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Public Debt Dynamics in New Zealand

Melissa Piscetek

New Zealand Treasury Working Paper 19/01

July 2019

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Abstract

This paper develops a framework to decompose the change in New Zealand's public debt ratio into four component effects: the primary balance, real GDP growth, real interest rates, and exchange rates. We study New Zealand's debt dynamics over three periods: the decade after the Global Financial Crisis (2008 - 2018), the five-year forecasts (2019 - 2023), and the medium-term projections (2024 - 2033). We find asymmetry between the component effects of the debt dynamics on New Zealand's public debt ratio. The primary balance is the larger contributor to the public debt ratio (either positive or negative), while the automatic debt dynamics (the interest-growth differential and exchange rates) are relatively benign.

KEYWORDS

Public debt; debt dynamics; fiscal policy, debt sustainability, fiscal sustainability.

Executive Summary

We establish a framework to analyse New Zealand's public debt dynamics, by augmenting the Fiscal Strategy Model (FSM) with a debt dynamics model. We apply the framework to study New Zealand's public debt ratio in recent history, and to project the dynamics into the future. This contributes to the literature on debt dynamics by formalising an accounting framework to study New Zealand's debt dynamics.

We find asymmetry between the component effects of the debt dynamics on New Zealand's public debt ratio. The primary balance is the larger contributor to the public debt ratio (either positive or negative), while the automatic debt dynamics (the interestgrowth differential and the exchange rate effect) are relatively benign. This pattern may continue. Declining global real interest rates have affected public debt dynamics, and the Treasury forecasts that low interest rates will persist over the next five years.

Since 2008, the primary balance had the largest effect on gross public debt levels in New Zealand. In the years following the Global Financial Crisis (GFC) and Canterbury earthquakes, public debt rose sharply. The Government's fiscal response reduced gross debt from 2013. Across the forecast years (2019 to 2023), the gross debt ratio is expected to decline due to forecast primary surpluses. The medium-term projections (2024 to 2033) show a slightly different trend. Although the gross debt ratio is expected to be lower by 2033, we project a deteriorating primary surplus and increasingly unfavourable automatic debt dynamics. These dynamics are partly driven by the assumption that government bond rates will return to their historical average. Although outside the scope of this paper, there is some evidence that bond yields will remain low. If this is the case, it may alleviate concerns about the automatic debt dynamics in the projection period.

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Public Debt Dynamics in New Zealand

1 Introduction

New Zealand experienced a cycle of public debt accumulation over the past decade. In the wake of the Global Financial Crisis (GFC), and compounded by the Canterbury earthquakes of 2010 and 2011, core Crown debt-to-GDP (a gross debt measure) increased by about 20 percentage points, reaching a peak of 40 percent of GDP in 2013. In 2011, the Government targeted a return to Budget surplus by fiscal year 2015. This target was achieved mainly through slowing the growth of nominal spending so that expenditure-to-GDP declined (Philip, Bose & Sullivan 2017). Since then, debt levels have reduced and, at the time of writing, core Crown debt is at 34 percent of GDP. The New Zealand Treasury (the Treasury) forecasts that core Crown debt will decline to 26 percent of GDP by 2024.¹

New Zealand's increased public debt in the years following the GFC is consistent with global trends for advanced economies. Between 2007 and 2018, gross debt-to-GDP for advanced economies increased by 50 percent (IMF 2019). However, relative to advanced economies, New Zealand's initial gross debt ratio was low. The gross debt ratios for advanced economies, New Zealand, and the global average, is illustrated in Figure 1.





Source: IMF data mapper

¹ The latest forecasts at the time of writing are the 2018 Half-Year Economic and Fiscal Update, published on 13 December 2018.

While New Zealand's public debt ratio remains modest by international standards, history shows us that debt levels can rapidly change. The purpose of this analysis is to develop a framework that can track and explain debt changes in the past, as well as project its dynamics into the future. We introduce a debt dynamics framework and apply it to the Treasury's Fiscal Strategy Model (FSM). The result is a model that attributes the change in New Zealand's gross debt ratio to key factors: the primary balance, real GDP growth, real interest rate, and exchange rate.

This model shows the interaction between the primary balance and the automatic debt dynamics.² This feature adds utility to the model, by improving the ability to analyse the reasons behind changes in debt. For example, if real GDP grows faster than real interest rates, even a neutral primary balance would lead to a reduction in the gross debt ratio. In contrast, if the real interest rate exceeds the real GDP growth rate, the public debt burden may become unsustainable unless the government raises large enough primary surpluses. These tradeoffs are faced by governments, and the debt dynamics model provides a lens to put these tradeoffs into perspective.

The remainder of this paper is structured as follows: Section 2 introduces two concepts of debt sustainability: the academic definition of sustainability, and the more policy relevant definition used in this paper. Section 3 sets out the framework we use to analyse public debt dynamics, along with other measures of debt sustainability. Section 4 presents the results across three periods: fiscal year 2008 to 2018, the Treasury's baseline forecast period (fiscal year 2019 to 2023), and the baseline medium-term projection period (fiscal year 2024 to 2033). Section 5 concludes.

² Automatic debt dynamics refers to GDP growth rate less real interest rate and exchange rate depreciation.

2 Sustainability and debt dynamics

Public debt policy is an important fiscal policy issue, yet there is no consensus on what a suitable debt level is with respect to economic growth. Some studies have found nonlinearity where high levels of initial debt have a proportionately larger (negative) effect on growth (Kumar and Woo 2010, Cecchetti et al 2011). Pescatori, Sandri and Simon (2014) find that the trajectory of debt can be just as important as debt levels, and possibly more important to understand growth prospects. To add more complexity to this issue, it is unclear whether governments still face an intertemporal budget constraint in an environment of low nominal (and real) interest rates that are less than growth rates. Blanchard (2019) presents empirical evidence that this is the historical norm in the United States, rather than the exception, and suggests that public debt may have no fiscal cost.

The model introduced in this paper does not provide answers to these questions. Its purpose is to aid the assessment of debt sustainability by allowing policymakers to assess New Zealand's public debt dynamics. The approach used in this paper is to disaggregate the changes in public debt-to-GDP into the effects of the primary balance³, real GDP growth, real interest rates, and the exchange rate.

This Section begins with an introduction to the concept of debt sustainability. We start with the formal, academic definition and then introduce a broader, policy pragmatic, approach that is relevant for this study. This Section concludes by introducing a formal framework to assess public debt dynamics, and we extend this framework in Section 3 so that it is relevant for the New Zealand context.

2.1 Measures of sustainability

2.1.1 The intertemporal solvency condition

Sustainability can be expressed in-terms of the government's intertemporal budget constraint (Buckle and Cruickshank 2013). Debt is sustainable if the intertemporal solvency condition is satisfied, where the expected present value of the future primary balances (future income less expenses) covers the existing stock of debt. The intertemporal solvency condition can be expressed as:

$$D_0 = (1+i)^{-N} D_N + \sum_{t=1}^{N} (1+i)^{-t} P B_t$$
(1)

where D_0 is the initial stock of debt, Dn is the stock of debt at time t for t = N periods, (1 + i) equals nominal interest and PB_t equals the primary balance in period t. For simplicity, we assume no foreign currency denominated debt, which means that the exchange rates and foreign inflation are excluded from the condition. This budget constraint does not impose spending constraints on the government, because higher deficits simply mean higher debt. To arrive at a more meaningful budget constraint, a terminal debt limit is imposed. Specifically, a no Ponzi game (transversality) condition is applied:

$$\lim_{N\to\infty} (\frac{1}{1+\mathrm{i}})^N D_N = 0$$

³ The primary balance measure is calculated by excluding net interest expense from the cash surplus/deficit when analysing gross public debt dynamics (IMF 2014).

The no-Ponzi game solvency condition can be expressed as follows:

$$D_0 \le \sum_{t=1}^{\infty} (1+i)^{-t} P B_t$$
(2)

This condition requires that the present value of debt decline to zero at the limit, which restricts the government's ability to service debt by issuing new debt on a regular basis. While this condition does not rule out terminal period debt or even growing debt, it does rule out the growth of debt at a rate that is higher than the nominal interest rate (IMF 2017b).

Using the intertemporal solvency condition to assess debt sustainability has its limitations. The approach relies on unobservable information for a future that may not eventuate. Furthermore, solvency can be achieved under the condition even with immediate primary deficits, provided that primary surpluses are generated sometime in the future (IMF 2017b).

2.1.2 Other measures of sustainability

Governments can be viewed as infinitely lived agents that might never repay all their outstanding debt (Ley 2010). Therefore, perhaps more important in the long-term is an assessment of the government's ability to repay its debts relative to a measure of repayment capacity (Ley 2010). Bartolli and Cottarelli (1994) find that, where economic growth exceeds the interest rate, governments face no binding solvency constraint, and could issue debt to service old debt, which would contravene the no-Ponzi game solvency condition. They argue that a milder definition of solvency is appropriate. They propose a bounded debt-to-GDP solvency condition, whereby nominal debt may continue to grow, but that growth in debt must not exceed the rate of GDP growth. They argue that this approach is consistent with the financial solvency condition that is based on an assessment of collateral and liability.⁴

The International Monetary Fund's (IMF's) approach to debt sustainability is that debt cannot grow faster than incomes and the capacity to repay it. Debt is sustainable if projected debt-to-GDP ratios are stable, decline, and are sufficiently low⁵ and if a country can service its debt without the need for implausibly large policy adjustments, renegotiation, or default. Sustainability rules out the accumulation of debt at a rate greater than the capacity to service debt (especially in the long run). (IMF 2017b)

A debt-to-GDP ratio that is stable or in decline implies solvency if interest rates exceed the GDP growth rate (though this is not a favourable condition for the economy). Alternatively, debt-to-GDP can decline even if nominal debt levels increase. This would occur if the GDP growth rate exceeds the interest rate (though it would contravene the solvency condition). Therefore, while debt-to-GDP that is stable or in decline does not

⁴ The boundedness approach to solvency means debt is sustainable if debt-to-GDP is stable or falls. However, it does not guarantee that the no-Ponzi game condition holds. If the interest rate exceeds the growth rate, then the bounded debt-to-GDP approach and the no-Ponzi game solvency condition are equivalent assessments of solvency, however, if the growth rate exceeds the interest rate, the bounded debt-to-GDP approach is less strict as debt-to-GDP could fall even with primary deficits, which is not consistent with the no-Ponzi game assessment of solvency. (Bartolini & Cottarelli 1994).

⁵ In addition to declining, debt ratios must be sufficiently low to avoid the risk of default.

guarantee solvency, it is the decline in the debt burden (in this case debt-to-GDP) that we are concerned with. (IMF 2017b).

2.1.3 A debt dynamics framework

The empirical debt sustainability literature began with Bohn (1995), who ran regressions of the primary balance on lagged debt and other variables to check for debt sustainability. Bohn's framework has been applied to cross-country datasets and has been extended to include a non-linear specification allowing for default risk (D'Erasmo, Mendoza and Zhang 2016). Chung and Leeper (2007) imposed a linearized intertemporal government budget constraint on an identified vector autoregression and studied its implications for fiscal financing. They found robust evidence in favor of a stabilizing role for the primary surplus following shocks to taxes and transfers. Leeper, Plante and Traum (2009) use Bayesian methods to estimate and evaluate a dynamic stochastic general equilibrium (DSGE) model that estimates fiscal policy rules to understand the economic effects of fiscal policy. They show how government debt has been financed historically and examine how adjustments in each fiscal instrument affected the observed equilibrium.

The approach we take in this paper is to use an intertemporal accounting identity that links the accumulation of debt stocks over time to the fiscal balance, disaggregating projected debt-to-GDP into its contributory factors.

The case with no foreign currency denominated borrowing

Building on the debt evolution formula and assuming for simplicity that there is no foreign currency denominated debt (IMF 2017b; Ley 2010)⁶:

$$D_{t+1} = (1 + i_{t+1})D_t - PB_{t+1}$$
(3)

where D_t is the stock of debt at time t, $(1 + i_{t+1})$ equals nominal interest at time t + 1 and PB_{t+1} equals the primary balance in period t + 1.

To measure the debt burden, the level of debt stock is expressed as a ratio of GDP. Therefore, dividing equation (3) by nominal GDP (Y) at t + 1 gives:

$$\frac{D_{t+1}}{Y_{t+1}} = (1+i_{t+1})\frac{D_t}{Y_{t+1}} - \frac{PB_{t+1}}{Y_{t+1}}$$

Denoting the contemporaneous ratios as lower case, we can also let $Y_{t+1} = (1 + g_{t+1})(1 + \pi_{t+1})Y_t$. where g_{t+1} equals the real growth rate of the economy and π equals the domestic inflation rate. We can then show the previous equation as:

$$d_{t+1} = \frac{(1+i_{t+1})D_t}{(1+g_{t+1})(1+\pi_{t+1})Y_t} - pb_{t+1}$$

Expressing the final contemporaneous ratio in lower case, we are left with:

$$d_{t+1} = \frac{(1+i_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})}d_t - pb_{t+1}$$

⁶ We extend this to include foreign currency denominated debt in Section 3.

Applying the Fisher equation that links nominal and real interest rates:

$$1 + i_{t+1} = (1 + r_{t+1})(1 + \pi_{t+1})$$

we arrive at:

$$\frac{(1+r_{t+1})}{(1+g_{t+1})} = \frac{(1+i_{t+1})}{(1+\pi_{t+1})(1+g_{t+1})} = \emptyset$$

where r_{t+1} equals the real interest rate at time t + 1 and \emptyset reflects the coefficient on automatic debt dynamics for a closed economy. With this notation, the government budget constraint becomes:

$$d_{t+1} = \frac{(1+r_{t+1})}{(1+g_{t+1})}d_t - pb_{t+1}$$

This can also be written as:

$$d_{t+1} = \emptyset d_t - pb_{t+1}$$

Next, the change in the debt-to-GDP ratio can be obtained by deducting d_t from both sides and factoring the equation:

$$d_{t+1} - d_t = [\frac{(1+r_{t+1})}{(1+g_{t+1})} - 1]d_t - pb_{t+1}$$

Notice that:

$$\left[\frac{(1+r_{t+1})}{(1+g_{t+1})} - 1\right] = \left[\frac{(1+r_{t+1})}{(1+g_{t+1})} - \frac{(1+g_{t+1})}{(1+g_{t+1})}\right] = \left[\frac{(r_{t+1}-g_{t+1})}{(1+g_{t+1})}\right]$$

This results in an equation that disaggregates the change in debt-to-GDP into movements in interest rates, real GDP growth, past debt and primary balances:

$$d_{t+1} - d_t = \frac{(r_{t+1} - g_{t+1})}{(1 + g_{t+1})} d_t - pb_{t+1}$$

This can be rewritten as:

$$\Delta d_{t+1} = \frac{(r_{t+1} - g_{t+1})}{(1 + g_{t+1})} d_t - pb_{t+1}$$
(4)

And if we assume constant rates for the automatic debt dynamics, we can write the previous equation as:

$$\Delta \mathbf{d}_{t+1} = \frac{(\mathbf{r} - \mathbf{g})}{(1 + \mathbf{g})} d_t - p b_{t+1}$$

The interest rate-growth differential is an important driver of the debt dynamics. The debt dynamics are favourable if r < g (if $\emptyset < 1$) and unfavourable if r > g (if $\emptyset > 1$). If we assume constant values for the parameters (\emptyset , pb) so that d_{t+1} and d_t have a linear relationship, favourable debt dynamics imply a return to a stable equilibrium if debt is changed from its equilibrium (IMF 2013b). Unfavourable debt dynamics imply the opposite: debt becomes explosive if its level is changed from the equilibrium based on constant parameters.

Unfavourable debt dynamics mean that more effort is required to stabilise debt and thus achieve debt sustainability. This underscores the importance of market confidence on borrowing rates and economic growth (IMF 2012). Furthermore, if a country is at a borderline unsustainable level of debt, any shock that lowers growth or increases interest rates could push debt into unsustainable territory.

Globally, the automatic debt dynamics have been favourable since 2008, mainly reflecting lower global interest rates. In his 2019 American Economic Association Presidential Lecture, Oliver Blanchard asks what the implications of current low global interest rates are for government debt policy. He establishes that this condition has been the historical norm in the United States and is expected to continue to hold for a long time. He argues that public debt in this case may have no fiscal cost, though public debt may have welfare costs.

3 Analytical framework

This Section presents the analytical framework that is used to assess public debt dynamics in New Zealand. The Treasury's existing Fiscal Strategy Model (FSM) projects the financial performance and the financial position of the government over a medium-term horizon and links the fiscal flows to the corresponding debt stocks. We augment this model with the public debt dynamics framework set-out in this section. We also introduce other measures to assess debt sustainability: the debt stabilising primary balance and coefficient on the automatic debt dynamics.

3.1 Methodology

3.1.1 Economic Variables in the Fiscal Strategy Model

The FSM projects New Zealand's public balance sheet, income statement and statement of cash flows. The FSM also contains historical years (historical data), the five-year economic and fiscal forecasts, and the ten-year projections. Under the Public Finance Act (1989), the ten-year projections are required to be published in the government's annual report on fiscal strategy.

The economic forecasts

The FSM takes the medium-term economic forecasts as exogenous inputs from Matai, which is the Treasury's macro-econometric forecasting model of the economy. Matai is a dynamic simultaneous equations model, consisting of a set of behavioural equations that characterize the behaviour of New Zealand's economy.

The economic projections

The FSM uses the forecast years as a base to produce the medium-term projections. While this is a growth-based projection model that applies growth rates forecast base, for some of the economic variables, levels are targeted. The projections involve relatively few interactions, drivers and assumptions, and are smooth trends that are not subject to the influences of the business cycle. Projections cannot be used to "forecast" the future, as that would imply a more rigorous methodology. Projections provide an indication of what the future may look like given historical policy settings.

For real (and nominal) GDP, the first projected year's value is derived by applying a growth rate to the final forecast year's GDP value. Each year, the projected GDP rate grows from the preceding year in the same manner. From this point forward, trend growth is assumed in the projections, although, for some economic variables, a transition from their end-of-forecast value to their long-term trend level is required. Real GDP is projected via a labour-based production function, as:

Real
$$GDP_{t+1} = (Real GDP_t)(1 + total hours worked growth_{t+1})(1 + labour productivity growth_{t+1})$$

Real GDP equals the real GDP in the previous year multiplied by total hours worked growth and labour productivity growth. Total hours worked growth is determined using the unemployment rate (UR), average weekly hours worked (AWHW) and the labour force (LF):

Total hours worked growth_{t+1} =
$$\frac{(LF_{t+1})(1 - UR_{t+1})(AWHW_{t+1})}{(LF_t)(1 - UR_t)(AWHW_t)}$$

Key economic long-term assumptions

Most economic variables are at, or very close to, their assumed long-run trend growth rates or levels at the end of the forecast period. A few may require transition in the early years of the projections. In these cases, the annual convergence rate is based on recent actual and forecast performance. The labour productivity growth rate, unemployment rate, average weekly hours worked, CPI measured inflation and ten-year government bond rate are important for the debt dynamics and are set to target certain long-term rates. Table 1 sets these out.

Table 1: Key economic projection assumptions

Variable	Units and scale	Long term assumption
Unemployment rate	Annual average (% of labour force)	4.3%
GDP deflator	Annual % growth	2.0%
Average weekly hours worked	Hours per week	33.55
Labour productivity growth	Hours worked measure	1.5%
Government 10-year bonds	Average percent rate	5.3%

Source: The Treasury (HYEFU 2018)

3.1.2 The public debt dynamics

The public debt dynamics framework (equation 5) is an extension of the framework setout in Section 2 that now accounts for foreign currency denominated debt. Full derivations are available in Appendix 2.

$$\Delta d_{t+1} = \frac{i_{t+1}^w - \pi_{t+1}(1+g_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})} d_t - \frac{g_{t+1}}{(1+g_{t+1})(1+\pi_{t+1})} d_t + \frac{a_t \varepsilon_{t+1} \left(1+i_{t+1}^f\right)}{(1+g_{t+1})(1+\pi_{t+1})} d_t - p b_{t+1} + o t_{t+1} + res_{t+1}$$
(5)

Where:

 $\Delta d_{t+1} =$ change in public debt-to-GDP between periods t and t + 1

 d_t = public debt to GDP in period t

 pb_{t+1} = primary balance-to-GDP in period t + 1

 $ot_{t+1} =$ other debt creating flows to GDP period t + 1

 res_{t+1} = a residual that ensures the identity balances⁷

 π_{t+1} = inflation in period t + 1

 $g_{t+1} = \text{real GDP growth in period } t+1$

 ε_{t+1} = the rate of exchange rate depreciation $e_{t+1}/e_t - 1$

 e_{t+1} = the nominal exchange rate, which is defined as domestic currency per US dollar

 a_t = foreign debt as a share of total debt = $\frac{e_t D_t^f}{D_t}$

 i_{t+1}^w = effective interest rate (local currency) * $(1 - \alpha_t)$ plus (foreign currency) * α_t

 i_{t+1}^{f} = nominal interest rate on foreign currency denominated debt in period t + 1

⁷ If a change in debt cannot be explained via the previous components, there must be unidentified residual flows. The residual may be comprised of the recognition of contingent liabilities.

This equation forms the basis for the decomposition of the change in public debt-to-GDP into the following components: i) primary fiscal balance, ii) real GDP growth, iii) the real interest rate, iv) the real exchange rate, v) other debt creating flows and, iv) a residual balancing term. The last term, the residual, is the actual change in debt-to-GDP less the sum of (i) to (v) which ensures that the identity holds. It could reflect the impact of debt restructuring, realised contingent liabilities and measurement errors.

Contribution of the effective real interest rate:

$$\frac{i_{t+1}^{w} - \pi_{t+1}(1+g_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})}d_t$$

Contribution of real GDP growth:

$$-\frac{g_{t+1}}{(1+g_{t+1})(1+\pi_{t+1})}d_t$$

Contribution of exchange rate depreciation:

$$\frac{a_t \varepsilon_{t+1} (1 + i_{t+1}^f)}{(1 + g_{t+1})(1 + \pi_{t+1})} d_t$$

3.1.3 Debt stabilising primary balance

When setting fiscal sustainability targets, fiscal authorities may first try to stabilise the public debt-to-GDP ratio. This requires an estimate of the debt stabilising primary balance. To find the debt stabilising primary balance, we use equation 5 and set Δd_{t+1} equal to zero. For simplicity, we also set the other debt creating flows (ot_{t+1}) and the residual (res_{t+1}) to zero. Then we rearrange to solve for pb_{t+1}^* , which is the primary balance that leads to no change in debt between periods, as follows:

$$pb_{t+1}^* = \frac{i_{t+1}^w - \pi_{t+1}(1+g_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})}d_t - \frac{g_{t+1}}{(1+g_{t+1})(1+\pi_{t+1})}d_t + \frac{a_t\varepsilon_{t+1}(1+i_{t+1}^f)}{(1+g_{t+1})(1+\pi_{t+1})}d_t$$
(6)

We compare New Zealand's historical and forecast primary balances to the debt stabilising primary balance for each year as another measure of sustainability.

3.1.4 Coefficient on the automatic debt dynamics

The interest rate-growth differential is an important driver of the debt dynamics. The trajectory of public debt-to-GDP depends on the value of the parameter phi (\emptyset), which is the coefficient on the automatic debt dynamics. For a country with foreign currency denominated debt, the coefficient on automatic debt dynamics can be expressed as follows (derived in Appendix 2):

$$\phi_{t+1}^* = \frac{\left[1 + i_{t+1}^w + a_t \varepsilon_{t+1} \left(1 + i_{t+1}^f\right)\right]}{(1 + g_{t+1})(1 + \pi_{t+1})} \tag{7}$$

This equation shows that higher interest rates (local and foreign) will lead to unfavourable debt dynamics, and higher real GDP growth and inflation will lead to more favourable debt dynamics. As in Section 2.1.3, the debt dynamics are favourable if $\phi_{t+1}^* < 1$ and unfavourable if $\phi_{t+1}^* > 1$.

We calculate this historical parameter for New Zealand, along with its forecast and projected values as a final test of sustainability to supplement the main analysis.

3.2 Data

New Zealand's key fiscal indicator is net core Crown debt-to-GDP⁸; however, for consistency with the IMF and others (World Bank 2005, Vanlaer et al 2017), we use a gross debt measure for our analysis.⁹ In-terms of the coverage of the public sector, we use available statistics at the core Crown level. Table 2 sets out the data sources.

Table 2: Data sources

Variable	Variable description	Data used	Data source
i ^w t+1	Effective weighted average interest rate	Core Crown interest payments Core Crown borrowings Interest payments on foreign currency denominated debt (in NZD) Foreign currency denominated debt (in NZD)	New Zealand Debt Management The Treasury (fiscal data, HYEFU 2018 & HYEFU 2018 FSM)
π_{t+1}	Rate of inflation in period $t + 1$ as measured by the GDP deflator	Nominal GDP Real GDP	The Treasury (fiscal data, HYEFU 2018 & HYEFU 2018 FSM)
g_{t+1}	Rate of real GDP growth in period $t + 1$	Real GDP	The Treasury (fiscal data, HYEFU 2018 & HYEFU 2018 FSM)
d_t	Public debt to GDP in period <i>t</i>	Core Crown borrowings Nominal GDP	The Treasury (fiscal data, HYEFU 2018 & HYEFU 2018 FSM)
a _t	Foreign currency denominated debt as a share of total debt in period <i>t</i>	Foreign currency denominated debt (nominal value in foreign currency year-on-year) Core Crown borrowings	New Zealand Debt Management The Treasury (fiscal data, HYEFU 2018 & HYEFU 2018 FSM)
ε_{t+1}	Rate of exchange rate depreciation	Exchange rate (NZD/foreign currency)	Reserve Bank of New Zealand
i ^f _{t+1}	Nominal interest rate on foreign currency denominated debt in period <i>t</i> + 1	Interest payments on foreign currency denominated debt (in NZD) Foreign currency denominated debt (in NZD)	New Zealand Debt Management
pb _{t+1}	Primary balance in period <i>t</i> + 1	Core Crown cash-flow statement: Interest payments + net cash-flow from operations + net cash- flow from investing + issues of circulating currency less net movements in cash	The Treasury (fiscal data, HYEFU 2018 & HYEFU 2018 FSM)

⁸ Excluding NZ Super Fund and advances

⁹ This framework can be extended to disaggregate the net debt dynamics, which may be used to supplement gross debt dynamics analysis.

4 Results

4.1 History: 2008 to 2018

This start of the sample period 2008 to 2018 coincides with the onset of the GFC. While the worst of the GFC was thought to be over by 2010, the economic recovery proved to be slower than anticipated (Philip et al 2017). The destructive Canterbury earthquakes in late 2010 and early 2011 led to further deterioration of the Crown accounts. By 2013, net debt had increased by almost five times the 2008 level.

In Budget 2011, the Government set out a goal to return to surplus no later than 2015/16, which was subsequently brought forward to 2014/15. Budgets from 2011 onwards implemented a fiscal strategy based on reducing the growth of core Crown operating expenses. Overall, the return to surplus was achieved largely through a reduction in expense growth, which stabilized and began to reduce debt-to-GDP. Fiscal policy can affect real GDP growth via aggregate demand in the short-term. Consistent with this, fiscal policy began to have a contractionary effect on aggregate demand from 2012, after it had been expansionary in the years following the GFC (Philip et al 2017). Figure 2 sets out the core Crown debt to GDP ratio over this period.



Figure 2: Core Crown debt-to-GDP

Source: Author using data from the Treasury

Debt decomposition

Table 3 sets out the cumulative debt decomposition for 2008 to 2018^{.10} As per the methodology established in section 3.1, the relevant drivers assessed are the primary balance, automatic debt dynamics (the interest-growth differential and contribution from exchange rate depreciation), other debt creating flows and a residual.

¹⁰ Cumulative by adding the yearly impact for each contributory factor for the duration of the review period.

Table 3: Debt decomposition

Public debt decomposition	2008 to 2018 (cumulative)
Change in core Crown borrowings (gross debt)	+13.7%
Identified debt-creating flows (A+B+C)	+13.0%
Core Crown primary balance (A)	+14.1%
Automatic debt dynamics (B)	-1.1%
Contribution from interest rate/growth differential	-1.2%
Real interest rate	+7.2%
Real GDP growth	-8.3%
Contribution from real exchange rate depreciation	0.0%
Other debt-creating flows (C)	0.0%
Residual	+0.7%

Source: The Treasury and author's calculations

Gross public sector debt increased by approximately 13.7 percentage points between 2008 and 2018. The primary balance has the largest impact over this period, contributing to a cumulative 14.1 percentage point increase in debt.

The automatic debt dynamics account for a small reduction in the debt ratio over this period (1.1 percentage points). The growth-interest differential is small across this period, which reflects not only low interest rates but also subdued growth. The contribution from the real exchange rate depreciation was negligible across the period (a 0.05 percentage point change if rounded to two decimal points) because the Government's holdings of foreign currency denominated debt was minimal.¹¹ A small residual of 0.7% ensures that the identity balances.

Figure 3 breaks the dynamics down into their year-on-year impacts. The annual change in public debt is shown via the line graph and the bar graph disaggregates the effect of each of the contributory factors. A positive item reflects an increase in the debt-to-GDP ratio, while a negative item reflects a decrease in the debt-to-GDP ratio.

¹¹ New Zealand's Debt Management currently focus on New Zealand Dollar issuances in the domestic market. Foreign currency denominated issuances were paid down over the previous decade to nil. The 2018/19 borrowing programme forecasts do not include any foreign currency debt issuances.





Source: The Treasury and author's calculations

The gross debt ratio increased in the first half of the period and the largest increases occurred in fiscal years 2009 and 2011, which is consistent with the effects of the GFC and the Canterbury earthquakes. Figure 3 illustrates the relatively large primary balance effect across this period. In 2009, the effects of the GFC are noticed. The primary deficit accounts for the largest increase (approximately 7 percentage points of GDP). In 2011, the net increase of approximately 8 percentage points is mainly attributed to the primary deficit. From 2012 to 2018 gross debt-to-GDP either grows at a lower positive rate (2012 and 2015) or reduces.

Coefficient on the automatic debt dynamics

Figure 4 plots the coefficient on automatic debt dynamics (\emptyset) and real interest (r) and growth (g) rates for each year of the past decade. As set out in Section 2.1.3, a value of \emptyset that is less than one implies favourable automatic debt dynamics. Our estimates for the past decade show that, while close to the critical value of one, \emptyset exceeded one for multiple years. The effect of the interest-growth differential is the most unfavourable in 2009 due to negative real GDP growth.









Source: Author's calculations

The estimated values for \emptyset indicate relatively favourable automatic debt dynamics for New Zealand since 2008. This reflects the low global interest rates that were experienced in the post-GFC years. Interest rates on U.S. bonds have been and are still low, which reflects the effects of the GFC and quantitative easing (Blanchard 2019). Declining global real interest rates have affected public debt dynamics globally. New Zealand has followed the global trend with declining ten-year bond rates on government debt, as illustrated in Figure 5.

Figure 5: US Government and New Zealand Government nominal ten-year bond rates



Source: Federal Reserve Board, RBNZ, Haver

Debt stabilising primary balance

As a final measure of sustainability, Figure 6 plots the debt stabilising primary balance and the actual primary balance across the period. We see that the primary balance measure for 2009 to 2012 is below the debt stabilising primary balance, which coincides with the increase in debt-to-GDP we observe over these years. From 2013 onwards, the primary balance exceeds the debt stabilising primary balance in every year excluding 2015, which is consistent with the reduction in gross debt-to-GDP that we observe for each year apart from 2015.





Source: Author's calculations

From 2008 to 2012, we observed an increase in the gross debt ratio. The increase is attributable to the primary balance (deficit) effects of the GFC and the Canterbury earthquakes. A more sustainable debt path emerges from 2013 to 2018, driven by the primary balance (surpluses) and aided by the favourable automatic debt dynamics. This is consistent with the Government's approach to building fiscal space in the post-GFC years by decreasing expenditure-to-GDP and reducing debt. Declining global interest rates, which reflect the effects of the GFC and quantitative easing, have led to favourable automatic debt dynamics across the period (where r < g) so the public debt burden decreases, all else equal.

4.2 The forecasts: 2019 to 2023

In this section we apply the Treasury's latest economic and fiscal forecasts (HYEFU 2018 at the time of writing) to the debt dynamics framework. The economic and fiscal forecasts are included as exogenous inputs into the FSM and the debt dynamics framework.

HYEFU 2018 forecasts that the economy will expand at a pace that is close to its full capacity, supported by population growth, government spending, accommodative monetary policy and trading partner growth. Real GDP growth is expected to increase to 3.0 percent, on average, over 2019 and 2020, and is forecast to grow at a solid pace for the remaining forecast years. The unemployment rate is projected to remain around 4.0 percent over the forecast horizon, below the Treasury's estimate of the medium-term sustainable rate. As growth picks up, continued labour market tightness is expected to underpin a rise in wage growth and contribute to a sustained increase in inflation. (HYEFU 2018). In line with the post-GFC years, interest rates are forecast to remain low. In addition, primary surpluses are forecast for each year apart from 2022, partly driven by an increase in tax-to-GDP over the 2018 HYEFU forecasts.

Over the five-year forecasts, and as a percentage of GDP, both the gross debt and net debt ratio are expected to decline, as illustrated by Figure 7.





Source: Author using data from the Treasury

Debt decomposition

Table 4 sets out the cumulative debt decomposition for the baseline HYEFU 2018 forecasts.

Public debt decomposition	2019 to 2023 (cumulative)
Change in core Crown borrowings (gross debt)	-8.1%
Identified debt-creating flows (A+B+C)	-8.0%
Core Crown primary balance (A)	-5.9%
Automatic debt dynamics (B)	-2.1%
Contribution from interest rate/growth differential	-2.1%
Real interest rate	+1.8%
Real GDP growth	-3.9%
Contribution from real exchange rate depreciation	N.A.
Other debt-creating flows (C)	0.0%
Residual	0.0%

Source: The Treasury and author's calculations

We expect the gross debt ratio to decrease by 8.1 percentage points between 2019 and 2023. The primary balance amounts for the largest reduction of 5.9 percentage points. The automatic debt dynamics contribute to a 2.1 percentage point reduction in the gross

debt ratio as the growth-interest differential is forecast to be small, yet favourable. The forecast dynamics are illustrated in Figure 8.



Figure 8: The debt dynamics

Source: The Treasury and author's calculations

The gross debt ratio is projected to decline in each year excluding a small increase in 2022. The largest reductions are expected to occur in 2019 and 2023 and would be driven by the forecast primary surpluses. The growth-interest differential is favourable across the period.

Coefficient on the automatic debt dynamics

HYEFU 2018 forecasts low interest rates across the period. This is consistent with global forecasts. In New Zealand, real GDP growth is forecast to increase in the first three years of the period, underpinned by – among other things – low interest rates.

We estimate favourable values of \emptyset for each year of the forecasts (i.e. values of less than one). This means that, for each year r < g (Figure 9).



Real interest and growth (r and g)



Source: Author's calculations

Debt stabilising primary balance

Due to the favourable automatic debt dynamics, the debt stabilising primary balance is negative across all the forecast years. The forecast primary balance exceeds the debt stabilising primary balance in each forecast year excluding fiscal year 2022 when a primary deficit is forecast. Smaller primary surpluses could (ceterus paribus) be run in most years without destabilising debt.

Figure 10: Primary balance & debt stabilising primary balance



Source: Author's calculations

Across the period, the gross debt ratio is expected to steadily decrease. Forecast primary surpluses will have the most pronounced effect on the gross debt ratio, while the automatic debt dynamics are forecast to be favourable and will thus enable further reduction.

The primary surplus is the main driver of New Zealand's forecast debt reduction over the period (cumulatively 6 percent of GDP). Fiscal policy can affect real GDP growth via aggregate demand in the short-term. The effect of the fiscal position on real growth has been reflected in the HYEFU 2018 forecasts to the extent that it is accounted for in the forecasting process.

4.3 The projections: 2024 to 2033

In the HYEFU 2018 FSM, most economic variables are at their trend growth rates by the end of the forecasts. Real GDP growth is projected to between 2.1 percent and 2.3 percent across the projections. The long-term assumption for the unemployment rate is 4.3 percent, which is achieved in 2026, and the long-term government bond rate is expected to reach a long-term stable rate of 5.3 percent by 2028.

After an initial decline, the Treasury projects gross and net debt levels to increase incrementally for each year of the projections, though by 2032 the gross and net debt ratios are still slightly lower than the 2023 ratios.



Figure 11: Core Crown debt-to-GDP

Source: Author using data from the Treasury.

Debt decomposition

Table 5 sets out the cumulative debt decomposition for the baseline projections.

Public debt decomposition	2024 to 2033 (cumulative)
Change in core Crown borrowings (gross debt)	-0.6%
Identified debt-creating flows (A+B+C)	-0.6%
Core Crown primary balance (A)	-2.0%
Automatic debt dynamics (B)	+1.3%
Contribution from interest rate/growth differential	+1.3%
Real interest rate	+6.5%
Real GDP growth	-5.2%
Contribution from real exchange rate depreciation	N.A.
Other debt-creating flows (C)	0.0%
Residual	0.0%

Table 5: Debt decomposition

Source: The Treasury and author's calculations

The level of gross debt is projected to decrease by a cumulative 0.6 percentage points from 2024 to 2033. The primary balance is projected to contribute to a reduction of the gross debt ratio of two percentage points, while the automatic debt dynamics are expected to contribute to a small increase in the gross debt ratio (1.3 percentage points).





Source: The Treasury and author's calculations

The Treasury projects the gross debt ratio to decrease each year until 2027. Debt reduction is driven by (decreasing) primary surpluses for the first four years of the projections, and this is supported by the favourable debt dynamics in the first three years of projections. From 2027 onwards, small primary deficits and slightly unfavourable automatic debt dynamics contribute to the projected increase in the gross debt ratio.

Coefficient on the automatic debt dynamics

Figure 13 shows \emptyset is on an upward trend as real GDP growth remains within a band of 2.1 and 2.3 percent, and government bond rates converge to their long-run historical average of 5.3 percent in nominal terms (real rate of 3.3 percent). From 2026 onwards, the real borrowing rate is projected to be greater than real GDP growth, which means that \emptyset is greater than one. To keep debt on a sustainable track from 2026 – all other things equal – primary surpluses will be required.









Source: Author's calculations

Debt stabilising primary balance

In the context of unfavourable automatic debt dynamics from 2026, primary surpluses will be required to stabilise debt-to-GDP. Figure 14 shows that the projected primary balance falls below the projected debt stabilising balance from 2026. This supports the increase in the debt ratio that we see from 2027.



Figure 14: Primary balance & debt stabilising primary balance

Source: Author's calculations

Although the gross debt ratio is expected to be 0.6 percentage points lower by the end of the projections, from 2027 onwards, deteriorating primary surpluses and increasingly unfavourable automatic debt dynamics are reflected in the upward trend in the debt ratio. Therefore, in order to stabilise debt, primary surpluses will be required from fiscal year 2026. Although the rate of increase in gross debt-to-GDP is small (0.3 percentage point increase from 2027 onwards), there is a shift in the overall trajectory of debt to a path that is less sustainable.

It is important to reinforce the uncertainty that underlies the projections. Economic and fiscal variables converge to long-run average rates. However, in the case of interest rates, history may not be a good guide. Blanchard (2019) finds that, although the gap between interest rates and growth rates is expected to narrow, many forecasts and market signals have interest rates remaining below growth rates for a long time. While it is outside the scope of this paper to discuss the long-term history, we do find evidence that low rates have persisted over recent years (see Figure 5). Whether rates will continue to remain low or will return to levels consistent with long-term averages, is an important question. If rates remain low, it would change the perspective on public debt dynamics in New Zealand as it may alleviate concerns about public debt dynamics in the projection period.

The projections also have characteristics that could make it more difficult to achieve primary surpluses in projected years, when compared to the forecasts. Firstly, the projections assume that tax-to-GDP stabilises, while no such constraints are placed on tax forecasts (tax-to-GDP increased by one percentage point of GDP over the 2018 HYEFU forecasts). Secondly, the projections account for an ageing population, and the public pension expenses lift by around one quarter of a percentage point of GDP over the forecast years, but by more than 1 percentage point of GDP over the projected years. While these are technical assumptions, the flattening of tax-to-GDP in projections and significant lift in public pension costs provide impediments over projections to attaining primary surpluses that are either not present (flat tax to GDP) or less significant (the rise of pension expenses) in forecasts.

4.4 Scenario analysis

The Treasury prepares alternative forecast tracks that illustrate how the economy may evolve if some of the main economic forecasts are altered. As a final measure, the debt dynamics are analysed under an alternative forecast track. In the selected downside scenario, which is from the HYEFU 2018 forecasts, declining trade volumes weigh directly on global growth, lowering the demand for New Zealand exports, while weaker sentiment lowers business investment, consumption, and global commodity prices. The overall impact of the scenario sees GDP growth falling in nominal and real terms, affecting tax revenue and the fiscal position. (New Zealand Treasury, 2018e)s





Source: Author using data from the Treasury.

Debt decomposition

Table 6 sets out the cumulative effect of the underlying drivers of gross debt under the downside scenario, compared to the baseline scenario.

Table 6: Debt decomposition

Public debt decomposition (cumulative)	2019 to 2023	2019 to 2023
	Baseline	Downside
Change in core Crown borrowings (gross debt)	-8.1%	-6.0%
Identified debt-creating flows (A+B+C)	-8.0%	-5.5%
Core Crown primary balance (A)	-5.9%	-3.6%
Automatic debt dynamics (B)	-2.1%	-1.9%
Contribution from interest rate/growth differential	-2.1%	-1.9%
Real interest rate	1.8%	1.9%
Real GDP growth	-3.9%	-3.8%
Contribution from real exchange rate depreciation	N.A.	N.A.
Other debt-creating flows (C)	0.0%	0.0%
Residual	0.0%	0.5%

Source: The Treasury and author's calculations

The gross debt ratio is forecast to decrease by 6 percentage points under the downside scenario. The automatic debt dynamics amount to a small reduction in gross debt (1.9 percentage points) as the growth-interest differential is forecast to be small, yet favourable, across this alternative forecast horizon. The primary balance effect is less under the downside scenario compared to the baseline, which reflects the weaker forecast fiscal position.





Source: The Treasury and author's calculations

Coefficient on the automatic debt dynamics

The effect of the automatic debt dynamics is small; however, it is projected to deteriorate across the projection horizon and its effect on the accumulation of debt increases over time. The value of this variable under the alternative scenario is less favourable in 2019

and 2020, though it reverts to a similar level (and less than one) from 2021 onwards. This is illustrated in Figure 17.







Source: Author's calculations

Debt stabilising primary balance

The primary balance is forecast to exceed the debt stabilising primary balance under the downside scenario for every year excluding 2020 and 2022. As expected, the forecast primary balance is weaker under the downside scenario. This is illustrated in Figure 18

Figure 18: Primary balance & debt stabilising primary balance



Source: Author's calculations

Based on the downside scenario, the gross debt ratio is forecast to decrease by 6 percentage points between 2023 and 2032 (compared to 8.1 percentage points under the baseline forecasts). The effects of the downside scenario on the debt dynamics is primarily via the weaker forecast primary balance measure.

5 Conclusion

The analysis in this paper contributes to the literature on debt dynamics by developing a model to study New Zealand's public debt dynamics in history, for the five-year forecast horizon, and for the medium-term projections. The model decomposes the change in the public debt-to-GDP ratio into four key components: the primary balance, real GDP growth, real interest rates and exchange rate effects. This model can be applied consistently to inform New Zealand's fiscal policy process on the dynamics of public debt.

We find that there is asymmetry of the effect of primary balances and the automatic debt dynamics on New Zealand's public debt ratio. The primary balance is the greater contributor to public debt levels (whether adding to it or reducing it), and the automatic debt dynamics (the interest-growth differential and the effect of exchange rate depreciation) are relatively benign. This trend may continue. Declining global real interest rates have affected public debt dynamics, and New Zealand has followed the global trend with declining ten-year bond rates on government debt. The Treasury forecasts low rates to persist into the five-year forecast horizon.

Since 2008, the primary balance had the largest effect on gross public debt levels in New Zealand. In the years immediately following the GFC and Canterbury earthquakes, public debt rose sharply, however the Government's response to higher debt led to a reduction in gross debt from 2013. Across the forecast years (2019 to 2023), the gross debt ratio is expected to steadily decrease due to primary surpluses.

The medium-term projections (2024 to 2033) show a slightly different trend. Although the gross debt ratio is expected to be slightly lower by 2033, based on current fiscal settings, we project a deteriorating primary surplus and increasingly unfavourable automatic debt dynamics. We caveat this by saying that the deteriorating debt dynamics are driven by the underlying projection assumption that government 10-year bond rates will return to their historical average of 5.3 percent, while real GDP growth reverts to on-trend growth (and eventually r > g). While it is outside the scope of this paper to discuss the projection assumption for long-term government bond rates, there is global evidence that bond yields are remaining low, and thus it is important to reinforce the uncertainty that underlies the forecasts and projections. If rates remain low, it would alleviate any concern about public debt dynamics in the projection period.

The abstractions used in this analysis suffer from some limitations. Changes in GDP do not affect the tax-to-GDP ratio or expenditure to GDP levels beyond the forecast years. Further development work on the FSM could incorporate some macro-economic feedbacks, though the model does not feature multiple and simultaneous feedback mechanisms to the macro-economic and fiscal variables.

Further, this method does not specify a threshold level of sustainable debt. The debt path is deemed to be sustainable so long as public debt-to-GDP declines, although debt levels should also be sufficiently low. While a public debt-to-GDP ratio that is stable or in decline implies solvency if interest rates exceed the GDP growth rate, it may be problematic to assume sustainablility if debt is stabilised at a high rate.

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Appendix 1: The solvency condition

The steps to derive the solvency condition are to i) start with the flow budget constraint (substitution over time), and ii) impose the transversality condition (no-Ponzi game condition).

The flow budget constraint:

$$G_{t+1} + i_{t+1}D_t - R_{t+1} + OT_{t+1} = D_{t+1} - D_t$$

 D_{t+1} and D_t denote the stock of government debt in periods t + 1 and t respectively, R_{t+1} is government revenue in period t + 1 and G_{t+1} is non-interest expenditure in the same period. $i_{t+1}D_t$ equals interest payments on debt in period t + 1 based on debt D_t in period t + 1. OT_{t+1} reflects other flows (i.e. bank capitalisation).¹²

The overall budget balance is the difference between revenue and expenditure (including interest expenditure). Therefore (and if we assume OT_{t+1} equals zero):

$$R_{t+1} - G_{t+1} = PB_{t+1}$$

Where PB_{t+1} equals the primary balance in period t + 1. We then solve for D_{t+1} . This rearrangement of the budget constraint provides us with an evolution of debt formula:

$$D_{t+1} = (1 + i_{t+1})D_t - PB_{t+1}$$

From this, iterate forward, starting from $D_{t+1} = D_1$ derive the intertemporal budget constraint for t = 2 and t = 3, as follows (note the iteration is based on an assumption of a constant interest rate over the years):

$$D_{1} = (1 + i)D_{0} - PB_{1}$$

$$D_{2} = (1 + i)D_{1} - PB_{2}$$

$$= (1 + i)[(1 + i)D_{0} - PB_{1}] - PB_{2}$$

$$= (1 + i)^{2}D_{0} - (1 + i)PB_{1} - PB_{2}$$

$$D_{3} = (1 + i)D_{2} - PB_{3}$$

$$= (1 + i)[(1 + i)^{2}D_{0} - (1 + i)PB_{1} - PB_{2}] - PB_{3}$$

$$= (1 + i)^{3}D_{0} - (1 + i)^{2}PB_{1} - (1 + i)PB_{2} - PB_{3}$$

Then derive the intertemporal budget constraint for *t*=*N*

$$D_N = (1+i)^N D_0 - \sum_{t=1}^N (1+i)^{N-t} P B_t$$

¹² Note: we exclude the change in money supply for simplicity.

To obtain the solvency condition, divide both sides by $(1 + i)^N$:

$$\frac{D_N}{(1+i)^N} = \frac{(1+i)^N D_0 - \sum_{t=1}^N (1+i)^{N-t} PB_t}{(1+i)^N}$$
$$\frac{D_N}{(1+i)^N} = D_0 - \sum_{t=1}^N (1+i)^{-t} PB_t$$

Solve for D_0 :

$$D_0 = (1+i)^{-N} D_{\rm N} + \sum_{t=1}^{N} (1+i)^{-t} P B_t$$

Then, take the limit as $N \rightarrow \infty$ and impose the transversality condition (no-Ponzi game condition):

$$\lim_{N\to\infty} (\frac{1}{1+\mathrm{i}})^N D_N = 0$$

The solvency condition becomes:

$$D_0 \le \sum_{t=1}^{\infty} (1+i)^{-t} PB_t$$

If the transversality condition holds, then on average over the infinite horizon primary balances are needed to ensure the solvency condition is met. For the transversality condition to hold, debt cannot grow at a rate equal to or higher than the interest rate.

Appendix 2: The debt dynamics

With no foreign currency denominated debt

We start with the flow budget constraint¹³:

$$D_{t+1} = (1 + i_{t+1})D_t - PB_{t+1}$$

In order to measure the debt burden in a more meaningful sense over time, the level of debt stock is expressed as a ratio of GDP. Therefore, we divide the flow budget constraint by nominal GDP (Y) at time t + 1:

$$\frac{D_{t+1}}{Y_{t+1}} = (1+i_{t+1})\frac{D_t}{Y_{t+1}} - \frac{PB_{t+1}}{Y_{t+1}}$$

No capitalisation reflects the contemporaneous ratios. We also set Y_{t+1} equal to $(1 + g_{t+1})(1 + \pi_{t+1})Y_t$, where: *g* equals the real growth rate of the economy and π equals domestic inflation as measured by the change in the GDP deflator:

$$d_{t+1} = \frac{(1+i_{t+1})D_t}{(1+g_{t+1})(1+\pi_{t+1})Y_t} - pb_{t+1}$$

Express the final contemporaneous ratio with no capitalisation:

$$d_{t+1} = \frac{(1+i_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})}d_t - pb_{t+1}$$

Apply the Fisher equation to link nominal and real interest rates:

$$\frac{(1+r_{t+1})}{(1+g_{t+1})} = \frac{(1+i_{t+1})}{(1+\pi_{t+1})(1+g_{t+1})} = \emptyset$$

Where r_{t+1} equals the real interest rate at time t + 1 and \emptyset reflects the automatic debt dynamics. The government budget constraint becomes

$$d_{t+1} = \frac{(1+r_{t+1})}{(1+g_{t+1})}d_t - pb_{t+1}$$

Which can be written as:

$$d_{t+1} = \emptyset d_t - pb_{t+1}$$

Next derive the change in the debt-to-GDP ratio. Deduct d_t from both sides and factor:

$$d_{t+1} - d_t = \left[\frac{(1+r_{t+1})}{(1+g_{t+1})} - 1\right]d_t - pb_{t+1}$$

Notice that:

$$\left[\frac{(1+r_t)}{(1+g_t)} - 1\right] = \left[\frac{(1+r_t)}{(1+g_t)} - \frac{(1+g_t)}{(1+g_t)}\right] = \left[\frac{(r_t - g_t)}{(1+g_t)}\right]$$

¹³ For simplicity, we assume no 'other' flows that could impact on the accumulation of debt.

Therefore:

$$d_{t+1} - d_t = \frac{(r_{t+1} - g_{t+1})}{(1 + g_{t+1})} d_t - pb_{t+1}$$

This is the key debt dynamics law of motion equation and can be rewritten as:

$$\Delta d_{t+1} = \frac{(r_{t+1} - g_{t+1})}{(1 + g_{t+1})} d_t - p b_{t+1}$$

And if we assume certain factors are constant over time it can be written as:

$$\Delta d_{t+1} = \frac{(r-g)}{(1+g)} d_t - p b_{t+1}$$

Debt stabilising primary balance

To calculate the debt stabilising primary balance, we equalise the debt-to-GDP levels for the current period and the previous period:

$$d_{t+1} = d_t$$

Substitute this into the equation for the law of motion equation:

$$0 = \frac{(r_{t+1} - g_{t+1})}{(1 + g_{t+1})} d_t - pb_{t+1}$$

Solve for pb_{t+1} to obtain the debt stabilising primary balance pb_{t+1} *:

$$pb_{t+1} *= \frac{(r_{t+1} - g_{t+1})}{(1 + g_{t+1})} d_t$$

Therefore, the debt stabilising primary balance simply equals the debt dynamics.

With foreign currency denominated debt

We begin with the flow budget constraint, but with the additional feature that a government borrows from abroad as well as domestically (IMF 2017b):

$$D_{t+1} = D_{t+1}^d + e_{t+1} D_{t+1}^f$$

Where D_{t+1}^d equals domestic currency denominated debt and D_{t+1}^f equals foreign currency denominated debt. The nominal exchange rate (e_{t+1}) is defined as domestic currency per dollar. An increase in e_{t+1} over e_t means a depreciation of the domestic currency.

Therefore, the flow budget constraint becomes:

$$D_{t+1}^d + e_{t+1}D_{t+1}^f = (1 + i_{t+1}^d)D_t^d + (1 + i_{t+1}^f)e_{t+1}D_t^f - PB_{t+1} + O_{t+1}$$

Where i_{t+1}^d equals the nominal interest rate on domestic currency denominated debt and i_{t+1}^f equals the nominal interest rate on foreign currency denominated debt. Other debt creating flows is shown as O_{t+1} .

We can rewrite this expression to account for the share of domestic versus foreign debt and the rate of depreciation of currency:

$$D_{t+1} = (1 + i_{t+1}^d)(1 - \alpha_t)D_t + (1 + i_{t+1}^f)\alpha_t(1 + \varepsilon_{t+1})D_t - PB_{t+1} + O_{t+1} + Res_{t+1}$$

Where $\alpha_t = \frac{e_t D_t}{D_t}$ and ε_{t+1} = the rate of exchange rate depreciation $\frac{e_{t+1}}{e_t} - 1$

Therefore, this equation replaces domestic and foreign debt by their shares: $(1 - \alpha_t)$ and α_t , respectively. We then obtain debt-to-GDP ratios and use no capitalisation to denote contemporaneous ratios:

$$d_{t+1} = \left(1 + i_{t+1}^d\right)\left(1 - \alpha_t\right)\frac{D_t}{Y_{t+1}} + \left(1 + i_{t+1}^f\right)\alpha_t\left(1 + \varepsilon_{t+1}\right)\frac{D_t}{Y_{t+1}} - pb_{t+1} + o_{t+1}$$

Let Y_{t+1} equal $(1 + g_{t+1})(1 + \pi_{t+1})Y_t$. Therefore:

$$d_{t+1} = \frac{\left(1 + i_{t+1}^d\right)\left(1 - \alpha_t\right) + \left(1 + i_{t+1}^f\right)\alpha_t\left(1 + \varepsilon_{t+1}\right)}{\left(1 + g_{t+1}\right)\left(1 + \pi_{t+1}\right)}d_t - pb_{t+1} + o_{t+1} + res_{t+1}$$

We can rewrite this to reflect a weighted average interest rate, which then gives us the following key equations for debt dynamics:

$$i_{t+1}^{w} = i_{t+1}^{d} (1 - \alpha_t) + i_{t+1}^{f} \alpha_t$$

$$d_{t+1} = \frac{\left[1 + i_{t+1}^w + a_t \varepsilon_{t+1} \left(1 + i_{t+1}^f\right)\right]}{(1 + g_{t+1})(1 + \pi_{t+1})} d_t - pb_{t+1} + ot_{t+1} + res_{t+1}$$

Where:

 i^{w} = weighted average of domestic and foreign nominal interest rate

 i^{f} = nominal interest rate on foreign currency denominated debt

 ε = change in the exchange rate (local currency per USD/foreign currency)

We then rewrite the coefficient on d_t as follows:

$$\frac{[1+i_{t+1}^{w}+a_{t}\varepsilon_{t+1}(1+i_{t+1}^{f})]}{(1+g_{t+1})(1+\pi_{t+1})} = \emptyset_{t+1}^{*}$$

Therefore we can rewrite the evolution of debt-to-GDP equation as:

$$d_{t+1} = \emptyset_{t+1}^* d_t - pb_{t+1} + ot_{t+1} + res_{t+1}$$

We next find the change in the debt-to-GDP ratio. Deduct d_t from both sides and then factor the equation. We are left with:

$$d_{t+1} - d_t = (\emptyset_{t+1}^* - 1)d_t - pb_{t+1} + ot_{t+1} + res_{t+1}$$

Expressed as:

$$\Delta d_{t+1} = (\emptyset_{t+1}^* - 1)d_t - pb_{t+1} + ot_{t+1} + res_{t+1}$$

Where:

$$(\emptyset_{t+1}^* - 1)d_t$$
 = automatic debt dynamics

Where:

$$\phi_{t+1}^* - 1 = \frac{\left[1 + i_{t+1}^w + a_t \varepsilon_{t+1} \left(1 + i_{t+1}^f\right)\right]}{(1 + g_{t+1})(1 + \pi_{t+1})} - \frac{(1 + g_{t+1})(1 + \pi_{t+1})}{(1 + g_{t+1})(1 + \pi_{t+1})}$$

If we subtract the ratios it becomes:

$$=\frac{1+i_{t+1}^{w}+a_{t}\varepsilon_{t+1}\left(1+i_{t+1}^{f}\right)-(1+g_{t+1})(1+\pi_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})}$$

If we then isolate the various components that lead to the change in debt, we then expand:

$$= \frac{1 + i_{t+1}^{w} + a_t \varepsilon_{t+1} (1 + i_{t+1}^{f}) - (1 + \pi_{t+1} + g_{t+1} + g_{t+1} \pi_{t+1})}{(1 + g_{t+1})(1 + \pi_{t+1})}$$
$$= \frac{1 + i_{t+1}^{w} + a_t \varepsilon_{t+1} (1 + i_{t+1}^{f}) - 1 - \pi_{t+1} - g_{t+1} - g_{t+1} \pi_{t+1}}{(1 + g_{t+1})(1 + \pi_{t+1})}$$

Simplify as follows:

$$\frac{i_{t+1}^{w} + a_t \varepsilon_{t+1} \left(1 + i_{t+1}^{f}\right) - g_{t+1} - \pi_{t+1} (1 + g_{t+1})}{(1 + g_{t+1})(1 + \pi_{t+1})}$$

We then rearrange to set up for the final equation which breaks down the contributory components to the automatic debt dynamics:

$$\frac{i_{t+1}^w - \pi_{t+1}(1 + g_{t+1}) - g_{t+1} + a_t \varepsilon_{t+1} \left(1 + i_{t+1}^f\right)}{(1 + g_{t+1})(1 + \pi_{t+1})} = (\emptyset_{t+1}^* - 1)$$

If the coefficient on automatic debt dynamics is substituted into the equation for the change in debt-to-GDP, we get an equation for the change in debt that is disaggregated into the effects of its various components:

$$\Delta d_{t+1} = \frac{i_{t+1}^{w} - \pi_{t+1}(1+g_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})} d_{t} - \frac{g_{t+1}}{(1+g_{t+1})(1+\pi_{t+1})} d_{t} + \frac{a_{t}\varepsilon_{t+1}(1+i_{t+1}^{f})}{(1+g_{t+1})(1+\pi_{t+1})} d_{t} - pb_{t+1} + ot_{t+1} + res_{t+1} +$$

Where:

$$\frac{i_{t+1}^{w} - \pi_{t+1}(1+g_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})}d_t = \text{contribution of the effective real interest rate}$$
$$\frac{g_{t+1}}{(1+g_{t+1})(1+\pi_{t+1})}d_t = (\text{less}) \text{ the contribution of the real GDP growth}$$
$$\frac{a_t \varepsilon_{t+1}(1+i_{t+1}^f)}{(1+g_{t+1})(1+\pi_{t+1})}d_t = \text{contribution of exchange rate effects}^{14}$$

Debt stabilising primary balance

To calculate the debt stabilising primary balance because the debt-to-GDP level is to remain unchanged:

$$d_{t+1} = d_t$$

Solve for the debt stabilising primary balance (we assume no other debt creating flows or residual). Again, the debt stabilising primary balance equals the automatic debt dynamics.

$$pb_{t+1}^* = \frac{i_{t+1}^w - \pi_{t+1}(1+g_{t+1})}{(1+g_{t+1})(1+\pi_{t+1})}d_t - \frac{g_{t+1}}{(1+g_{t+1})(1+\pi_{t+1})}d_t + \frac{a_t\varepsilon_{t+1}\left(1+i_{t+1}^f\right)}{(1+g_{t+1})(1+\pi_{t+1})}d_t$$

¹⁴ Or in other words, the exchange-rate induced valuation gains or losses in the foreign-debt obligations.

Appendix 3: Assumptions & variables

History: 2008 to 2018

	Units & scale	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Core Crown borrowings	Billions NZD	37.34	50.55	58.58	76.89	84.68	84.87	89.09	95.65	95.04	94.11	98.295
Real GDP	Billions NZD	197.13	193.85	195.50	197.78	203.15	207.64	213.21	221.57	229.94	237.631	244.155
Nominal GDP	Billions NZD	189.01	189.51	196.73	205.80	215.12	218.76	236.65	245.02	257.74	273.276	287.705
GDP deflator	Annual % growth	5.2%	2.0%	2.9%	3.4%	1.8%	-0.5%	5.4%	-0.4%	1.4%	2.6%	2.5%
Real GDP growth	Annual % growth	2.4%	-1.7%	0.8%	1.2%	2.7%	2.2%	2.7%	3.9%	3.8%	3.3%	2.7%
Primary balance measure	Billions NZD	1.120	-6.583	-5.824	-16.887	-5.159	2.539	-1.546	-1.348	2.293	3.031	1.174
Effective nominal interest rate on core Crown borrowings (weighted average interest rate)	Ratio (percent)	6.5%	5.8%	3.9%	4.4%	4.4%	4.3%	4.2%	4.3%	3.8%	3.7%	3.7%
Effective real interest rate on core Crown gross debt	Ratio (percent)	1.2%	3.8%	0.9%	0.9%	2.5%	4.9%	-1.1%	4.7%	2.4%	1.1%	1.2%
Foreign currency debt	Billions NZD	0.587	0.867	0.697	0.698	0.263	0.104	0.093	0.460	0.011	0.000	0.000
Interest payments on foreign currency debt	Billions NZD	0.040	0.048	0.041	0.036	0.027	0.011	0.009	0.007	0.002	0.000	0.00
Nominal Exchange Rate end of period	NZD/USD	1.3130	1.5330	1.4430	1.2080	1.2710	1.2850	1.1390	1.4660	1.4080	1.365	N.A
Nominal Exchange Rate end of period	NZD/JPY	0.012	0.016	0.016	0.015	0.016	N/A	N/A	N/A	N/A	N/A	N/A
Nominal Exchange Rate end of period	NZD/GBP	2.62	2.54	2.17	1.94	1.97	1.96	1.94	N/A	N/A	N/A	N/A

Source: The Treasury (HYEFU 2018), New Zealand Debt Management (NZDM), Reserve Bank of New Zealand (RBNZ)

The forecasts: 2019 to 2023

	Units & scale	2019	2020	2021	2022	2023
Core Crown borrowings	Billions NZD	91.739	93.84	92.994	98.08	95.097
Real GDP	Billions NZD	251.269	259.093	266.113	272.651	278.998
Nominal GDP	Billions NZD	300.168	316.827	333.118	348.736	364.287
GDP deflator	Annual % growth	1.4%	2.4%	2.4%	2.2%	2.1%
Real GDP growth	Annual % growth	2.9%	3.1%	2.7%	2.5%	2.3%
Primary balance measure	Billions NZD	9.289	1.283	4.339	-1.920	6.101
Effective nominal interest rate on core Crown borrowings	Ratio (percent)	3.5%	3.4%	3.5%	3.1%	3.2%
Effective real interest rate on core Crown gross debt	Ratio (percent)	2.1%	1.1%	1.1%	0.9%	1.1%
Foreign currency debt	Billions	0.000	0.000	0.000	0.000	0.000
Interest payments on foreign currency debt	Billions NZD	0.000	0.000	0.000	0.000	0.000
Nominal Exchange Rate end of period	NZD/USD	N/A	N/A	N/A	N/A	N/A
Nominal Exchange Rate end of period	NZD/JPY	N/A	N/A	N/A	N/A	N/A
Nominal Exchange Rate end of period	NZD/GBP	N/A	N/A	N/A	N/A	N/A

Source: The Treasury (HYEFU 2018), NZDM, RBNZ

The projections: 2024 to 2033

	Units & scale	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Core Crown borrowings	Billions NZD	94.746	96.117	98.894	103.453	108.410	113.867	119.861	126.267	133.144	140.565
Real GDP	Billions NZD	285.147	291.520	298.132	304.895	311.759	318.634	325.548	332.499	339.514	346.631
Nominal GDP	Billions NZD	379.762	396.015	413.096	430.916	449.430	468.529	488.268	508.667	529.788	551.711
GDP deflator	Annual % growth	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
Real GDP growth	Annual % growth	2.2%	2.2%	2.3%	2.3%	2.3%	2.2%	2.2%	2.1%	2.1%	2.1%
Primary balance measure	Billions NZD	3.786	2.349	1.296	-0.051	0.058	0.116	0.192	0.108	-0.012	-0.176
Effective nominal interest rate on core Crown borrowings	Ratio (percent)	3.6%	3.9%	4.2%	4.6%	4.8%	5.1%	5.4%	5.4%	5.4%	5.4%
Effective real interest rate on core Crown gross debt	Ratio (percent)	1.6%	1.9%	2.2%	2.5%	2.8%	3.1%	3.4%	3.4%	3.4%	3.4%
Foreign currency debt	Billions NZD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Interest payments on foreign currency debt	Billions NZD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Nominal Exchange Rate end of period	NZD/USD	N/A									
Nominal Exchange Rate end of period	NZD/JPY	N/A									
Nominal Exchange Rate end of period	NZD/GBP	N/A									

Source: The Treasury (HYEFU 2018), NZDM, RBNZ

Downside scenario

	Scale	2018	2019	2020	2021	2022
Core Crown borrowings	Billions NZD	91.974	95.969	97.114	103.834	102.174
Real GDP	Billions NZD	250.535	256.300	263.435	270.500	277.380
Nominal GDP	Billions NZD	298.159	308.410	327.108	344.911	362.147
GDP deflator	Annual % growth	1.0%	1.1%	3.2%	2.7%	2.4%
Real GDP growth	Annual % growth	2.6%	2.3%	2.8%	2.7%	2.5%
Primary balance measure	Billions NZD	8.751	-0.434	2.088	-3.839	4.527
Effective nominal interest rate on core Crown borrowings	Ratio (percent)	3.7%	3.5%	3.5%	3.6%	3.1%
Effective real interest rate on core Crown gross debt	Ratio (percent)	2.7%	2.4%	0.3%	0.9%	0.7%
Foreign currency debt	Billions NZD	0.000	0.000	0.000	0.000	0.000
Interest payments on foreign currency debt	Billions NZD	0.000	0.000	0.000	0.000	0.000
Nominal Exchange Rate end of period	NZD/USD	N/A	N/A	N/A	N/A	N/A
Nominal Exchange Rate end of period	NZD/JPY	N/A	N/A	N/A	N/A	N/A
Nominal Exchange Rate end of period	NZD/GBP	N/A	N/A	N/A	N/A	N/A

Source: The Treasury (HYEFU 2018 - unpublished), NZDM, RBNZ

Appendix 4: Results

History: 2008 to 2018

New Zealand public sector debt dynamics	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Change in core Crown borrowings	-0.7%	6.9%	3.1%	7.6%	2.0%	-0.6%	-1.2%	1.4%	-2.2%	-2.4%	-0.3%	13.71%
Identified debt- creating flows (A+B+C)	-0.8%	4.6%	3.0%	8.1%	2.4%	-0.1%	-0.8%	0.8%	-1.4%	-1.9%	-0.9%	12.96%
Core Crown	0.0%	0.5%	2.0%	0.0%	0.4%	4.0%	0.7%	0.0%	0.0%	4 40/	0.4%	44.00%
balance (A)	-0.6%	3.5%	3.0%	8.2%	2.4%	-1.2%	0.7%	0.6%	-0.9%	-1.1%	-0.4%	14.08%
Automatic debt dynamics (B)	-0.2%	1.2%	0.0%	-0.1%	0.0%	1.0%	-1.4%	0.3%	-0.5%	-0.8%	-0.5%	-1.12%
from interest rate/growth differential	-0.2%	1.1%	0.0%	-0.1%	-0.1%	1.0%	-1.4%	0.3%	-0.5%	-0.8%	-0.5%	-1.16%
Real interest rate	0.2%	0.8%	0.3%	0.3%	0.9%	1.9%	-0.5%	1.7%	0.9%	0.4%	0.4%	7.18%
Real GDP growth	-0.4%	0.3%	-0.2%	-0.3%	-1.0%	-0.9%	-1.0%	-1.4%	-1.4%	-1.2%	-0.9%	-8.35%
Contribution from exchange rate depreciation	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.05%
Other debt-	• • • • •		• • • • •				• • • • •	• • • • •		• • • • •	• •••	
(C)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.00%
Residual	0.1%	2.3%	0.1%	-0.5%	-0.4%	-0.4%	-0.4%	0.5%	-0.8%	-0.5%	0.7%	0.75%
Debt stabilising primary balance	-0.2%	1.2%	0.0%	-0.1%	0.0%	1.0%	-1.4%	0.3%	-0.5%	-0.8%	-0.5%	
automatic debt dynamics (ø)	0.988	1.056	1.001	0.998	0.998	1.026	0.963	1.008	0.986	0.978	0.985	

Source: The Treasury and author's calculations.

All values as percentage points of nominal GDP unless otherwise specified. Rounding may lead to differences between yearly and total values.

The forecasts: 2019 to 2023

New Zealand public sector debt dynamics	2019	2020	2021	2022	2023	Total
Change in core Crown borrowings	-3.6%	-0.9%	-1.7%	0.2%	-2.0%	-8.1%
Identified debt-creating flows (A+B+C)	-3.4%	-1.0%	-1.8%	0.1%	-2.0%	-8.0%
Core Crown primary balance (A)	-3.1%	-0.4%	-1.3%	0.6%	-1.7%	-5.9%
Automatic debt dynamics (B)	-0.3%	-0.6%	-0.45%	-0.4%	-0.3%	-2.1%
Contribution from interest rate/growth differential	-0.3%	-0.6%	-0.5%	-0.4%	-0.3%	-2.1%
Real interest rate	0.7%	0.3%	0.3%	0.2%	0.3%	1.8%
Real GDP growth	-1.0%	-0.9%	-0.8%	-0.7%	-0.6%	-3.9%
Contribution from exchange rate depreciation	-	-	-	-	-	-
Other debt-creating flows (C)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Residual	-0.2%	0.1%	0.1%	0.1%	0.0%	0.1 %
Debt stabilising primary balance	-0.3%	-0.6%	-0.5%	-0.4%	-0.3%	
Coefficient on automatic debt dynamics (ø)	3.1%	0.4%	1.3%	-0.6%	1.7%	

Source: The Treasury and author's calculations

All values as percentage points of nominal GDP unless otherwise specified. Rounding may lead to differences between yearly and total values.

The projections:	2024 to	2033
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New Zealand public sector debt dynamics	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	Total
Change in core Crown borrowings	-1.2%	-0.7%	-0.3%	0.1%	0.1%	0.2%	0.2%	0.3%	0.3%	0.3%	-0.6%
Identified debt-creating flows (A+B+C)	-1.2%	-0.7%	-0.3%	0.1%	0.1%	0.2%	0.2%	0.3%	0.3%	0.3%	-0.6%
Core Crown primary balance (A)	-1.0%	-0.6%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.0%
Automatic debt dynamics (B)	-0.2%	-0.1%	0.0%	0.1%	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	1.3%
Contribution from interest rate/growth differential	-0.2%	-0.1%	0.0%	0.1%	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	1.3%
Real interest rate	0.4%	0.5%	0.5%	0.6%	0.6%	0.7%	0.8%	0.8%	0.8%	0.8%	6.5%
Real GDP growth	-0.6%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-5.2%
Contribution from exchange rate depreciation	-	-	-	-	-	-	-	-	-	-	-
Other debt-creating flows (C)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Residual	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Debt stabilising primary balance	-0.2%	-0.1%	0.0%	0.1%	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	
Coefficient on automatic debt dynamics (ø)	0.994	0.997	0.999	1.002	1.005	1.009	1.012	1.012	1.012	1.013	

Source: The Treasury and author's calculations

All values as percentage points of nominal GDP unless otherwise specified. Rounding may lead to differences between yearly and total values.

Downside scenario

New Zealand public sector debt dynamics	2019	2020	2021	2022	2023	Total
Change in core Crown borrowings	-3.3%	0.3%	-1.4%	0.4%	-1.9%	-6.0%
Identified debt-creating flows (A+B+C)	-3.0%	0.2%	-1.4%	0.5%	-1.8%	-5.5%
Core Crown primary balance (A)	-2.9%	0.1%	-0.6%	1.1%	-1.3%	-3.6%
Automatic debt dynamics (B)	0.0%	0.0%	-0.7%	-0.7%	-0.5%	-1.9%
Contribution from interest rate/growth differential	0.0%	0.0%	-0.7%	-0.7%	-0.5%	-1.9%
Real interest rate	0.8%	0.7%	0.1%	0.1%	0.2%	1.9%
Real GDP growth	-0.9%	-0.7%	-0.8%	-0.8%	-0.7%	-3.8%
Contribution from exchange rate depreciation	-	-	-	-	-	-
Other debt-creating flows (C)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Residual	-0.3%	0.1%	-0.1%	0.0%	-0.1%	-0.5%
Debt stabilising primary balance	0.0%	0.0%	-0.7%	-0.7%	-0.5%	
Coefficient on automatic debt dynamics (ø)	2.9%	-0.1%	0.6%	-1.1%	1.3%	

Source: The Treasury and author's calculations

All values as percentage points of nominal GDP unless otherwise specified. Rounding may lead to differences between yearly and total values.