A more relaxed gross debt target (60% of GDP) sees the fiscal gap fall from 1.57% to 1.31% for T = 2051. These results reflect the fact that only small changes in the tax-to-GDP ratio, when implemented now, are needed to achieve a particular debt ratio in 2051.

6.2.4 Alternative interest rate scenarios

The "Lower interest rate" scenario in Table 5 adopts the Baseline assumptions with the exception that the real interest rate (and nominal rate given an unchanged inflation assumption) is lowered to 3% so that it is closer to the rate of economic growth (see Appendix). The differential at 2051 falls from around 3.5 percentage points in the Baseline, to around 1.5 percentage points in the Lower alternative. In the "Higher interest rate" scenario the real interest rate is 7% and the differential at 2051 increases from around 3.5 percentage points to 5.5.

Under both of the alternative interest rate assumptions, fiscal gaps at shorter time horizons follow the pattern shown in Table 6. The fiscal gaps are negative until around 2030 and then become positive. For terminal dates up until around 2030, primary surpluses dominate the calculations. Reducing the real interest rate in this period sees a slightly larger negative fiscal gap compared to the Baseline assumption (and so there is more scope to reduce the primary surplus). Increasing the real interest rate during this period sees slightly smaller negative gaps.

However, as the time horizon goes out to 2051 there are increasingly more primary deficits in the calculation. By 2051, reducing the real interest rate sees the fiscal gap increase relative to the Baseline, from 1.57% to 1.96%. Increasing the real interest rate reduces the gap from 1.57% to 1.21%.

6.2.5 Alternative net migration scenarios

Alternative net migration assumptions will change demographics projections. These demographic changes will then influence the size of the labour force, and all other things being equal, the level of GDP and tax revenues. On the expense side, demographic changes associated with alternative net migration assumptions will influence age-related spending, with the composition influenced by the age and gender mix of migrants.

The Baseline scenario uses a medium net migration assumption of 5,000 per year. A zero net migration assumption sees the fiscal gap rise to 1.96% (the labour force effect is dominating the expense effect). Higher net migration of 10,000 generates a lower (but still positive) fiscal gap of 1.04%.

6.2.6 Delayed adjustment scenario

Both Auerbach (1997) and the CBO consider scenarios where the fiscal gap is calculated at some point beyond the initial year (and so closer to T). Given the profile of primary balances, delaying policy action increases the size of the fiscal gap for a given terminal date.[17]

The Delayed Adjustment scenario in Table 5 uses 2026 as the year in which the tax change is implemented. This choice is arbitrary and simply reflects the approximate mid-point of the projection horizon. As expected, delaying the adjustment means that the change in the primary balance needed from 2026 is larger, with the fiscal gap rising to 4.24%. This scenario assumes that the path of primary balances in the period prior to 2026 is as per the unconstrained Baseline, which sees debt-to-GDP declining.

6.2.7 Starting point and other sensitivities

The CBO results discussed in Section 3 show how changes in 10-year projections influence the fiscal gap with each successive calculation. In the New Zealand context, long-term fiscal scenarios start at the end of a set of short-term fiscal forecasts. The LTFM effectively "straight-lines" many of the key economic and fiscal parameters from the end-of-forecast position. Changes in the base (especially taxes) between forecasts will be permanent across the time horizon considered. This suggests that successive calculations of the fiscal gap through time should consider whether changes to key ratios are permanent (recall the CBO use of historic tax-to-GDP ratios). Section 7.2 discusses how revisions to fiscal gaps through time should be interpreted.

Changes to some structural parameters will also influence the fiscal gap. For example, assuming a long-term unemployment rate of 5% instead of 6% results in a lower, but still positive fiscal gap of 1.03%. With other key factors held constant (e.g., labour force growth and productivity growth), lower unemployment will see higher employment, a higher level of GDP and higher taxes. Unemployment expenses will also be lower.

Assuming higher labour productivity growth does not necessarily lower the fiscal gap because of the link through to real wages and most expense assumptions. For example, assuming labour productivity growth of 2% (and increasing assumed real per capita expense growth rates to match) still generates a positive fiscal gap of 1.76%. The projected ratio of non-finance expenses-to-GDP is essentially identical to that in the Baseline case.[18]

7 Policy issues

This section discusses some of the issues surrounding the interpretation of the fiscal gap that might influence its presentation and use as a long-term fiscal indicator. Applications of the fiscal gap have tended to emphasise its role as a "fiscal indicator". For example, solutions to a long-term fiscal imbalance require adjustments in specific taxes and/or expenditure programmes. But a necessary first step is to understand the size of the

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[17] For a group of 19 OECD countries, Roseveare, Leibfritz, Fore and Wurzel (1996) calculate changes in the tax-to-GDP ratio needed to keep net debt constant (see their Table 6. New Zealand is not included in the analysis). The required change generally increases as the time horizon is pushed out.

[18] The fiscal gap result is not strictly comparable to the Baseline calculation because altering labour productivity (all other things equal) also changes the differential between r and g. With higher labour productivity the differential is reduced. Adjusting the real interest rate upward to match the productivity growth change results in a fiscal gap of 1.66% (cf the Baseline of 1.56%).

imbalance and how large the adjustments must be in the aggregate (Auerbach, 1997). Further, the fiscal gap is an illustrative device for measuring the magnitude of long-term budgetary imbalances, not a prescription for policy (CBO, 1998). However, the uncertainty around fiscal gap calculations needs to be considered when assessing policy changes.

7.1 Uncertainty

Auerbach (1994) notes the natural response of policymakers to downplay long-term projections of the fiscal gap type because they involve considerable uncertainty. He argues that this uncertainty could be more explicitly recognised through the calculation of confidence intervals based on making explicit the stochastic nature of the projections (see for example Lee and Skinner, 1999; Lee and Edwards, 2001; CBO, 2001).

Furthermore, Auerbach suggests that even with unbiased projections, the prospect that things are just as likely to be "worse" than forecast as they are to be "better" should in the face of risk aversion generate more immediate action. Auerbach and Hassett (1999) provide a more explicit model of fiscal policy under uncertainty. They suggest that the consequences of relatively "bad" long-term fiscal outcomes argues for accelerated action, with some precautionary saving in addition to whatever changes are needed to respond to expected fiscal imbalances.

7.2 Policy adjustment

Auerbach (1994, 1997) makes two important points about policy adjustments. First, permanent time horizon fiscal gaps calculated at a particular date t indicate the size of the permanent change in the primary balance-to-GDP (Δ) needed for currently projected fiscal settings to satisfy the government's IBC. This change will satisfy the IBC if the projections at date t prove to be accurate. But a trajectory for primary balances based on Δ may not satisfy the IBC in year $t + 1$ once projections are revised. If the revisions to variables such as growth rates and other economic variables are assumed to be unpredictable, the process for Δ_t, Δ_{t+1}, Δ_{t+2},… will follow a random walk.

With perfect foresight, the strict tax-smoothing mode of Barro (1979) implies constant tax rates. But in the presence of uncertainty, new information leads to a revision of tax rates and tax-smoothing implies that tax rates would follow a random walk. This might suggest a policy of implementing each period's Δ immediately and as a consequence letting the tax rate follow a random walk. Tax rates would be revised on the basis of the new information affecting the fiscal gap. This will ensure that only small changes (spread over time) are needed, thereby minimising deadweight losses. This might be tempered by the infeasibility or undesirability of frequent changes in tax rates because of short-term macroeconomic considerations.

The CBO calculations of the fiscal gap suggest that Δ is influenced by revisions to projections (as illustrated in Table 1 above). Note that large expected events like population ageing are already incorporated into the projections of the primary balance. Auerbach argues that the fact that the fiscal gap will change does not alter the fact that it is an optimal forecast at date t.

Changes in the fiscal gap resulting from projection updates will capture a range of factors. These will include "forecasting changes", such as those around the levels of taxes and spending to GDP. However, changes in the starting point will also reflect structural policy decisions. For example, a decision to lower taxes will, without a corresponding change in spending, increase the fiscal gap (as the tax change will be modelled as permanent). Presentation of fiscal gap calculations through time should ideally decompose changes into their key sources.

Secondly, although uncertainty might suggest that governments deal with future fiscal problems closer to when they occur, Auerbach (1997) argues that the problem already has occurred. In this view, short-term fiscal surpluses are a misleading indicator because they exist only because accounting methods ignore the accruing liabilities of future entitlement benefits. Delaying policy adjustment until measured deficits increase will require even larger adjustments to policy settings that are less desirable on both efficiency and equity grounds.

8 Concluding remarks

Long-term debt projections generated by a model like the Treasury's LTFM are not always useful in communicating the extent of implied policy change. Resolving this issue requires a consideration of the government's intertemporal budget constraint (IBC), which requires that all government spending must eventually be financed, either in the current period through taxes or over time through interest on debt. The fiscal gap calculates the change in fiscal policy settings needed to achieve a particular debt target at some point in the future. When interpreting the fiscal gap results it is important to keep in mind the following points.[19]

First, like most current assessments of sustainability, the fiscal gap provides only a partial analysis. This is largely because theory and evidence provide limited insight on the long-run relationships between the fiscal position and variables like productivity growth.

Second, the fiscal gap involves arbitrary choices about the target debt-to-GDP ratio (as in Table 5) and the time horizon (as in Table 6). This reinforces Auerbach's argument in favour of an infinite time horizon and permanent fiscal gap.

Third, because it is a numerical indicator, the fiscal gap does not convey the timing of fiscal pressures. It is important to compliment the indicator with time-plots of projected fiscal aggregates.

Fourth, fiscal gaps will typically involve a sequence of debt reduction, and possibly (temporary) asset accumulation. A fiscal gap indicator says nothing about the gains of a particular financing approach (e.g., efficiency gains from tax-smoothing) or the potential difficulties involved (e.g., sustaining fiscal surpluses, management of a large pool of assets).

On this last point, the economic and policy issues surrounding population ageing are complex (see Turner *et. al.*, 1998; OECD, 2001; Visco, 2001) and go well beyond what can be captured in a single numerical indicator like the fiscal gap. Despite the above caveats, the fiscal gap can indicate, in a numerical sense, the potential size of long-term imbalances between taxes and spending under reasonable policy assumptions – including

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[19] The first three points are based on Balassone and Franco (2000).

those considered here, namely broadly constant tax-to-GDP and productivity-linked expense growth. The provision of alternative scenarios allows users to judge the seriousness of any fiscal imbalance based on their views on the path of taxes, spending, interest rates and other variables.

The fiscal gap can illustrate the direction of fiscal policy adjustment, the broad magnitude of that adjustment and how it changes through time. Such a measure can supplement existing indicators such as the balanced-budget tax rate which calculates the tax-to-GDP ratio needed annually to ensure the stability of a particular debt-to-GDP ratio (for example, see Figure 15.1 in Baker, 1999).

The fiscal gap can indicate the intertemporal consequences of fiscal policy. For example, adopting a wait-and-see approach may impose large adjustments further down the track (as in Table 5). Similarly, reductions in the primary balance (say through tax reductions or spending increases) may be consistent with a desired debt-to-GDP ratio over the medium-term. But, extending the time horizon could indicate that such a decision would increase the size of future imbalances (as in Table 6). Because the LTFM assumes that the interest rate and GDP are independent of the fiscal gap, the gaps prime purpose is to highlight the intertemporal distribution of fiscal policy.

Finally, the fiscal gap methodology provides a platform for the further examination of long-term fiscal imbalances under a wider range of assumptions (e.g., demographics, labour force participation, health spending) and modelling techniques (e.g., stochastic analysis).

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Appendix: Assumptions and model details

Until 2005, all fiscal gap scenarios are largely based on the four-year fiscal forecasts in the *Budget Economic and Fiscal Update 2001*.

Economic assumptions

Table A.1 summarises the economic assumptions in the short-term forecasts and long-term scenarios.

Table A.1 – Key economic assumptions (years ending June)

	2002	2003	2004	2005	2006- 2051 (average)
Real GDP growth (% change)	2.7	3.4	2.9	2.8	1.6
Nominal GDP growth (% change)	4.1	5.3	4.5	4.2	3.1
Labour force growth (% change)	1.2	1.5	1.5	1.2	0.1
Unemployment rate (Household Labour Force Survey, %)	5.4	5.1	5.1	5.1	6.0
Inflation (Consumer Price Index, % change)	2.3	2.3	2.2	1.8	1.5
Nominal interest rate (10-year Government bonds, %)	7.6	7.5	7.4	6.7	6.5
Compensation of Employees (% of nominal GDP)				42.5	42.5

Source: The Treasury, Statistics New Zealand

Real GDP grows in line with labour productivity (annual growth rate of 1.5%) and projected changes in labour input (which move in line with the labour force as rates of employment/unemployment and average hours worked are held constant).

Labour and capital shares of output are held constant at their 2005 ratios (i.e., the economy is assumed to be on trend from that point and so business cycle effects are ignored).

Demographic assumptions

Demographic information comes Statistics New Zealand (SNZ) population projections. The labour force projections used to derive labour force growth (in Table A.1 above) are also from SNZ. They are consistent with the population projections and are on 15 years and over basis. The population and labour force projections use a 1999 Base year. The Baseline fiscal gap scenario uses the SNZ “Medium” series population and labour force projections. The key assumptions are given in Table A.2.

Table A.2 – Key population and labour force assumptions (years ending June)

SNZ Medium population and labour force scenarios	1999 Base	2051
Fertility rate, births per female	1.98	1.90*
Mortality, male life expectancy at birth	75.2	82.0*
Mortality, female life expectancy at birth	80.4	86.5*
Net migration	Long term levels of 5,000 per year	
Labour force participation rates	Rates change until 2011. The rates for males are assumed to continue to decrease slightly for most ages 20 to 54 years. For ages 55+, the rates increase to reflect changes in the age of eligibility for NZS. For females, rates are assumed to continue increasing for most age groups. However, the pace of change slows and after 2011 the rates are assumed to remain stable at the 2011 level.	

***** Birth rates vary until the year 2011, and then remain unchanged. Mortality rates remain unchanged between 2051 and 2101.
Source: Statistics New Zealand

For simplicity, the LTFM holds average hours worked, the unemployment rate and labour productivity growth constant where in practice these may be influenced by changes in the age/gender composition of the labour force.

Tax revenues and expenses

The path of tax revenue is driven by nominal GDP growth. Because capital and labour shares of output are held constant, tax bases as shares of GDP also remain constant. In "bottom-up" mode the LTFM assumes the tax system is neutral with respect to nominal wage increases and to price inflation (i.e., there is no "fiscal drag").

Table A.3 summarises the expense assumptions used beyond 2005.

Table A.3 – Key expense assumptions

	2006 –
NZS	Demographically influenced and grows in line with wages after reaching 65% of the average wage
Health	Demographically influenced. Increases at 1.5% a year in real per capita terms in Baseline scenario. Increases at 2% and 1% a year in real per capita terms in Higher Spending and Lower Spending scenarios respectively
Education	Demographically influenced. Increases at 1.5% a year in real per capita terms in Baseline scenario. Increases at 2% and 1% a year in real per capita terms in Higher Spending and Lower Spending scenarios respectively
Social welfare transfers	Demographically influenced and indexed to wages
Other	Increase at 1.5% a year in real terms
Finance costs	A function of debt levels and interest rates

Source: The Treasury

The tax and expense assumptions underpin the projections of the operating balance in the projected "Statement of Financial Performance".

Assets and liabilities

The LTFM also projects a "Statement of Financial Position". Satellite models are used to project some of its specific components (e.g., outstanding student loans and the outstanding pension liability of government employees).

As discussed in Section 5.4, the LTFM assumes that replacement assets are purchased to maintain depreciating assets (so that depreciation is neutral in terms of the gross debt calculation).

Three items; Physical Assets, State Highways and the net worth of State-owned Enterprises and Crown Entities largely represent Crown assets. Excluding Military Equipment, assets at the Crown/Departmental level are largely land and buildings. Almost all decisions on physical asset purchases take place outside the budget process, by State-owned Enterprises and Crown Entities (funded from retained surpluses and debt) or by Departments (funded from depreciation funding in baselines, where funding means that an equal amount of depreciation is actually spent on replacement capital goods).

In the LTFM, Physical Assets increase in line with the growth of Total Other Expenses and Defence. State Highways increase in line with the growth of Total Other Expenses. As a result, the ratio of these expenses to the relevant asset is constant .

Finally, some items on the balance sheet remain constant in nominal dollar terms and so fall relative to GDP (e.g., Receivables and inventories, Payables and provisions, Currency issued, and Other financial assets).

The borrowing requirement (change in gross debt) is determined by the difference between the operating balance and changes in assets (e.g., net worth of State-owned Enterprises and Crown Entities, advances for student loans, changes in Physical Assets and State Highways) and changes in liabilities (other than gross debt). This captures the fact that the operating surplus does not reflect cash available for debt reduction (e.g., the retained surplus of State-owned Enterprises and Crown Entities). When the operating balance exceeds the (net) change in assets and liabilities, the borrowing requirement is negative and can be applied to debt reduction or financial asset accumulation.

Net debt is defined as gross debt less selected "Financial assets", where in Table 4 these comprise Marketable Securities and Deposits (predominantly in foreign-currency), advances to State-owned Enterprises and Crown Entities, outstanding student loans, other advances and cash. The selection of financial assets is arbitrary.

Outstanding student loans increase with continued borrowing and accumulating interest. The scheme matures (i.e., outstanding loans level off) as repayments increase. Outstanding loans are projected to increase from around 4.5% of GDP currently to 8% by 2020. They then tail off slightly to 7% by 2050. Other financial assets remain constant in nominal terms and fall as a share of GDP. The combination of these changes means that "Financial assets" increase from 11.5% of GDP to a peak of around 12.3% before returning to around 10%. As a result, net debt tends to reflect movements in gross debt.