TE TAI ŌHANGA
THE TREASURY

Long-term projections of the New Zealand Government's interest rate

Background Paper for the 2021 Statement on the Long-term Fiscal Position

September 2021

Te Kāwanatanga o Aotearoa
New Zealand Government

LTFS 2021 BACKGROUND PAPER:	Long-term projections of the New Zealand Government's interest rate
MONTH/YEAR	September 2021
AUTHORS	Oscar Parkyn Principal Advisor New Zealand Treasury 1 The Terrace, Wellington 6008, New Zealand Matthew Bell Senior Analyst New Zealand Treasury 1 The Terrace, Wellington 6008, New Zealand John Janssen Principal Advisor New Zealand Treasury 1 The Terrace, Wellington 6008, New Zealand
URL	Treasury website at September 2021: https://treasury.govt.nz/publications/background/ltfs21-bg-long-term-projections-nz-governments-interest-rate
ACKNOWLEDGEMENTS	The authors are grateful to colleagues in the Treasury, especially Daniel Dunstan, as well as at the Australian Treasury, United Kingdom Office for Budget Responsibility and the OECD, for their advice and assistance in producing this paper. If any errors remain, then they are entirely the responsibility of the authors.
NZ TREASURY	New Zealand Treasury PO Box 3724 Wellington 6008 NEW ZEALAND Email information@treasury.govt.nz Telephone 64-4-472 2733 Website www.treasury.govt.nz

Contents

List of Tables

List of Figures

Executive Summary

Long-term interest rates, both nominal and real, have been in decline in the last three decades in New Zealand and other advanced economies. There are a range of explanations for this decline. There is no single compelling explanation, but likely that there has been a combination of global drivers: slower productivity growth, global population ageing, savings glut and increased demand for safe assets. The Global Financial Crisis and secular stagnation (associated with the 'effective lower bound' on policy interest rates) has exacerbated structural forces. The COVID-19 pandemic led to further falls in the interest rate as saving increased and investment demand reduced. The subsequent international fiscal response and recovery has led to an increase in bond yields, but they remain at low levels by historical standards.

This background paper focuses on the interest rate assumptions in the historical trends approach as projected by the Long-term Fiscal Model (LTFM). The long-term fiscal statement also includes alternative scenarios projected using the Neoclassical Growth Model (NCGM). The key assumptions of these two models are compared in Table 2 of the Statement, with further details in Appendices Two and Three.

We have reviewed a range of information. These include the academic research, assumptions used by international and domestic agencies and financial markets.[1]

Over the next decade, interest rates are broadly expected to remain at historically low levels. Beyond the next decade, it would be appropriate to assume that interest rates remain below historical averages, reflecting that the drivers that have pushed rates down are likely to persist. Nevertheless, in line with the assumptions of most forecasters and financial market expectations, it would be appropriate to assume that interest rates will rise somewhat in the long term.

For the central historical trends scenario, we consider that the long-term stable value of the New Zealand nominal 10-year government bond rate of around 4.3% to be appropriate, consisting of a real rate of 2.3 percent and inflation rate of 2 percent. However, this value should be reached gradually over several decades. This assumption is broadly in line with information of financial markets, other forecasters, and align the long-run assumption with the Treasury's risk-free rate assumptions used for accounting valuation purposes.

However, given the considerable uncertainty, examining other scenarios is also valuable. It would be appropriate to consider a scenario where interest rates remain low around current levels. A scenario showing the 10-year bond rate at around 2 percent would be appropriate, although other scenarios could be contemplated including the possibility that rates fall further.

[1] Given the role of productivity as a factor influencing long-term interest rates, it is worth noting that the Treasury's labour productivity growth methodology was changed at the 2019 Half Year Economic and Fiscal Update. For an explanation of the new methodology, see: https://www.treasury.govt.nz/system/files/2019-12/hyefu19-bp-labour-productivity-growth.pdf

We should also recognise that higher rates, reached faster, are also possible. This could be driven by structural changes in the global economy including more expansionary fiscal settings and a rapid recovery from the COVID-19 pandemic. It could also be the case that low interest rates have been more cyclical than appreciated and that the theoretical link between interest and growth rates will re-assert itself faster. It would be appropriate to consider a scenario where interest rates rise to around 5.5% within a decade as a potential higher interest rate scenario.

The implications for public debt sustainability will depend on the difference between the interest rate and the economy's trend growth rate ('r-g'). This range of scenarios will imply different requirements for the primary balance in order to stabilise the debt-to-GDP ratio.

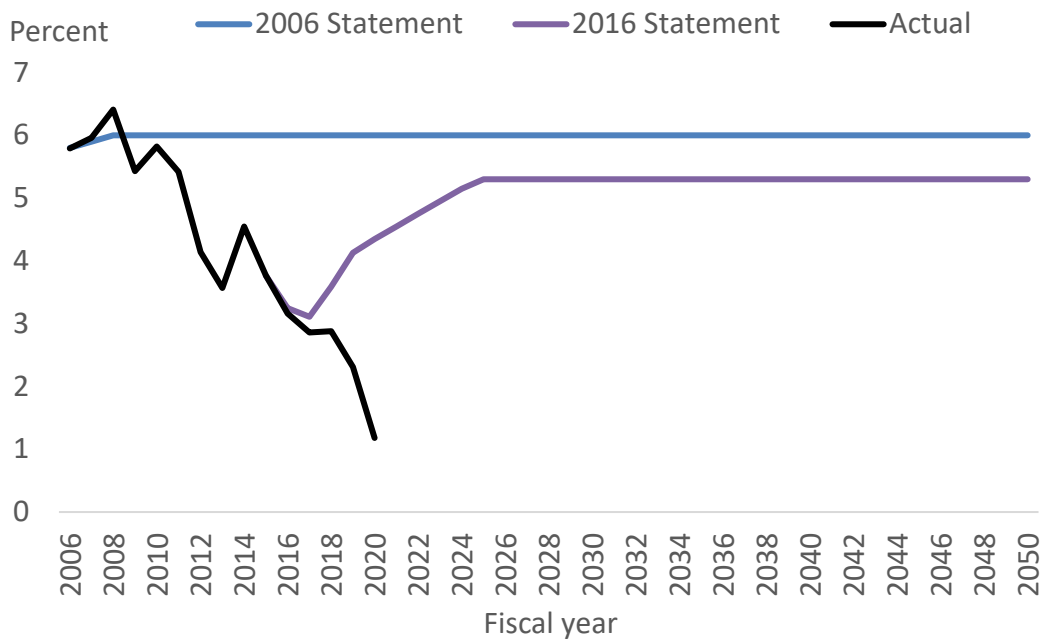
Introduction

The Treasury produces a statement on the long-term fiscal position ("statement") at least every four years. This statement is a requirement of the Public Finance Act. The statement provides information about the long-term outlook and risks for New Zealand's public finances. The statement presents fiscal projections for at least 40 years ahead. The Treasury must use its best professional judgments about the outlook and risks.

The fiscal projections require an assumption about the government's interest rate, with the government 10-year bond being the form of interest bearing instrument projected. An interest rate assumption is needed to project the government's interest expenses (ie, the interest payments that service the public debt). Moreover, the government's interest rate is a key variable for assessing public debt sustainability.

The interest rate assumption needs to be tested to consider the latest data, research and evidence. Projecting interest rates has been challenging in recent decades. There has been a trend decline in government interest rates in recent decades in many advanced economies.

Figure 1: Long-term projections of New Zealand 10-year government bond yields



Source: The Treasury

The trend decline in interest rates has surprised most forecasters and those preparing long-term fiscal projections. For example, as shown in Figure 1, the Treasury's 2006 *Statement* used a projection assumption for the 10-year bond yield of 6% for 2008 to 2050. By 2016, it had fallen to around 3%. The 2016 *Statement* projected the bond yield to rise gradually to 4% by 2020, and further increase to reach 5.3% by the mid-2020s. Instead, the 10-year bond yield fell further, averaging 1.2% in the 2019/20 fiscal year.

Method

Overview

The Treasury's Long-term Fiscal Model (LTFM) is used to construct fiscal projections for at least 40 years ahead. The LTFM projects the public finances by combining detailed modelling of the government's financial statements and deterministic relationships between fiscal, economic and demographic variables.

The LTFM uses the Treasury's economic and fiscal forecasts to set its base for the initial five years. These forecasts are published in Economic and Fiscal Updates at least twice per year. In the forecast period, the interest rate is endogenously determined using a macroeconomic model. The interest rate forecast is developed with reference to initial conditions, based on financial market data, and a monetary policy rule. The forecast for the 10-year bond yield is derived from the forecast short-term interest rate.

The *projection period* refers to the fiscal years that follow the initial five-year *forecast period*. In the projection period, the interest rate projection is exogenously determined based on assumptions.

Projecting the government's interest expenses requires more than an interest rate projection. It also requires assumptions about the level, composition and maturity structure of the public debt.

The LTFM includes a projection of the nominal, 10-year, New Zealand government bond yield. This rate is used because it is a key benchmark rate and is close to the average term to maturity of New Zealand government securities. The average term to maturity was 7.6 years in 2021 (IMF, 2021).

To project the government's interest expenses, the LTFM calculates an effective interest rate that is applied to the stock of public debt.

Interest rate projection method

The LTFM includes a projection of the 10-year, nominal, New Zealand government bond yield. The initial value is from the final year in the forecast base. The projection is constructed based on an assumption for the long-run value and a transition path.

The method projects the bond yield from its end of forecast value using a logistic function. This is a mathematical form that assumes that the bond rate will converge toward a stable value in the long run.

The formula is as follows:

$$i_{t+1} = i_t \left(1 + k\left[1 - \frac{i_t}{\bar{\imath}}\right]\right)$$

where:

- i_t denotes the bond yield in year t
- k is a constant parameter that sets the rate of convergence, and
- $\bar{\imath}$ is the assumed long-run value of the bond yield.

This method has the advantage of requiring only one simple and transparent formula. There are only two parameters, namely a stable, long-run value and a rate of convergence.

When applied in the LTFM the projection formula includes modelling logic to ensure that, when the projection gets within 10 basis points of the long-run stable value, it then transitions to this value over the ensuing five years. This stops the asymptotic approach and ensures that the stable value is actually attained.

The formula is sufficiently flexible to represent a range of possible projection paths. The logistic functional form ensures that the long-run stable assumption is approached in an asymptotic manner. The two parameters can be easily altered so that the projection is either stabilised at a higher or lower level or reaches the desired stable value in either a shorter or longer transition period.

The interest rate projection in the fiscal projections and fiscal sustainability

The evolution of public debt is determined by the government's primary balance (difference between non-interest spending and revenue) and the interest payments on the debt. This can be represented in the stylised equation (Piscetek, 2019):

$$D_{t+1} = (1 + i_t)D_t - P_t$$

where D_t is the public debt at the end of year t and P_t is the primary balance. In the LTFM, there is an effective interest rate that reflects the specific composition of the public debt.

When measured as a percentage of GDP, the dynamics can be represented by the equation:

$$d_{t+1} = \frac{1 + i_t}{1 + g_t} d_t - p_t$$

where d_t is the debt-to-GDP ratio, p_t is the primary balance-to-GDP ratio and i_t and g_t are the (nominal) interest rate and growth rate respectively (alternatively, both variables can be specified in real terms).

A stable debt-to-GDP ratio in the long run is considered to be an indicator of debt sustainability. Thus the interest-growth rate differential is critical for the evolution of the debt-to-GDP ratio and therefore debt sustainability. The low interest rate environment, if sustained, would have profound implications for the fiscal and welfare costs of public debt (Blanchard, 2019). If safe interest rates remain persistently below trend growth rates there will be significant (positive) implications for public debt sustainability. Blanchard presents evidence that this has been a reasonably common condition through history, although financial repression likely played a part through much of the sample period.

Long-term interest rate trends

There has been a trend decline in government interest rates in many advanced economies since 1990, including New Zealand (Figure 2). While part of the decline reflected lower rates of inflation, real interest rates have also declined. The charts below show the reduction in real interest rates, whether measured using an inflation adjustment (Figure 3) or observed inflation-indexed bond yields (Figure 4).

Long-term interest rates can be decomposed into a component that reflects expectations about the future path of short-term policy rates and a term premium. The term premium reflects compensation for the risk of holding interest rate securities. Callaghan (2019) uses a term structure model to analyse the drivers of New Zealand bond yields in New Zealand (Figure 5). It is found that the term premium for New Zealand 10-year bonds has trended down since the 1990s. However, most of the fall in interest rates can be accounted for by a lower expected short-term interest rate.

Figure 2: Nominal government 10-year bond yields

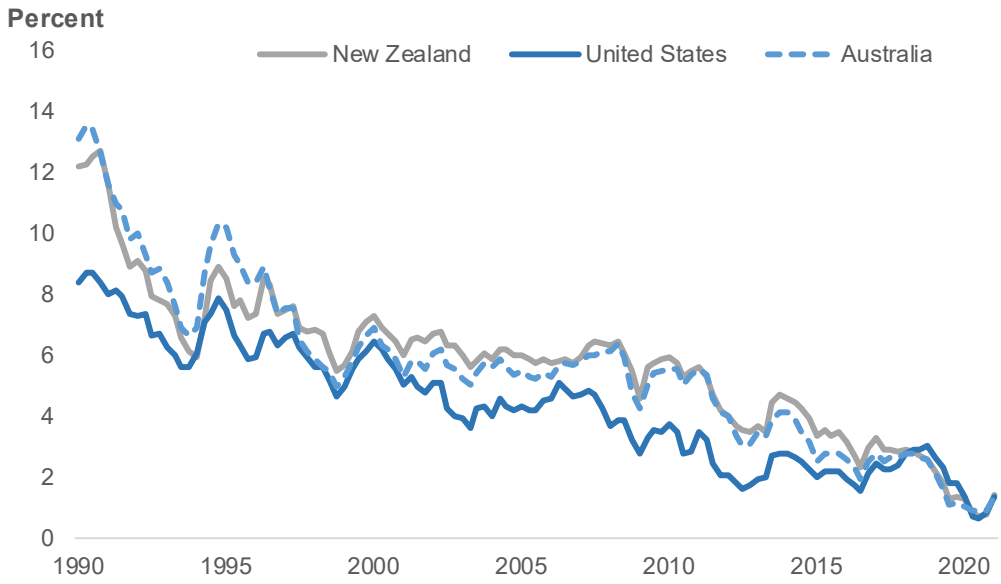


Figure 3: Real government 10-year bond yields (nominal rates less consumer inflation rate)

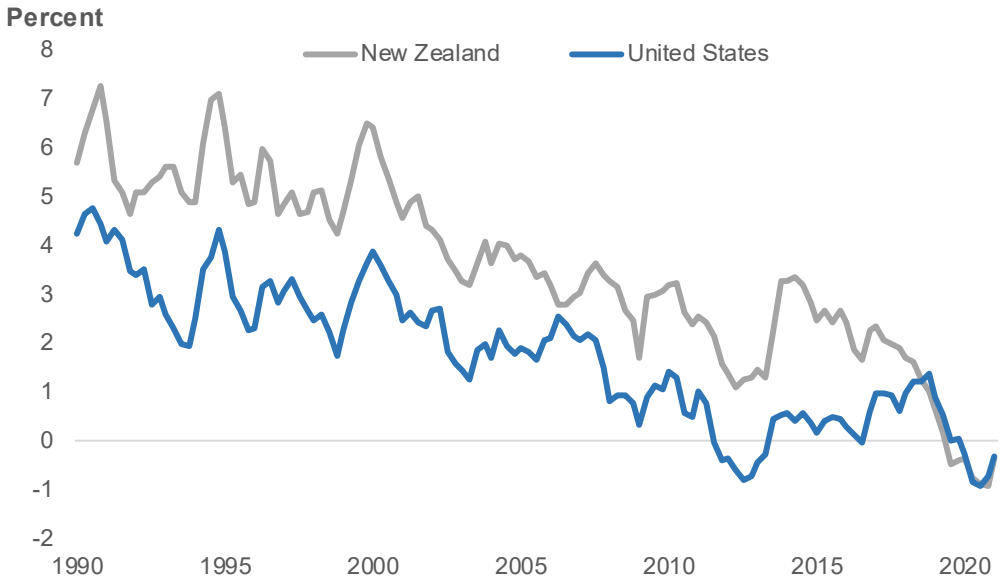


Figure 4: Government inflation-indexed bond yields

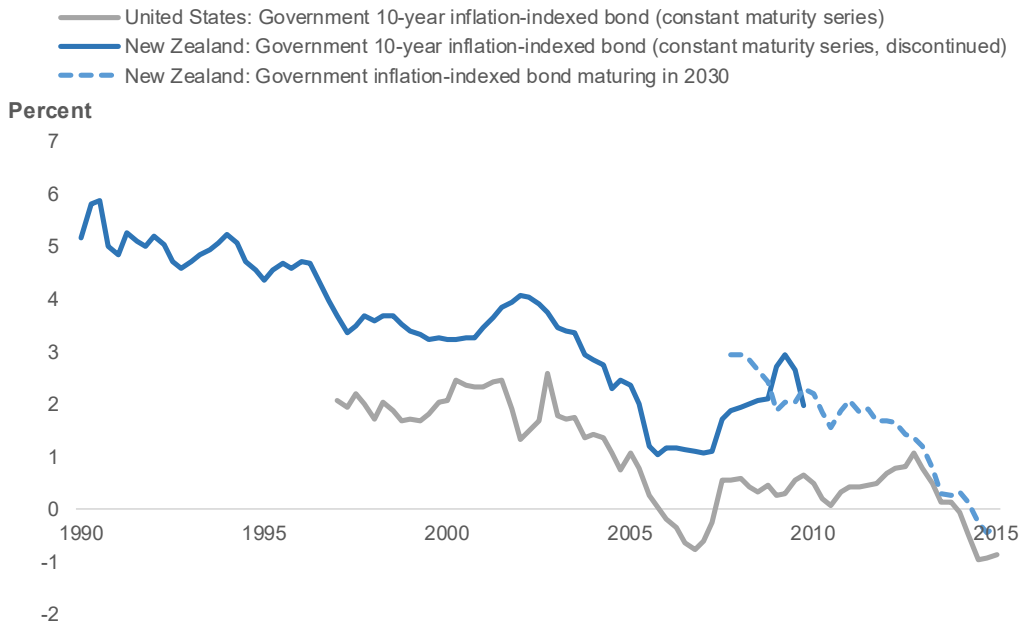
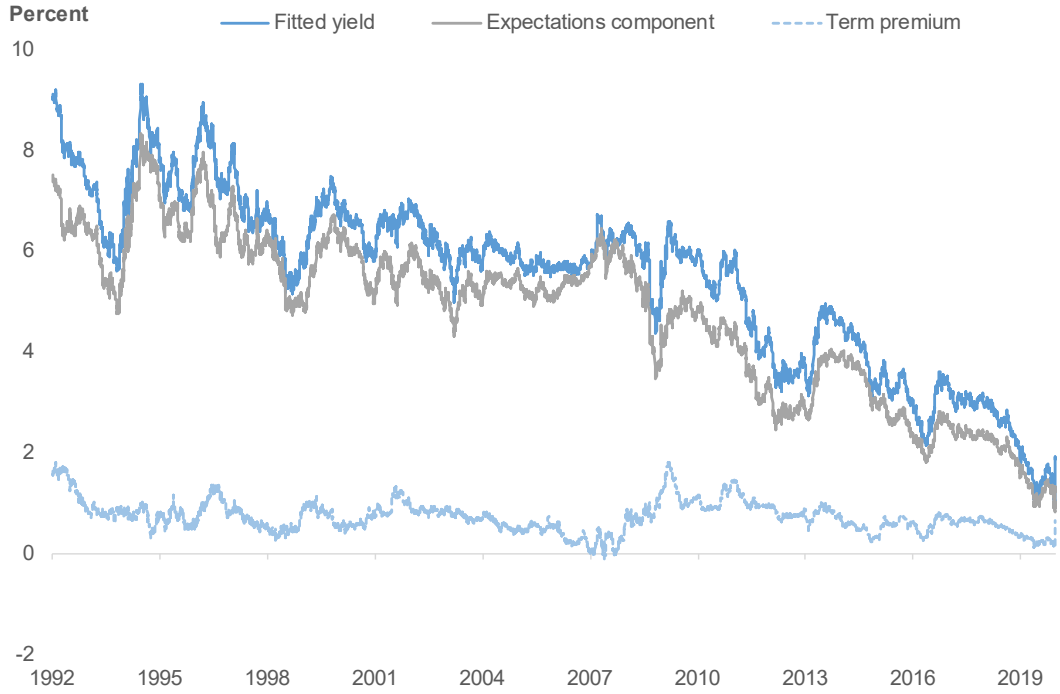


Figure 5: Decomposition of New Zealand government bond yield



Source: Callaghan (2019)

Influences on interest rates

There is a large body of research that attempts to explain the trend decline in global interest rates and the future outlook. Both the Congressional Budget Office (CBO) (Gamber, 2020) and the Office of Budget Responsibility (OBR) (United Kingdom Office of Budget Responsibility, 2021) have recently reviewed this research. This section provides a summary of the research.

There are differing frameworks used to discuss interest rates. One approach is to estimate the neutral real interest rate that would be consistent with stable inflation and a closed output gap. Interest rates can also reflect cyclical deviations from the neutral rate reflecting cyclical factors and monetary policies. Much of the literature explains the decline in real interest rates by identifying factors that shift the supply and demand for saving. This framework is not in conflict with the concept of the neutral interest rate, but provides a structural interpretation of the neutral rate.

The literature identifies the following factors as those associated with changes in the demand and supply of saving: lower trend productivity growth, demographic forces such as slowing labour force growth and ageing populations, a global saving glut, safe asset shortage, falling price of capital goods, and increases in income inequality. It is likely that a range of factors have influenced interest rates and some explanations overlap to an extent (see: Rachel and Smith, 2015; 2017; Lane, 2019).

Some research focuses on the link between equilibrium real interest rates and trend economic growth rates. Economic theory suggests that there should be a positive relationship between these variables. Holston, Laubach and Williams (2017) show evidence that trend economic growth rates have declined in many advanced economies since the 1980s. Based on a relationship with trend growth, they estimate that neutral real interest rates have declined over this period. Some researchers, however, argue that there is only a weak empirical link between interest rates and economic growth (eg, Rachel and Smith, 2015; 2017), and therefore point to factors in addition to trend growth rates.

Of particular relevance to the long-term fiscal statement are changes in global demographics. The world's population is ageing. Population ageing is associated with saving and investment channels. Saving rates depend on the age structure of the population, since people tend to do more saving in prime working age years and reduce their saving in older years. Since the 1980s, an increasing share of the global population has moved into middle age, which has increased desired saving. At the same time, labour force growth rates have declined. This reduces investment demand as less capital is required to maintain the ratio of capital to labour.

There are some offsetting forces that are likely to have put upward pressure on interest rates, but their impacts have been outweighed by the forces applying downward pressure. These factors include higher public debt, an expanded US safety net and a rising capital share of income.

Some of the cyclical factors have been the high interest rates used to achieve a disinflation in the 1980s and then the responses to the Global Financial Crisis (GFC) and COVID-19. As well as long-term structural factors, the GFC and COVID-19 pandemic have put downward pressure on interest rates. In both cases, precautionary saving increased (particularly in the form of safe assets) and investment demand reduced. In addition, the central banks of major advanced economies reduced policy rates and used alternative monetary policies, such as large-scale asset purchases. Quantitative easing policies are thought to put downward pressure on interest rates through signalling and term premium channels.

While cyclical factors are expected to unwind, they may be highly persistent. There is evidence that macroeconomic shocks can affect trend output, a phenomenon known as hysteresis (Cerra, Fatas and Saxena, 2020). Rare shocks may also have persistent effects on risk perceptions that increase demand for safe assets.

In terms of the more structural influences, Rachel and Smith (2015) examine six factors using a saving and investment framework. On the saving side, their analysis suggests the desired saving schedule has shifted out due to: demographic factors (accounting for 90 basis points of the fall in global real interest rates); higher inequality within countries (45 basis points); and a preference shift towards higher saving by emerging market governments following the Asian crisis (25 basis points). On the investment side, a decline in desired investment is attributed to: a fall in the relative price of capital goods (accounting for 50 basis points of the fall in real rates); a preference shift away from public investment projects (20 basis points); and the rising spread between the risk free rate and the return to capital (70 basis points).

Together these effects can account for 300 basis points of the fall in global real rates. Overall, lower expectations for trend growth and the shifts in desired saving and investment can account for about 400 basis points of the 450 basis point decline in the global long-term neutral rate since the 1980s. The remaining 50 basis points is unexplained. It could reflect other structural trends, cyclical factors, or that the market measure of real interest rates (derived from government bond yields) is affected by regulatory changes or Quantitative Easing.

The long-term outlook for interest rates depends on the direction of these various factors in the future. Some of these trends are expected to be persistent, whereas some are expected to reverse. There is considerable uncertainty.

The outlook for trend economic growth is uncertain. There are a range of views on the outlook, largely depending on degrees of optimism about technological progress. Most forecasters assume that total factor productivity growth will be below the average from mid-1990s to mid-2000s, reflecting recent trends, which implies that the fall in trend productivity growth will persist.

The effects of an ageing population in reducing saving rates is expected to persist into the 2020s, but then could reverse in future decades as the average age of the population increases. Goodhart and Pradhan (2020) argue that this demographic reversal will push up real interest rates as the dissaving of the elderly starts to dominate the saving of the middle-aged. However, Vlieghe (2021) concludes that we are only about two thirds of the way through this demographic reversal. The key mechanism is not the lower saving rates of the elderly, but rather that, as people age, they hold higher levels of assets (the accumulated *stock* savings over their lifetime), in particular safe assets, and those assets are only run down slowly and partially late in life.

The behaviour of interest rates also depends on policies. In particular, it is possible that more expansionary fiscal policies could lead to higher interest rates in the future than expected. Choices around inflation targets and monetary policies could also have implications for nominal interest rates.

Overall, the CBO, like many institutions, consider that that there will be some unwinding of cyclical factors and reversal of effects of population ageing. They therefore consider it most likely that there is some upward pressure on real interest rates over the long term. However, they consider that many of the factors that have put downward pressure on interest rates will persist, such that interest rates will remain below their historical averages.

In its most recent fiscal risks report, the OBR (2021) assesses the various factors behind the decline in global interest rates, drawing a distinction between the safe rate on government bonds and risky returns to capital more generally. The OBR conclude that although the various factors have attracted much attention, there is no clear consensus about their relative importance. Differing time periods and definitions of the real interest rate mean that the size of the decline to be explained varies across studies. Nonetheless, slower productivity growth and demographic change feature most consistently in the empirical studies. Since 2000, the shift in preferences towards safe assets is also likely to have been a factor pushing government bond yields below returns on riskier assets, while purchases by central banks have helped to offset the upward pressure coming from higher bond issuance. Other factors are likely to have played a part too, though their precise contribution remains uncertain.

In the next section we consider the specific assumptions used by agencies that make long-term projections.

Review of assumptions used by international agencies

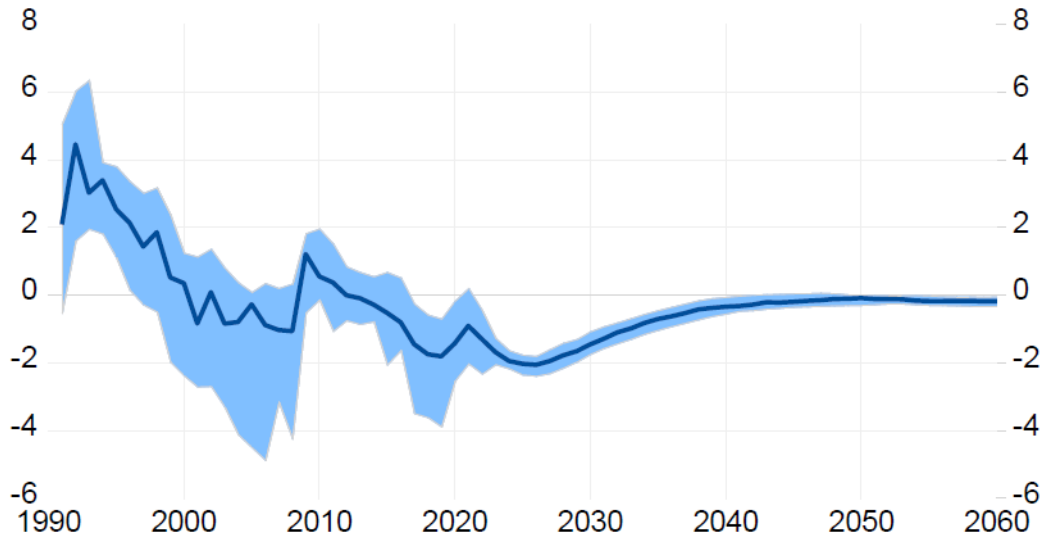
We review the assumptions used by a range of international institutions. These are fiscal forecasting agencies or other organisations that make assumptions about future interest rates.

OECD

The OECD regularly publishes long-term scenario analysis that includes fiscal variables (Guillemette and Turner, 2018; 2021). The long-term projections of $r - g$ depend on projected growth rates, and projected short and long-term interest rates on government debt, which are anchored on a neutral short-term interest rate. In their 2021 update, the OECD note that for the great majority of OECD countries, $r - g$ is estimated to be negative at the start of the long-run projection horizon. There is considerable uncertainty around the initial neutral short-term interest rate, which generates space for judgement in modelling choices.

In the Holston, Laubach and Williams (2017) approach discussed above, the neutral real interest rate is equal to the economy's trend growth rate plus an unobserved stochastic component that captures other influences. In the OECD baseline scenario, this unobserved component is assumed to gradually disappear over the projection period, so that neutral short-term real interest rates gradually converge toward real potential growth. As a result, initial $r - g$ differentials tend to shrink toward zero over time (see Figure 6 below). The OECD note that this is consistent with the empirical result of Wyplosz (2019), who finds an average differential of 0.1 percentage points historically using 895 annual observations from 22 OECD countries. Differences across countries in $r - g$ differentials are also assumed to gradually disappear and what remains is mainly due to country-specific fiscal risk premia in long-term interest rates. In the case of New Zealand, the assumed nominal interest rate rises from about 3.2% in 2020 to 3.4% in 2060. Annual nominal GDP growth declines from 4.8% to 3.6%, so that $r - g$ gap is essentially eliminated as per Figure 6.

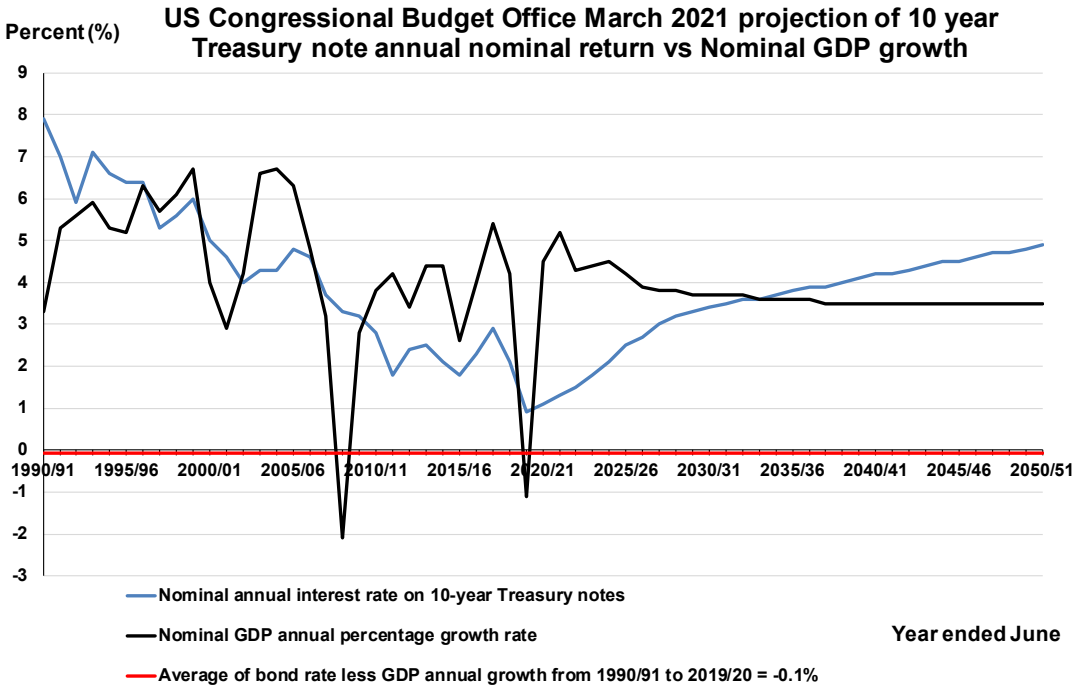
Figure 6: Difference between implicit average interest rate on government debt and potential growth rate across OECD countries, median and interquartile range in % points



Source: OECD

United States Congressional Budget Office

Figure 7: CBO nominal interest rate and growth rate projections



Source: CBO, authors' calculations

The Congressional Budget Office (CBO) makes 30-year long-term fiscal projections. This includes projections of US interest rates. The CBO lowered their long-run assumption for the real annual return rate for the US 10-year Treasury note to 2.3% in 2015. At that time they expected to reach 2.2% only five years later and attain 2.3% by 2027/28. However, with each annual update since then the transition path has been extended.

The CBO's latest long-term projection, at the time of writing, was done in March 2021. In this they take until 2045/46 to reach a 2.3% real annual return rate for the 10-year Treasury note. However, they now continue to increase beyond that, reaching 2.7% by the end of the projection in 2050/51.

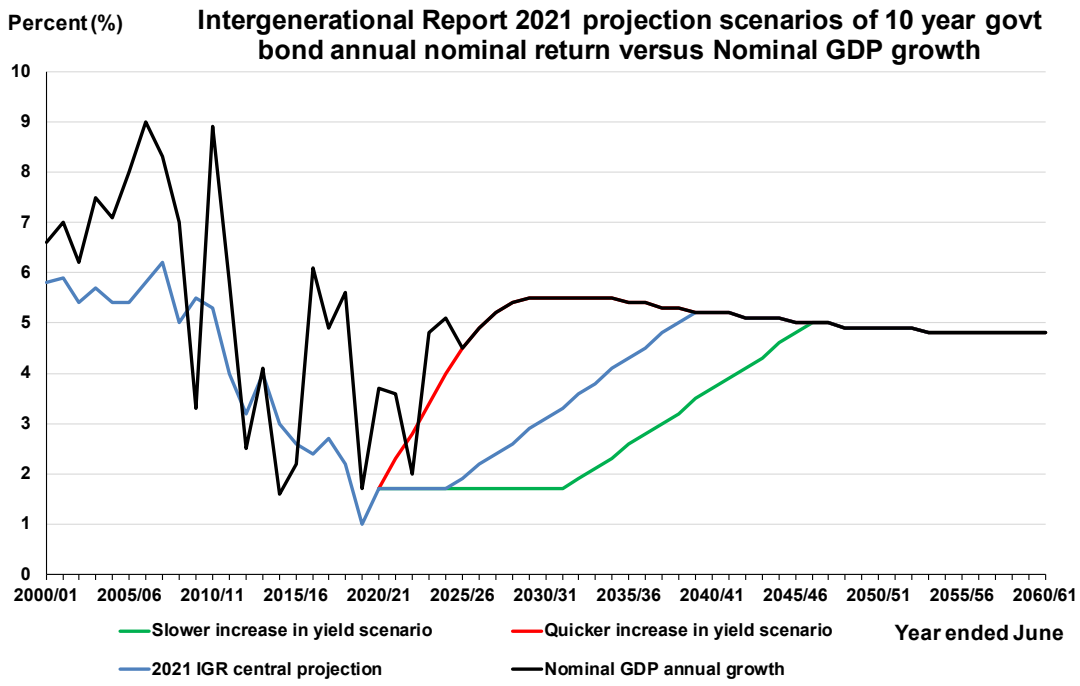
A graph from this projection comparing the annual nominal rate of return on 10-year United States Treasury notes and annual nominal GDP growth is shown in Figure 7.

The CBO's projection does not appear to involve any obvious link between interest rates and economic growth. The nominal annual return rate on 10-year Treasury notes initially rises steadily in the projected years before reducing to more gradual increases beyond 2030. It catches up to a gradually declining nominal GDP growth projection by 2033/34 and then just continues to rise above it. At the end of the projection, 2050/51, the nominal annual return rate of 4.9% is 1.4 percentage points above the nominal GDP annual growth rate of 3.5%.

Australian Treasury

The Australian Treasury published their latest Intergenerational Report (IGR) in June 2021. With this publication they appear to have moved away from using a truly stable long-run assumption for the annual nominal return rate on the Australian government 10-year bond, and instead are applying a similar logic to that used by the United Kingdom's Office of Budget Responsibility (OBR).

Figure 8: Australian Treasury nominal bond yield and nominal GDP annual growth projections



Source: Australian Treasury

Page 79 of the IGR notes "…an assumption that the 10-year bond yield gradually converges to around 5 per cent by 2039-40, consistent with long-term nominal GDP growth." (Australian Treasury, 2021). As Figure 8 clearly shows, once all of the bond yield projections, including the higher and lower yield scenarios, reach parity with the annual growth rate of nominal GDP, they remain equal to it in later projected years.

Figure 8 also includes the scenarios run in the IGR concerning slower and quicker increases to government bond yields. The central projection holds them constant at 1.7% over the forecast years before they begin to increase in 2025/26 at around 20 basis points per year until attaining parity with projected annual growth in nominal GDP around 2039/40. The "Quicker increase" scenario begins rising from 2021/22, at 50 basis points per year on average, until it catches up to nominal GDP growth in 2027/28. By contrast, the "Slower increase" scenario does not change from 1.7% until 2032/33, after which it rises at about 20 basis points annually until it reaches nominal GDP annual growth in 2046/47. Unlike the scenarios run in the LTFM for the long-term statements, the IGR scenarios all eventually reach the same levels, which are those of annual growth in nominal GDP.

This is the fifth edition of the IGR, the others being published in 2002, 2007, 2010 and 2015. Neither the 2002 nor 2007 editions appear to state what the underlying interest rate assumption is, but the 2010 version clearly explains that a stable 6% nominal annual interest rate is assumed throughout the projections (Australian Treasury, 2010). The 2015 IGR also states, "The long-term yield curve is based on an assumption that the long-term yield on 10-year Commonwealth Government Securities is 6 per cent." (Australian Treasury, 2015). Hence, the alignment with nominal GDP growth does appear to be a change in the modelling logic applied in the IGR projections of interest rates.

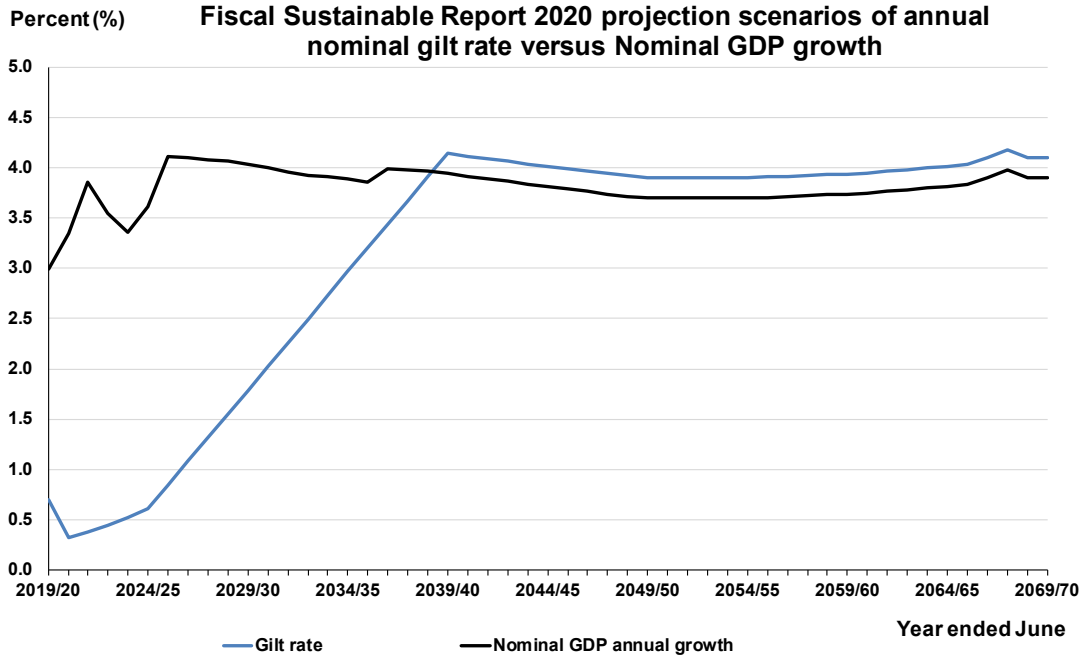
The United Kingdom's Office of Budget Responsibility

The Office of Budget Responsibility (OBR) projects the return rate on government bonds (termed 'gilt rates'), as part of their Fiscal Sustainability Report (FSR). In historical and forecast years the gilt rates are based on averages for bonds of varying maturity lengths. However, for the future period in which the gilt rates are projected they are largely based on 10 year maturities. The OBR have published these reports since 2011, initially every year, but every two years since 2018.

In paragraph 3.24 of the 2012 FSR it states that the interest rate on government debt was held constant at 5.0% from 2021/22 onwards, which was 10 basis points lower than in the 2011 FSR's projections (Office of Budget Responsibility, 2012). In the 2013 FSR they retained this 5.0% assumption but added that it was "close to but above our nominal growth rate projections" (Office of Budget Responsibility, 2013), and a similar comment was made in the 2014 report. These earlier reports did not explicitly state that the OBR aligned their long-run gilt rate projection with their projection of annual nominal GDP growth, and it would appear instead that they used a constant assumption, such as 5.0%. However, each report made a comment about how the gilt rate projection was close to that of nominal GDP growth. In the 2017 FSR it is clearly stated that "…we have kept the difference between the long-term nominal interest rate and nominal output growth at 0.2 percentage points, leaving interest rates close to but above our growth rate projections" (Office of Budget Responsibility, 2017). Unfortunately the data for the nominal GDP and gilt rate projections is not available from the OBR website for these earlier editions of the FSR.

It was not until the most recent July 2020 FSR that data showing year by year values of the projected gilt rate was made available, and even then the projected nominal GDP track had to be sourced from a different publication, the March 2020 Economic and Fiscal Outlook. From these two sources Figure 9 was produced. It clearly shows that, beyond 2039/40, the projected gilt rate is aligned to the projected nominal GDP annual growth rate with a small positive wedge of 20 basis points. So it would appear that, at least since the 2017 projection and possibly earlier, the OBR have been aligning their projection of the gilt rate with nominal GDP growth, albeit with a small positive wedge.

Figure 9: United Kingdom OBR nominal gilt rate and nominal GDP annual growth projections



Source: OBR, authors' calculations

In the July 2020 projection the OBR uses a 24 basis point annual increase from the final forecast year of 2024/25 until they reach a point, in 2039/40, where the projected gilt rate is 0.2 percentage points above the projected annual growth rate of nominal GDP. Beyond this year they simply retain this relationship with nominal GDP growth to project the gilt rate.

The OBR methodology derives from economic theory that holds that interest rates and growth rates should be related. While the more common approach by international fiscal agencies is to use some variation of eventually attaining an assumed "stable" level, as mentioned earlier the Australian Treasury now seems to be applying an interest rate projection methodology like that of the OBR.

The OBR uses a "stable" positive wedge of 0.2 percentage points between the gilt rate and the annual growth of nominal GDP. In conversations with OBR analysts, they said arguments could be made for either a positive or negative gap, or none at all, as the Australian Treasury applies. They emphasised that any wedge, whatever its sign, should be small.

Canadian Department of Finance

The Canadian Department of Finance is responsible for producing their government's *Update of Long-Term Economic and Fiscal Projections*. The 2018 document states that "The effective interest rate on interest-bearing federal debt is assumed to gradually increase from about 3.0 per cent in 2023-24 to 3.8 per cent by the mid-2040s and remain broadly stable around this level thereafter" (Canadian Department of Finance, 2018). This suggests that the Canadian Department of Finance also targets a long-run stable level of interest in their long-term projections. Their projected annual growth rates of nominal GDP (Canadian Department of Finance, 2018), rise from 3.5% in 2025/26 to 3.9% a decade later and then slightly reduce to 3.8% in 2045/46 and 3.7% by 2055/56. Consequently their stable nominal annual effective interest rate on government debt of 3.8% is actually very close to their fairly stable level of annual growth in nominal GDP once they reach the middle of the 2040s.

Swiss Federal Department of Finance

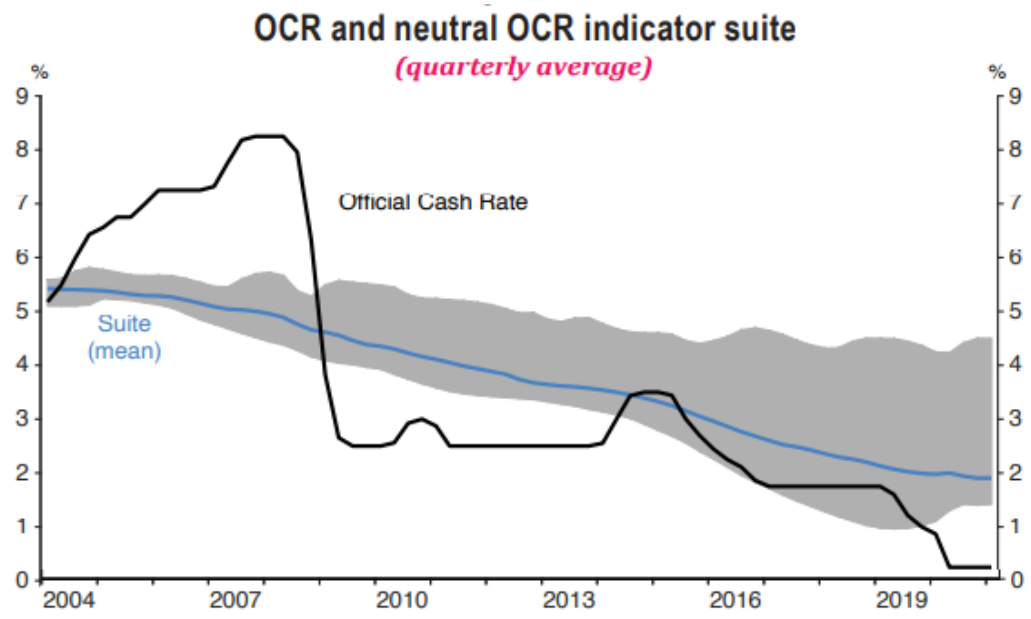
The Swiss Federal Department of Finance produces a *Report on Long-Term Sustainability* every four years, with the last one published in 2016 (Swiss Federal Department of Finance, 2016). It assumes a long-run stable real interest rate on 10-year bonds of 1.5%, or 2.5% for the nominal rate. Real GDP growth is projected to steadily decline with weakening labour force annual growth, dropping below the long-run real interest rate of 1.5% by the middle 2030s. This implies that the Swiss Federal Department of Finance is not linking long-run interest rate projections to annual GDP growth.

Review of assumptions used by domestic agencies

Neutral interest rate assumptions of the Reserve Bank of New Zealand and the Treasury

Economic forecasters make assumptions about the neutral short-term interest rate. The neutral rate provides an indication of what the interest rate would be absent cyclical effects. Nevertheless, there are two main caveats for using neutral short-term rates for long-term projections. The neutral rate is time varying, and therefore is not a projection of interest rates in the long-term future. And there may be a term premium between the short-term rates and a 10-year bond rate.

Figure 10: RBNZ's neutral nominal official cash rate



Source: RBNZ estimates.

Note: Shaded area indicates the range between the maximum and minimum values from a suite of neutral OCR indicators.

The Treasury's economics forecasts are contained in its *Economic and Fiscal Updates*. The Treasury last reviewed its nominal neutral interest rate in 2019 (The Treasury, 2019). The Treasury defined the neutral rate as the unobservable interest rate that prevails in an ideal world where the economy grows at its trend rate, inflation is stable at its target and the output gap is closed. It noted that estimates have large uncertainties. The Treasury considered a range of methods and estimates. Its judgement was that its forecasts would assume a terminal nominal neutral rate to be 3.0%.

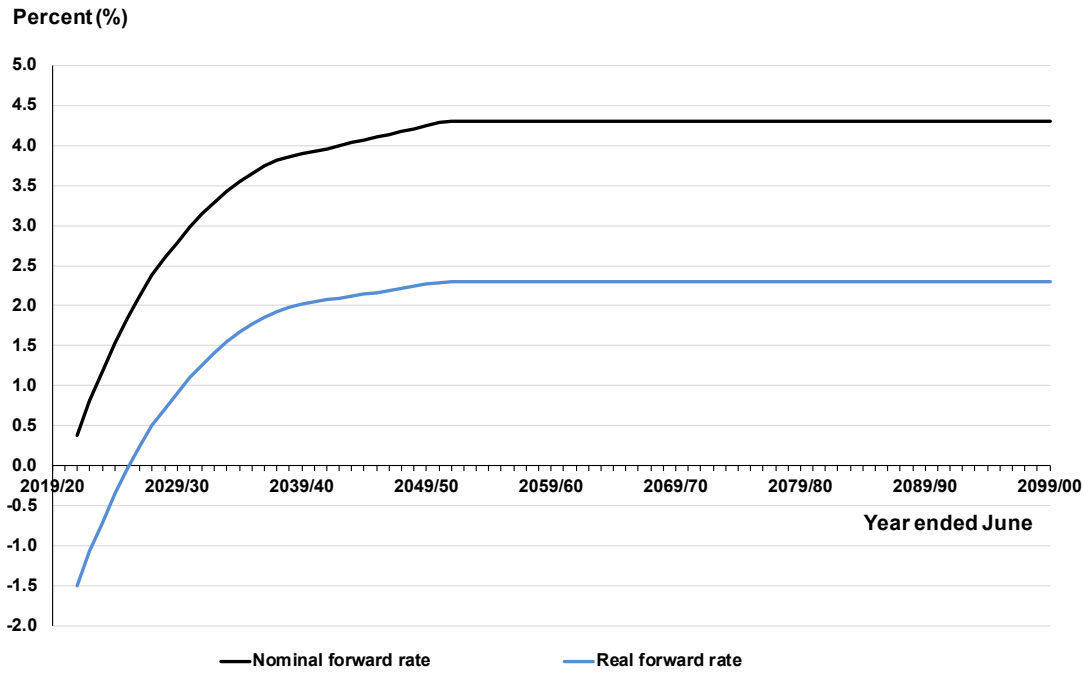
The Reserve Bank of New Zealand (RBNZ) publishes economic forecasts in its *Monetary Policy Statements*. Figure 10 shows the RBNZ's range of estimates for the nominal neutral official cash rate (OCR) in the May 2021 *Monetary Policy Statement* (RBNZ, 2021). The mean neutral OCR is estimated to be 1.9 percent in the first quarter of 2021. There is a range of estimates bounded by 1.4 and 4.5 percent.

Risk-free discount rates for accounting valuation purposes

The Treasury publishes a table of risk-free discount rates and consumer price index (CPI) assumptions that must be used in certain accounting valuations for the purpose of preparing the Financial Statements of the Government of New Zealand.

A review is conducted every 3 years that determines the discount rate method. The last full review was in 2019 with a subsequent limited scope review in 2020 to consider the effects of the COVID-19 pandemic.

Figure 11: Forward rate assumptions for accounting valuation purposes, June 2021



Source: The Treasury

The method uses market data for the short-to-medium term. This is then bridged to long-run assumptions, which are a judgment after analysing a range of sources. The review notes that "as there is no observable data for the real (or nominal) long-term risk-free discount rate, judgment is required in selecting the rate that proxies the long-term real risk-free discount rate. Recent historical nominal and real risk-free returns, returns on long-term nominal and inflation-indexed bonds, returns on relevant offshore nominal and inflation-indexed bonds and economic theory are all relevant to selecting the long-term risk-free discount rate" (The Treasury, 2019b).

The forward rate assumptions, for both nominal and real risk-free interest rates, are presented in Figure 11. The long-run real interest rate is assumed to be 2.30 percent and the long-run nominal rate is 4.30 percent.

New Zealand Superannuation Fund (NZSF)

The New Zealand Superannuation Fund (NZSF) publishes its *Statement of Performance Expectations* each year and in this annual report provides a *Statement of Estimated Fund Performance*, in which it constructs its long-term expected return rate. One of the parameters of this return rate is the risk-free return rate on 90-day Treasury bills. The NZSF reassesses all of the parameters, usually once every five years. In the June 2020 publication, the expected long-run annual return assumption for 90-day Treasury bills was re-assessed and reduced from 5% to 4%.

The NZSF construct their New Zealand risk-free return rate from a 2% inflation component, a 1.5% country risk premium for New Zealand, and a 0.5% global real equilibrium cash rate.

Information from financial markets

Financial prices contain information about financial market participants' expectations. In particular, long-term interest rates involve aggregate expectations of many people about the path of future interest rates. However, financial markets can be wrong and sometimes spectacularly so.

There are technical challenges with extracting expectations from financial market data. It is common to use forward rates derived from the yield curve to construct an indicator of expectations. However, forward rates will be affected by term premia. With this caveat, we will nevertheless look at forward rates as they provide a rough guide to market expectations.

We calculate forward rates for the New Zealand government bond yield curve. The Nelson-Seigel-Svennson method is used to obtain the forward rates. The model assumes a particular functional form to the prices of discount bonds. The functional form for the continuously compounded spot rate of time to maturity, T, is:

$$s(T) = \beta_0 + \beta_1 \frac{\left[1 - e^{-T/\tau_1}\right]}{T/\tau_1} + \beta_2 \left(\frac{\left[1 - e^{-T/\tau_1}\right]}{T/\tau_1} - e^{-T/\tau_1} \right) + \beta_3 \left(\frac{\left[1 - e^{-T/\tau_2}\right]}{T/\tau_2} - e^{-T/\tau_2} \right)$$

where β0, β1, β2, β3, τ_1 and τ_2 are parameters that need to be determined. The values of the six parameters are determined by optimising τ_1 and τ_2 and choosing all betas using ordinary least squares. The instantaneous forward rate for a given time to maturity, T, is given by

$$f(T) = \beta_0 + e^{-T/\tau_1} \left(\beta_1 + \beta_2 \frac{T}{\tau_2} \right) + \beta_3 e^{-T/\tau_2} \frac{T}{\tau_2}.$$

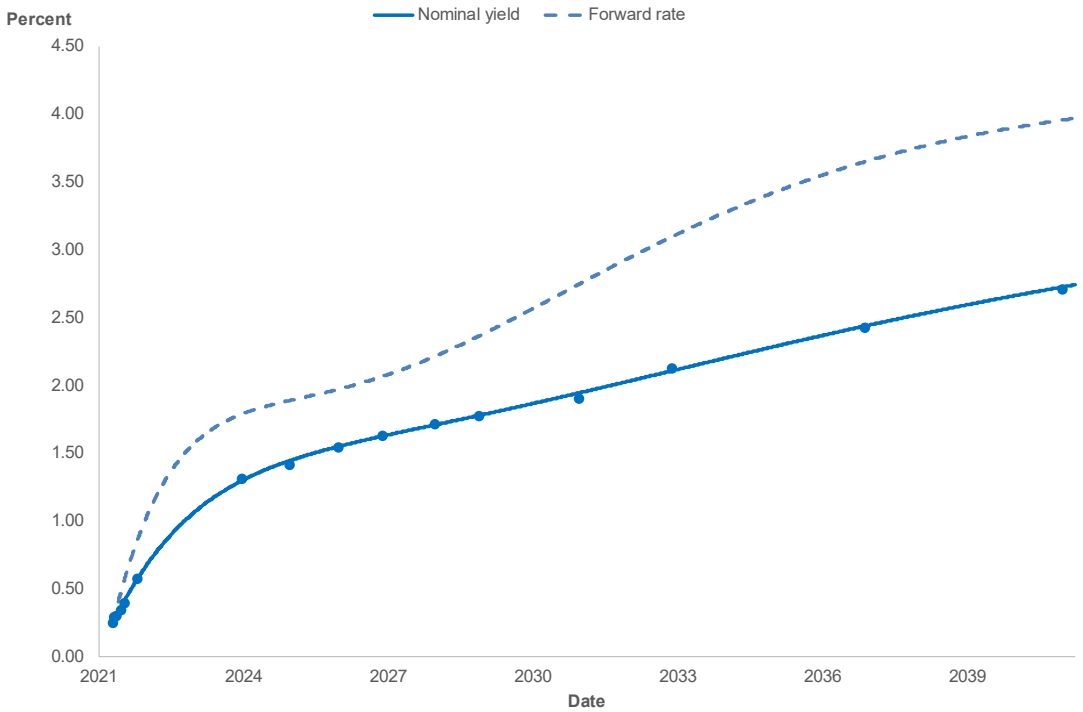
All these rates are quoted with continuous compounding.

We show forward rates for New Zealand in Figures 12 and 13. The nominal forward rates show a gradual rise over the next twenty years to 4.1 percent in 2041 (as at June 2021). The inflation-indexed forward rate is estimated to be 0.9 percent in 2030 and 1.8 percent in 2035 (as at May 2021).

We also examine forward rates for United States government bonds (Figures 14 and 15). We look at US bond rates as global rates are a significant driver of New Zealand rates, although New Zealand rates tend to be higher than US interest rates on average. The interest rate premium between US and NZ inflation-indexed yields is about 1 percentage point for government bonds with a maturity of around twenty years.

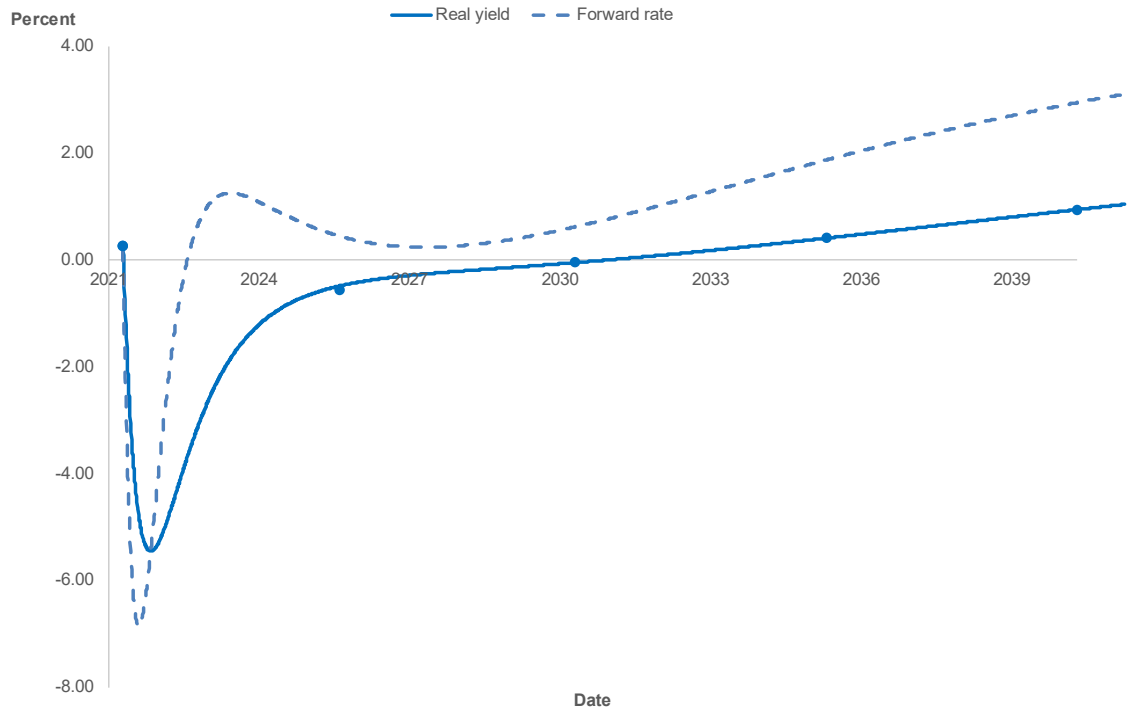
We show instantaneous forward rates as calculated in May 2021 following the method in Gurkaynak, Sack and Wright (2007), updated by the Federal Reserve. The forward rate for US nominal government bonds is 2.7 percent in 20 years and 3.0 percent in 30 years (as at May 2021). The forward rate for US inflation-indexed bonds is 0.4 percent in 20 years (as at May 2021). Thus we can conclude that US interest rates are consistent with expectations for interest rates to stay low over coming decades, albeit higher than current rates. The forward rates are somewhat lower than the interest rates projected by the CBO.

Figure 12: New Zealand nominal yield curve, September 2021



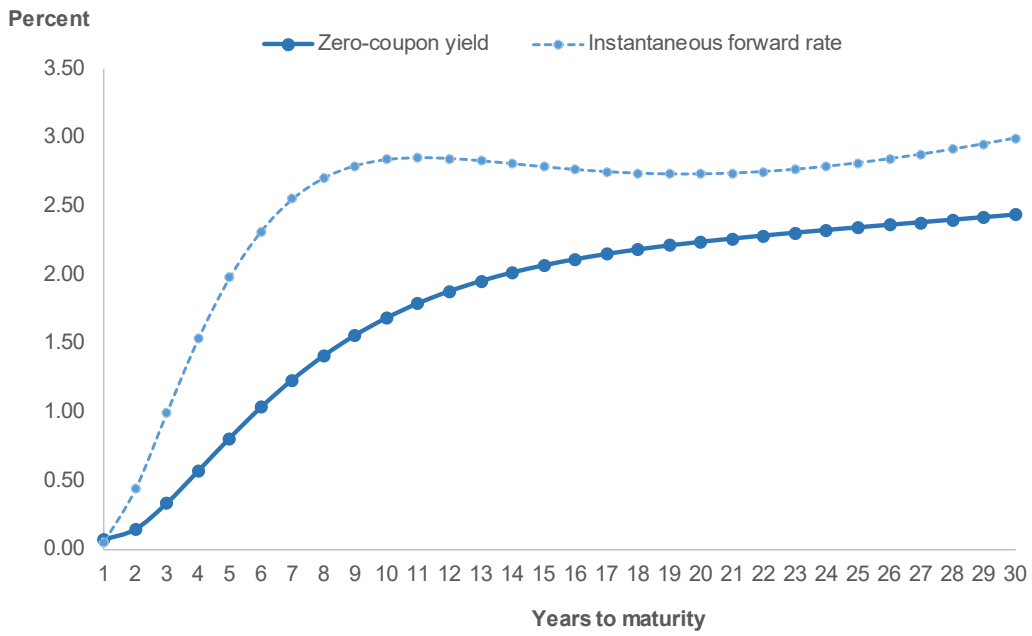
Source: New Zealand Debt Management

Figure 13: New Zealand inflation-indexed yield curve, September 2021



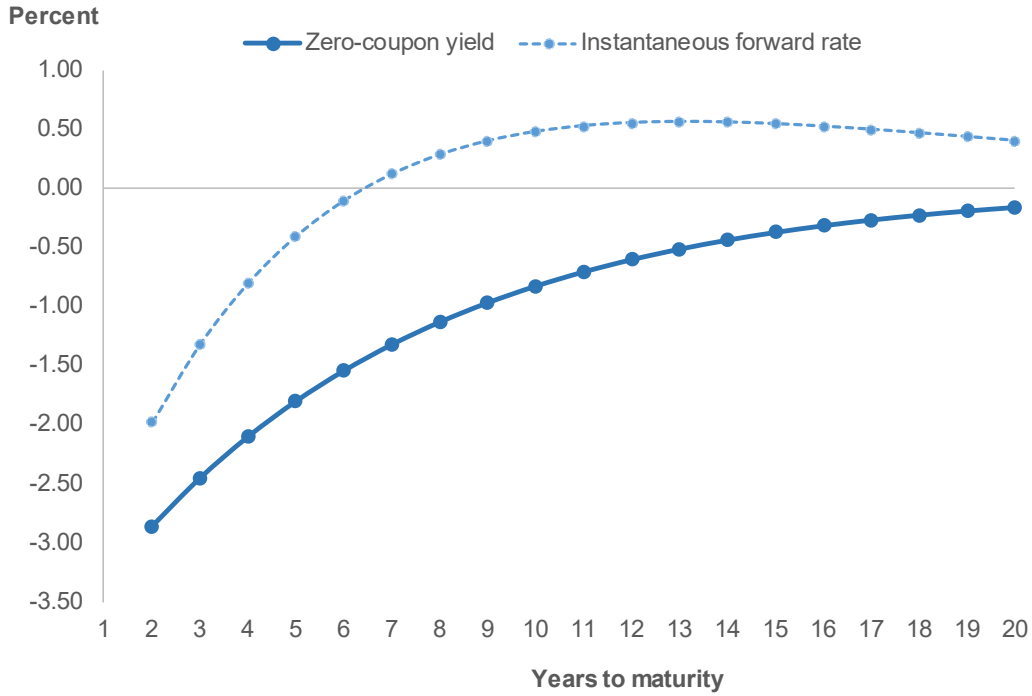
Source: New Zealand Debt Management

Figure 14: United States nominal yield curve, May 2021



Source: Gurkaynak, Sack and Wright (2007), updated by the Federal Reserve

Figure 15: United States inflation-indexed yield curve, May 2021



Source: Gurkaynak, Sack and Wright (2007), updated by the Federal Reserve

Table 1 below summarises the interest rate assumptions and projections from international and domestic agencies, as well as the information from financial markets.

Table 1: Interest rate assumption/projections

International agencies		
Institution	**Assumption**	**Last updated**
OECD	For New Zealand, the nominal interest rate rises from about 3.2% in 2020 to 3.4% in 2060. Annual nominal GDP growth declines from 4.8% to 3.6%, so that *r* – *g* gap is essentially eliminated.	2021
U.S. Congressional Budget Office	US 10-year real bond rate projected to rise to 2.7% by 2050/51. Does not stabilise nor become linked to GDP growth.	2021
Australian Treasury	Australian 10-year bond rate assumed to align with nominal GDP growth by 2039/40. Stays around 5% beyond that year.	2021
UK OBR	Long-term bond rate assumption is nominal GDP growth plus 0.2 percentage points. It is projected to be about 4%.	2020
Canadian Department of Finance	Long-term interest rate of 3.8% by 2045/46, which is close to nominal GDP growth.	2018
Swiss Federal Department of Finance	Assumes long-term nominal bond rate of 2.5% (1.5% real). No link to GDP growth.	2016
Domestic agencies		
Institution	**Assumption**	**Last updated**
The Treasury's neutral interest rate assumption	Neutral nominal interest rate assumed at end of forecast period is 3.0%.	2019
Reserve Bank of New Zealand	Nominal neutral interest rate: uses an indicator suite to express a mean and range. Mean is 1.9% (range: 1.4% to 4.5%).	2021
The Treasury's discount rate assumptions for accounting valuations	Discount rate assumptions for accounting purposes: Long-run real risk-free rate: 2.3% Long-run nominal risk-free rate: 4.3%	2019
New Zealand Superannuation Fund	Long-run nominal 90-day rate: 4.0%	2020
Financial markets		
Nominal forward rates show a gradual rise over the next twenty years to 4.1 percent in 2041		

Uncertainty and scenarios

We have reviewed a range of information, including the academic research, projection methods of other agencies and information from financial markets.

There is considerable uncertainty about the long-term outlook for interest rates. The uncertainty can be illustrated by the fact that interest rates have tended to be systematically lower than the expectations of professional forecasters and those implied by financial markets over recent decades. This points to structural factors that have shifted interest rates downwards. At the same time, interest rates are an endogenous variable. It is possible that policy changes – such as expansionary fiscal policy – could push interest rates higher than expected in the future. Cyclical factors, and the difficulties of disentangling cycle and trend, add to the uncertainty.

In light of the uncertainty, it is appropriate to consider a range of potential scenarios.

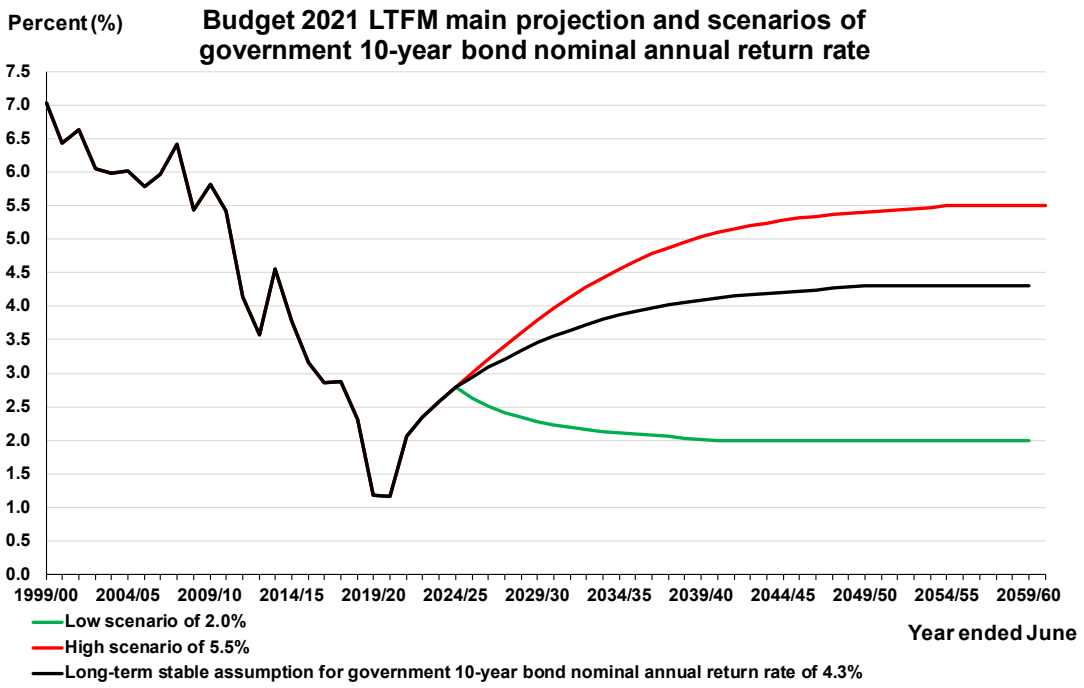
For the central scenario, we consider it appropriate to assume that interest rates will remain below their historical averages. A range of structural factors have pushed interest rates down and many of these structural factors are likely to have persistent effects on interest rates. However, over the long term, it is appropriate to assume a modest increase in interest rates, albeit remaining at levels below historical averages. This is due to some expected reversal of structural trends and unwinding of cyclical factors. For the long-term stable value of the New Zealand nominal 10-year government bond rate, we consider a rate of **4.3% to be appropriate**, consisting of a real rate of 2.3 percent and inflation rate of 2 percent. In line with the comments at the beginning of this paragraph, the bond rate projection should rise gradually, in order to take several decades to attain this long-run value.

This long-run stable value of 4.3% is broadly in line with information of financial markets and picks of other forecasters. It also aligns with the Treasury's risk-free rate assumptions used for accounting valuation purposes. The average difference, over the 30-year period from 1991/92 to 2020/21, between the average annual nominal rates of New Zealand government 10-year bonds and 90-day Treasury bills is 30 basis points. This means that the choice of 4.3% for the long-run stable value of the 10-year bond rate also corresponds well to a pick of 4.0% for the risk-free rate.

However, given the considerable uncertainty, it is appropriate to also illustrate other scenarios. In particular, the long run value is higher than current interest rates and higher than current estimates of the neutral rate. Moreover, we should give some weight to the fact that forecast errors have generally been to the downside over recent decades. Therefore it would be appropriate to consider a scenario where interest rates remain low at around current levels. A scenario showing the 10-year bond rate at around 2 percent would be appropriate, although other scenarios could be contemplated including the possibility that rates fall further.

We should also recognise that higher rates, reached faster, are also possible. This could be driven by structural changes in the global economy, including more expansionary fiscal settings and a rapid recovery from the COVID-19 pandemic. It could also be the case that low interest rates have been more cyclical than appreciated and that the theoretical link between interest and growth rates will re-assert itself quickly. Thus, it would be appropriate to consider a scenario where the 10-year bond yield rises to its historical average in the short-to-medium term. The 30-year average of New Zealand 10-year bond yields is 5.4 percent. Hence It would be informative to consider a scenario where interest rates rise to around 5.5% within a decade as a potential higher interest rate scenario.

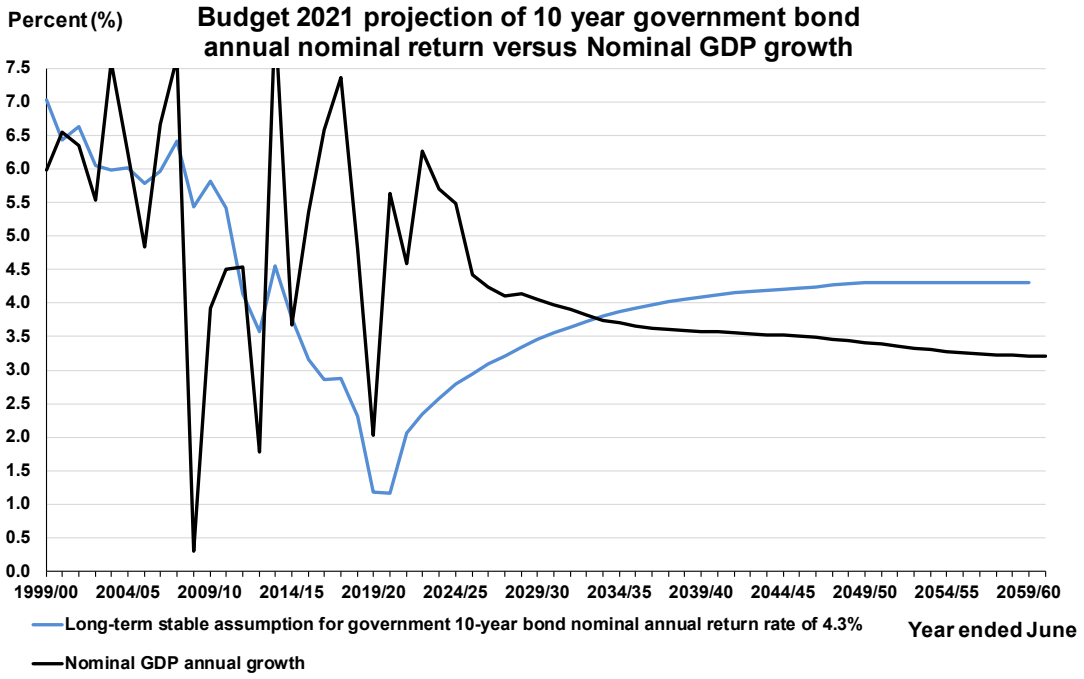
Figure 16: Long-run assumption for government 10-year bond rate with high and low scenarios



Source: The Treasury

In choosing to apply a long-run stable assumption for the government 10-year bond annual return rate, we have elected not to follow the UK Office of Budget Responsibility and Australian Treasury approach of aligning the bond return rate to annual growth in nominal GDP growth.

Figure 17: 2021 Long-term Fiscal Model projection of nominal bond yield and GDP growth

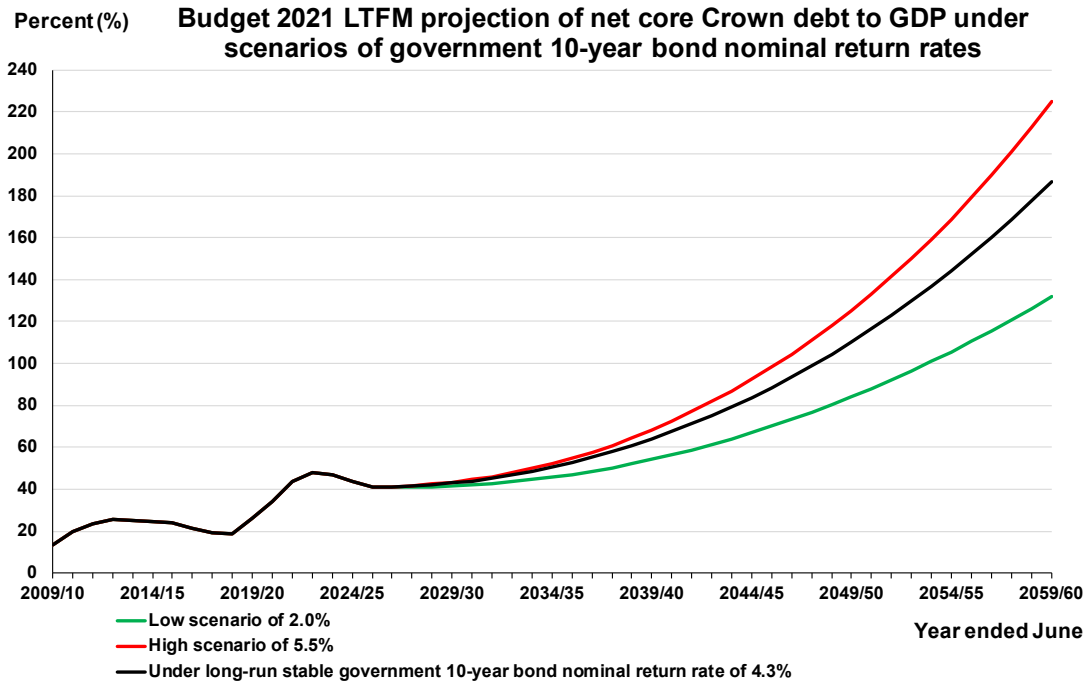


Source: The Treasury

The labour force growth projections produce a steady decline in the projected growth of the New Zealand economy. Consequently, aligning the projected bond rate to nominal GDP growth would cause it to decline, at a not insignificant rate, as soon as it had completed a long period of gradual increase to reach GDP growth. The resulting inverted U shape does not look very plausible, although with so much uncertainty about future interest rates an argument could be made for such a profile.

The implications for public debt sustainability will depend on the difference between the interest rate and the economy's trend growth rate ('r' and 'g'). Projected trend nominal economic growth rates gradually fall over the projection horizon to just over 3 percent. Therefore, our central scenario implies that r-g is negative over the short-to-medium term and then positive in the long term. In the lower interest rate scenario, r<g for the entire projection. In the higher interest rate scenario, r rises above g quickly, and r>g for the remainder of the projection period. Thus these scenarios will have different requirements for the primary balance to stabilise the debt-to-GDP ratio.

Figure 18: 2021 Long-term Fiscal Model projection of net debt to GDP under bond rate scenarios



Source: The Treasury

References

Australian Treasury (2010) Intergenerational Report, January 2010

Australian Treasury (2015) Intergenerational Report, March 2015

Australian Treasury (2021) Intergenerational Report, June 2021

Blanchard, Olivier (2019) "Public Debt and Low Interest Rates." American Economic Review, 109 (4): 1197-1229.

Callaghan, Michael (2019) "Expectations and the term premium in New Zealand long-term interest rates," Reserve Bank of New Zealand Analytical Notes series AN2019/02, Reserve Bank of New Zealand.

Canadian Department of Finance (2018) Update of Long-Term Economic and Fiscal Projections 2018, December 2018

Cerra, Valerie, Antonio Fatas and Sweta C. Saxena (2020) “Hysteresis and Business Cycles” IMF Working Paper, May 29, 2020

Gamber, Edward N. (2020) “The Historical Decline in Real Interest Rates and Its Implications for CBO’s Projections” Congressional Budget Office, Working Paper 2020-09, December 2020.

Goodhart, Charles and Manoj Pradhan (2020) The Great Demographic Reversal: Ageing Societies, Waning Inequality and an Inflation Revival.

Guillemette, Yvan. and David Turner (2018) "The Long View: Scenarios for the World Economy to 2060", OECD Economic Policy Papers, No. 22, OECD Publishing, Paris.

Guillemette, Yvan and David Turner (2021), “The long game: fiscal outlooks to 2060 underline need for structural reform”, OECD Economic Department Working Papers (forthcoming)

Gurkaynak, Refet S., Sack, Brian and Wright, Jonathan H. (2007) "The U.S. Treasury yield curve: 1961 to the present," Journal of Monetary Economics, Elsevier, vol. 54(8), pages 2291-2304, November.

Holsten, Kathryn, Laubach, Thomas and Williams John C. (2017) “Measuring the natural rate of interest: International trends and determinants” Journal of International Economics, 108(1), pages S59-S75.

IMF (2021) Fiscal Monitor, International Monetary Fund, April 2021.

Lane, Philip R. (2019, November 28) “Determinants of the real interest rate.” Remarks at the National Treasury Management Agency.

New Zealand Superannuation Fund (2020), “Statement of Performance Expectations 2020-21”, Statement of Estimated Fund Performance, page 9, June 2020

Piscetek, Melissa (2019) "Public Debt Dynamics in New Zealand," Treasury Working Paper Series 19/01, New Zealand Treasury.

Rachel, Lukasz and Thomas D. Smith (2015) “Secular drivers of the global real interest rate “ Bank of England Staff Working Paper No. 571, December 2015.

Rachel, Lukasz and Thomas D. Smith (2017) "Are Low Real Interest Rates Here to Stay?" International Journal of Central Banking, vol. 13(3), pages 1-42, September.

Rachel, Łukasz and Lawrence H. Summers (2019) "On Secular Stagnation in the Industrialized World," NBER Working Papers 26198, National Bureau of Economic Research, Inc.

RBNZ (2021) Monetary Policy Statement, May 2021.

Swiss Federal Department of Finance (2016) Report on the Long-Term Sustainability 2016, April 2016.

The Treasury (2019a) “MEI Special Topic: New Zealand's Nominal Neutral Interest Rate”, Monthly Economic Indicators, November 2019.

The Treasury (2019b) Risk-Free Discount Rates and CPI inflation Assumptions for Accounting Valuations, 21 May 2019.

United Kingdom Office of Budget Responsibility (2012) Fiscal Sustainability Report, July 2012

United Kingdom Office of Budget Responsibility (2013) Fiscal Sustainability Report, July 2013

United Kingdom Office of Budget Responsibility (2017) Fiscal Sustainability Report, January 2017

United Kingdom Office of Budget Responsibility (2020) Fiscal Sustainability Report, July 2020

United Kingdom Office of Budget Responsibility (2021) Fiscal Risks Report, July 2021

United States Congressional Budget Office (2021) Long-Term Budget Outlook, March 2021

Vlieghe, Gertjan (2021) Running out of room: revisiting the 3D perspective on low interest rates, Speech given at the London School of Economics, 26 July 2021.

Wyplosz, Charles (2019) Olivier in Wonderland, VoxEU, https://voxeu.org/content/olivier-wonderland