Modelling Shocks to New Zealand's Fiscal Position

Craig Fookes

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AUTHOR

Craig Fookes
1 The Terrace
PO Box 3724
Wellington 6140
New Zealand

Email craig.fookes@treasury.govt.nz

Telephone +64 4 917 6254

Fax +64 4 473 0982

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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

Abstract

This paper explores the use of scenario analysis as a contingency planning tool to examine how various purposefully-severe shocks could impact on the Crown's fiscal position. A magnitude 7.8 earthquake and a process of domestic deleveraging are used to test the resilience of the fiscal position (respectively) to a one-off spike in spending and a more protracted downturn in the economy.

A New Zealand economic crisis is not considered imminent, but historically unprecedented levels of private sector debt present a risk for the country's finances. Scenario analysis can model hypothetical shocks based on past experience either in New Zealand or abroad. However, the results cannot take into account many of the factors that allowed New Zealand to come through the recent global financial crisis in a better position than many other developed economies. The tool's usefulness is in considering how the size and structure of the balance sheet affect policy sustainability in a shock.

Our results suggest that a sustained decline in tax revenue represents a key risk to the fiscal position. The adjustments necessary to continue debt repayments and avoid a liquidity crisis are compared to historic episodes of fiscal consolidation. While low government debt provides a significant buffer, the resulting (necessary) burden of adjustment in a larger crisis could still fall heavily on taxpayers through fairly rapid changes to tax or government spending.

JEL CLASSIFICATION E65 Fiscal policy

KEYWORDS fiscal policy, risk management, Crown balance sheet, sovereign debt

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Modelling Shocks to New Zealand's Fiscal Position

1 Introduction

New Zealand has proven relatively resilient through the recent financial crisis. However, New Zealand, like any country, should, over a reasonable timeframe, expect to face a range of one-off economic shocks. Many shocks are short lived but may exert a significant fiscal cost. Examples could include unusually large swings in the terms of trade or risks associated with our relatively volatile natural environment. Other risks may have a more prolonged effect, which can lead to large changes in the fiscal position. For this reason, governments are equally concerned about economic imbalances or any factor that may unexpectedly alter the sustainability of policy over time.

Treasury has completed a number of studies looking at risk management and the Crown balance sheet. Bradbury, Brumby, and Skilling (1999) propose an analytic framework for sovereign risk based on measures of comprehensive net worth. Comprehensive net worth is a forward-looking measure that takes into account the present value of future tax and spending. Huther (1998), Fabling (2001), and Irwin and Parkyn (2009) use a mean-variance approach to estimate the volatility of the Crown's comprehensive balance sheet. Davis (2002) looked at uncertainty in the Crown's long-term fiscal projections. Work was also done by Grimes (2001) on the Crown's financial objectives and the issue of centralised versus decentralised financial management.

This paper explores the use of severe scenario analysis – sometimes referred to as stress testing – to supplement previous work on Crown risk. Scenario analysis can be used as a guide for contingency planning. While a crisis event would impact on a large share of the population, the focus of this paper is on how the fiscal position could evolve in such an event. Specifically, this analysis compares the potential size of fiscal adjustment to historical precedent to determine a subjective measure of liquidity risk. A liquidity crisis occurs when the government can no longer source enough cash at a reasonable cost to cover the cost of its current commitments.

The rest of this paper is divided into four main sections covering: Crown risk management; methodology; scenarios; and future work. Two main scenarios are modelled using HYEFU data from December 2010: an earthquake; and a process of economic rebalancing. The analysis in this paper was initiated before the September 2010 earthquake and, as such, the shocks in this paper are purely hypothetical. The focus of this paper is on how idiosyncratic shocks can be modelled, so no attempt has been made to incorporate any specific lessons from events in Canterbury.

2 Crown risk and crisis management

2.1 Sovereign risk management

The Crown provides services and holds assets on behalf of taxpayers and citizens. Crown risk management has two aspects. First, the Crown has a fiduciary duty to manage public resources effectively. Second, the Crown seeks to provide predictability about future tax rates and spending as a way to partly insulate taxpayers and citizens from unexpected variability (risk) in their net after-tax incomes[1]. This paper focuses on the question of whether current and projected government debt levels provide policy predictability by allowing the government room to respond in a crisis.

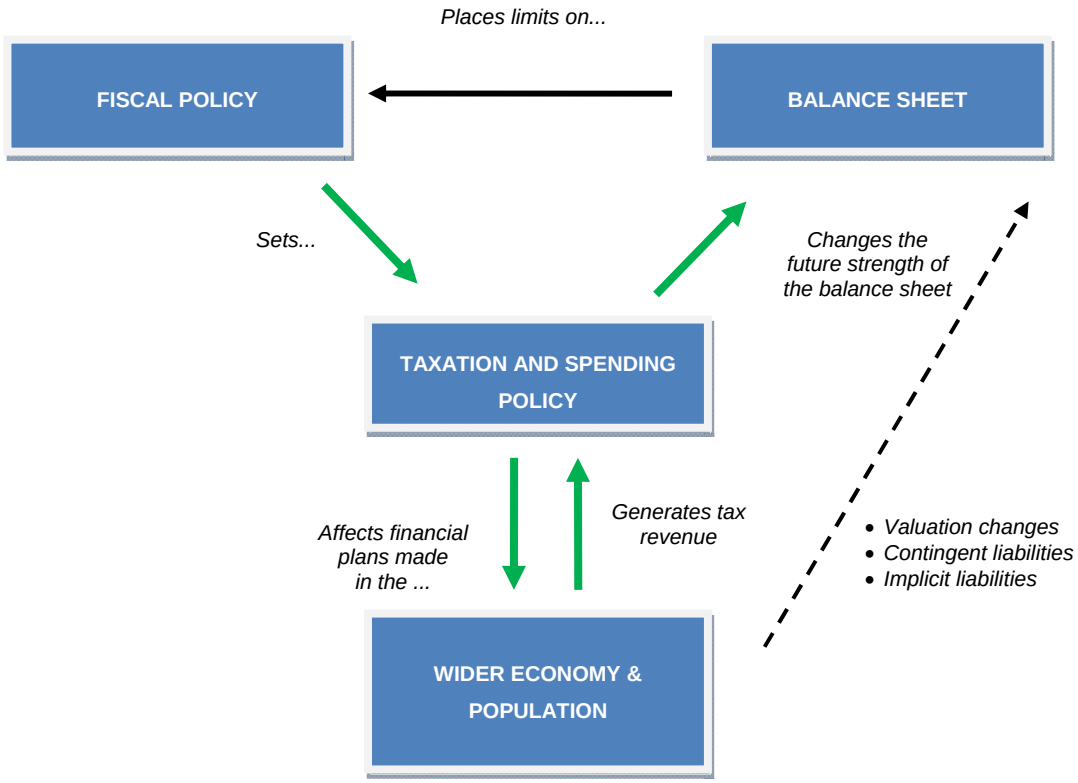
The ability to respond to risks as they materialise, despite an immediate decline in cash flow, requires financial strength. In this way, Crown risk, the balance sheet, and fiscal policy are closely interconnected (refer Figure 1). Vulnerabilities in the domestic or international economies create risks around the Crown's cash flow. The government can respond to a decline in cash flow in two ways. First, if net worth is sufficient, the government can cover deterioration in its cash balance by temporarily allowing the Crown balance sheet to decline in value, usually through increased borrowing or perhaps through running down assets. Conversely, the government could change taxes or spending immediately to take into account movements in its cash flow over time.

Changes in the Crown balance sheet can be used to reduce short-term risk for taxpayers, but the government cannot totally insulate taxpayers from risk. The requirement that the future value of tax receipts exceed the aggregate cost of future spending implies that the Crown must eventually pass the cost of a fiscal shock onto taxpayers. That is, while governments can 'smooth' adjustment costs, taxpayers remain the ultimate bearers of risk.

While a stronger balance sheet cannot totally insulate taxpayers from risk, a strong balance sheet is still seen as beneficial from a risk management perspective. A sufficiently strong balance sheet allows the government to minimise the cost of a fiscal contraction in three ways. First, implementing changes in a gradual and well signalled way allows private agents time to plan and adjust. Second, governments can also avoid contracting the budget in a downturn (pejoratively referred to as pro-cyclical policy for its role in deepening a cyclical downturn). Third, a more active role in trying to stabilise the economy is possible, for instance through fiscal stimulus or through targeted support for the private sector.

[1] Income here is defined as the full range of benefits accumulated over the period. These benefits include formal income such as wages, returns on investments, transfer payments, and subsides less taxes or other expense.

Figure 1: The interaction between fiscal policy and the balance sheet



The benefits of predictable fiscal policy are discussed at length in the tax smoothing literature (Barro, 1979). Tax smoothing suggests that governments can minimise the detrimental impact of fiscal adjustments by setting tax revenue at a level that allows tax rates to remain unchanged over the economic cycle. To do this, the government runs budget deficits in downturns that are repaid through surpluses in economic booms. The issue internationally in the recent financial crisis has been that the fiscal cost of maintaining policy through the recent crisis has far exceeded many governments' fiscal buffers. This is, perhaps, a consequence of not running sufficient surpluses through better times.

2.2 Sustainability, liquidity, and debt dynamics

Sustainability – the ability to balance receipts against expenditures over time – forms an overriding goal for fiscal strategy. However, it is liquidity that ultimately limits a government's ability to smooth its spending in a crisis. Liquidity is the ability to source cash at a reasonable cost in order to meet current commitments. Liquidity pressures may represent a loss of access to markets, but more often liquidity pressures are characterised by a rapid spike in the cost of borrowing. In practice, solvency and liquidity are closely related. It is access to credit markets that primarily determines Crown liquidity. However, markets will only lend if they expect the Crown to remain solvent over a reasonable timeframe.

Liquidity crises are costly for governments, taxpayers, and the economy as a whole. The government must act swiftly to restore faith in its long-term solvency. As a result, adjustment costs for taxpayers and the wider economy need to be considered alongside re-establishing access to markets. The experience of European nations through the recent crisis is illustrative. Several European countries are undertaking large fiscal contractions at a time when their economies are still in a recession. The costs of these fiscal contractions are magnified by the underlying weakness of private sector balance sheets throughout the economy. In the extreme, these weak private sector balance sheets can undermine the effectiveness of planned debt reductions if national incomes (GDP) falls faster than debt (refer Appendix 1). This dynamic is usually referred to as a debt spiral (UBS, 2010).

The large adjustment costs associated with re-establishing market access once it is lost underline the importance of an established track record for sound fiscal management. A solid track record affords more leeway as market participants are more likely to treat emerging deficits as temporary. The importance of a track record also explains why nearly half of all debt defaults since the 1970's have occurred at or below 60% of GDP, while other countries have been able to borrow in excess of 80% of GDP (Reinhart *et al*. 2003). In practice, defaults have often occurred in countries with a poor record for fiscal management, where markets have questioned the size of the adjustment costs, whether the consolidation could be self defeating, and whether the government has the resolve to complete the necessary reforms. In these cases, countries may be forced to either default or access resources through the IMF[2].

[2] The IMF as a preferred creditor lends for liquidity purposes. Loans are phased and often come with conditionality aimed at restoring solvency.

3 Methodology

3.1 Scenario analysis

Scenario analysis is a supplementary tool used to examine risks, such as liquidity risk, that are difficult to model through statistical analysis. Liquidity risk is difficult to model because financial market participants do not respond mechanically to changing fundamentals and may, for short periods, be subject to herding behaviour based on uncertainty and other psychological factors. Markets might lend one day based on a belief that the growing stock of debt can be reversed, then not at all the next.

Risks, such as liquidity risk, occur infrequently or may not show up in statistical records at all. Infrequent risks – referred to as tail risks[3] – are particularly challenging for governments as they are expected to remain operational. While traditional risk models rely on statistical records to model impact and probability, scenario analysis makes no adjustment for the expected probability. A direct examination of the size of a shock and its impacts allows examination of the Crown's ability to handle large shocks. In this way, scenario analysis provides additional information to results provided by other work on Crown risk (refer Irwin and Parkyn, 2009).

3.2 Economic modelling

Changes in modelling assumptions can be used to illustrate the potential impact of unprecedented events. The two stylised events, used to examine these changes, are a 7.8 earthquake (roughly 11 times larger than the September 2010 Canterbury quake) and a rapid process of domestic deleveraging. Each event would affect the Crown's fiscal position in a different way depending on its source, scope, and how the government responds. An earthquake shows how the fiscal position could respond to a large, but discrete, spike in recovery-related spending. Conversely, a process of deleveraging illustrates the destabilising effect of a growth shock with a more persistent effect. These shocks are illustrative, and are only two of the many potential shocks the Crown faces. A summary of some other major shocks is included in Table 1.

[3] Tail in this case refers to events in the tail of a probability distribution. Statistics may underweight events which occur infrequently or may even be absent from samples. However, modern risk management techniques are rapidly evolving. Nicolas Talib (2007) suggests that statistically unprecedented events should not be ignored. Collectively these tail events, while rare, may, in aggregate, have the potential to radically alter the course of subsequent policy. For example, the global crisis was almost without statistical precedent, but has had a greater impact on fiscal policy than the smaller and more frequent annual fluctuations associated with the business cycle.

Table 1: Select examples of major economic shocks

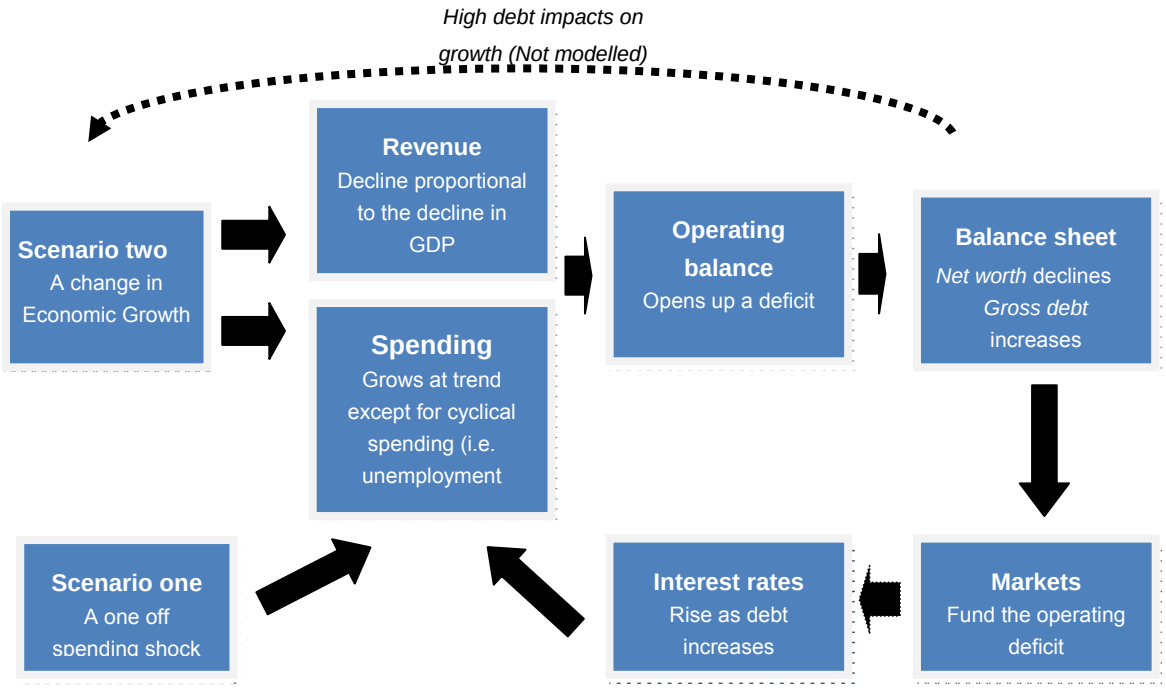
Examples of major shocks	Example	Impact on the economy	Persistence	Expected incidence	NZ specific, regional or global?
Pandemics and health emergencies	SARS, Swine Flu	• Disrupted demand due to staff vacancies • A longer-term supply response is also possible if labour force is reduced • Government revenue declines and spending increases	Usually short lived	Very rare	Usually Global
Natural disasters	An earthquake, volcanic eruption, large scale droughts, etc.	• Increased demand over the short-term due to investment and rebuilding • Abstracting from reinsurance, the current account deficit may widen, to the extent that materials are needed from abroad • A longer-term supply shock unlikely unless widespread human casualties result • Government spending increases, revenue may also increase following increased investment, but could be largely flat over a sufficient time period	Short to medium-term impact; but may have permanent effects	Very rare for large shocks to occur	NZ specific
Agricultural disease	A foot and mouth outbreak	• Short-term loss of supply, although stock numbers will eventually recover • Longer-term demand implications and possible trade restrictions • Government spending increases, and revenue decreases	Short-term impact, but may have permanent effects	Rare	Largely NZ specific
Economic rebalancing	International credit crisis, domestic housing market crash etc.	• Largely a demand shock through increased domestic savings or lower global demand • Loss of confidence in a disorderly correction could precipitate liquidity pressures • Lower tax revenue, calls for government support may exist	Medium-term impact	Rare	NZ specific, regional or global
Large negative terms of trade shock	A decline in demand/price perhaps associated with one of the above scenarios	• Falling export values, lower receipts • Lower tax revenue	Short-term impact	Fairly regular	Regional

The impact of changes in GDP, employment, and government spending associated with each shock were modelled using the Treasury's *Fiscal Strategy Model* (FSM). The FSM models how changes in financial flows (spending and tax) impact on key stock measures such as debt, net worth, or net debt. The FSM is not an economic model, which means the full interaction between economic variables and fiscal changes is not captured. Despite this, rudimentary analysis can be undertaken. The exact impact is highly uncertain. Thus, for these scenarios, the size of the changes has been based on previous modelling or the experience of other OECD countries. In each case, changes were made relative to the forecast financial numbers included in the *2010 Half Year Economic and Fiscal Update*

(HYEFU). Any scenario-specific changes to the standard assumptions published in the 2010 HYEFU documents are discussed in the relevant sections of this document.

Each of the scenarios modelled in this paper involve a significant increase in government debt. At elevated levels, government debt can impact on interest rates and economic growth. To recognise this impact, the FSM model has been adapted to include a feedback (refer Figure 2) between the stock of government debt and the five-year government bond rate[4]. Bond rates are assumed to increase by five basis points[5] for each percentage point increase in government debt (Baldacci & Kumar, 2010)[6].

Figure 2: The fiscal strategy model with interest rate feedback



While higher government debt might also slow growth (Pattillo *et al*., 2002, Reinhart & Rogoff, 2010), the impact of debt on growth has not been explicitly incorporated in our model. Higher interest rates create uncertainty that can impact on both capital accumulation and productivity growth. The IMF estimate that growth declines by 0.11% at debt levels beyond 30% of GDP (Kumar and Woo, 2010b). This rises to -0.16% at debt levels greater than 60% of GDP, and again to -0.19% once government debt rises above 90% of GDP. However, the exogenous growth figures used in this paper, are sourced from actual case studies that already implicitly include these detrimental growth effects. If included, the IMF's growth estimates would only change the estimated debt levels under each scenario by between one to two percentage points.

Comprehensive balance sheet analysis utilises a wide range of metrics and measures. This study, which focuses on liquidity risk, uses gross debt as an internationally recognised measure of rollover or liquidity risk (IMF, 2010). Some broader measures, such as net debt (the current focus of fiscal strategy), provide a better measure of solvency over time. However, gross debt, as a relatively simple measure, enjoys a more standardised definition that facilitates inter-country comparisons (see Box 1).

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4 A link between the operating allowance and interest rates is also possible, but, theoretically, the magnitude of the impacts should be similar.

5 A basis point is 1/100th of 1%.

6 In a crisis, the central bank may lower interest rates to stimulate growth, while government bond rates rise to attract lenders.

Box 1: Measures of financial strength

The balance sheet in accounting terms is a measure of financial strength at a point in time. Depending on the question you are interested in asking, there are different ways to measure or analyse the balance sheet.

Stock (Balance Sheet) Measures:

Measure	Definition	Best measures	Comparability between countries	Stability of estimates
Comprehensive net worth (CNW)	Measures whether the net present value of future receipts exceeds the net present value of future expenditures.	Solvency over time	Poor – no country reports this measure	Poor – difficult to estimate and subject to change depending on choice of discount rate
Accounting net worth (ANW)	The net worth figure reported in the Crown financial statements based on generally accepted accounting practice.	Solvency at a point in time	Poor – few countries publish a balance sheet	Low – subject to valuation changes
Net Debt	Net debt is gross debt minus core Crown financial assets (excluding advances and the NZSF which are held for policy purposes).	A measure of the assets and liabilities that the Crown could use as a buffer in crisis	Low – the definition of net debt varies between countries	Good – some financial assets may vary in value
Gross debt	Gross debt includes all debt issued by the sovereign (core Crown).	Liquidity risk on the liability side of the balance sheet	High – countries have different reporting entities, although the definition is fairly standard	High – the face value of debt is fixed in nominal terms

Flow (Income Statement) Measures:

Measure	Definition	Best measures	Comparability between countries	Stability of estimates
Operating Balance	The residual of revenues less expenses plus surpluses from Crown entities.	The operating deficit or surplus	High – the operating balance has an accepted definition	High
Structural balance	The operating balance less revenues or expenses that fluctuate over the economic cycle.	The proportion of the deficit that will not recover with growth	Low – separating structural and cyclical revenues is difficult	Low – estimates of cyclical revenues may be revised
Primary balance	The operating balance less net interest costs.	The proportion of the deficit needed to be cut to stabilise debt	High – Interest costs are easily identifiable	High

3.3 Estimating liquidity risk

We use two rough indicators to examine New Zealand's potential liquidity risk:

- First, the projected **stock and growth path of New Zealand debt** (public and private) under different scenarios is compared to other countries that have recently experienced liquidity pressures in the recent crisis.
- Second, the **size of adjustment in tax or spending** necessary to stabilise debt over a five year period is compared to large historical contractions.

3.3.1 Cross country comparisons of government debt

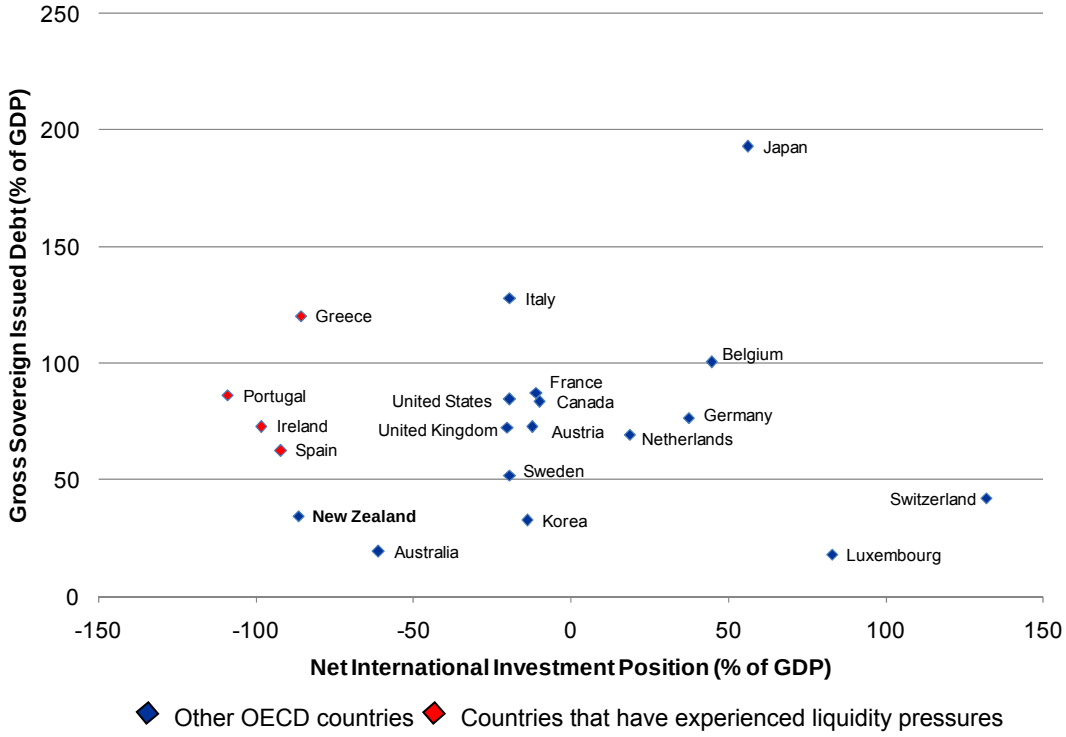
The recent global financial crisis provides an unprecedented opportunity to undertake a cross-country comparison of how markets could react to differing levels of debt in similar market conditions. A range of economies have responded quite differently to an identical shock triggered by a correction in the US housing market. This cross-country dataset can be used to infer a rudimentary risk scale.

Figure 3 looks at the impact of public and private sector debt on a government's ability to borrow. All else equal, higher levels of government debt (shown on the vertical axis) imply a higher level of risk, although the structure of the Crown balance sheet, economic vulnerabilities in the private sector, as well as the duration, maturity profile, and denomination of debt also play a role. Thus, while the gross sovereign debt measure used in Figure 3 suggests an increase in rollover risk, it provides a partial picture at best.

In contrast, the net international investment position (shown on the horizontal axis) is used to measure economy-wide risk. Economy-wide risk, for the purposes of this paper, suggests a higher level of uncertainty or risk around estimates for economic growth. A net external debt figure provides information about the overall levels of leverage in the economy. Higher leverage leads to more volatile changes in income, which can lead to more significant changes in behaviour. For a government, these changes in behaviour can aggregate into significant changes in tax revenue.

The make-up and structure of bank borrowing provide a notable exception. Recapitalising domestic banks was a large cost for many governments. The NIIP provides a partial measure of risks, although the size of gross private sector liabilities or significant un-hedged foreign currency borrowing may be more important. In New Zealand's case, around 70% of the NIIP is made up of debt, largely intermediated through the four major banks, but only 5% of this debt is un-hedged. More recently, steps have been made to lengthen the maturity structure that characterised New Zealand bank funding before the crisis. Thus, while international debt is a concern, the risk associated with the debt structure of New Zealand banks now looks more moderate compared to some of the economies used as comparators in this study.

Figure 3: A cross-country comparison of debt following the height of the financial crisis



Source: IMF 2009 BOP statistics, Statistics Ireland and New Zealand, OECD.

Note: Graph includes all OECD countries except Iceland, which had already had a sovereign liquidity crisis and borrowed from the IMF. In 2008 Iceland had an NIIP of 369% of GDP. In 2006 prior to the crisis its NIIP was closer to 120% of GDP.

Markets have viewed an increase in private sector debt as a risk for the sovereign. The countries that experienced significant liquidity pressures (coloured red) are clustered on the left hand side of Figure 3. A higher percentage of countries with large negative NIIPs (beyond 60-80% of GDP) experienced liquidity pressures, compared to countries with more moderate NIIP positions, where liquidity pressures have been absent. Markets have been more reluctant to lend to sovereigns with highly-leveraged private sectors.

Low government debt has been a key factor setting New Zealand apart from other countries with large negative NIIPs. However, overseas experiences suggest that the reduced resilience associated with private sector debt can lead to rapid changes in government debt in a crisis. An indicative risk scale to interpret the scenario outcomes discussed later in the paper is included in Table 2. The risk scale takes into account the starting level of debt and rate at which debt grows.

Table 2: Liquidity risk scale for the New Zealand government

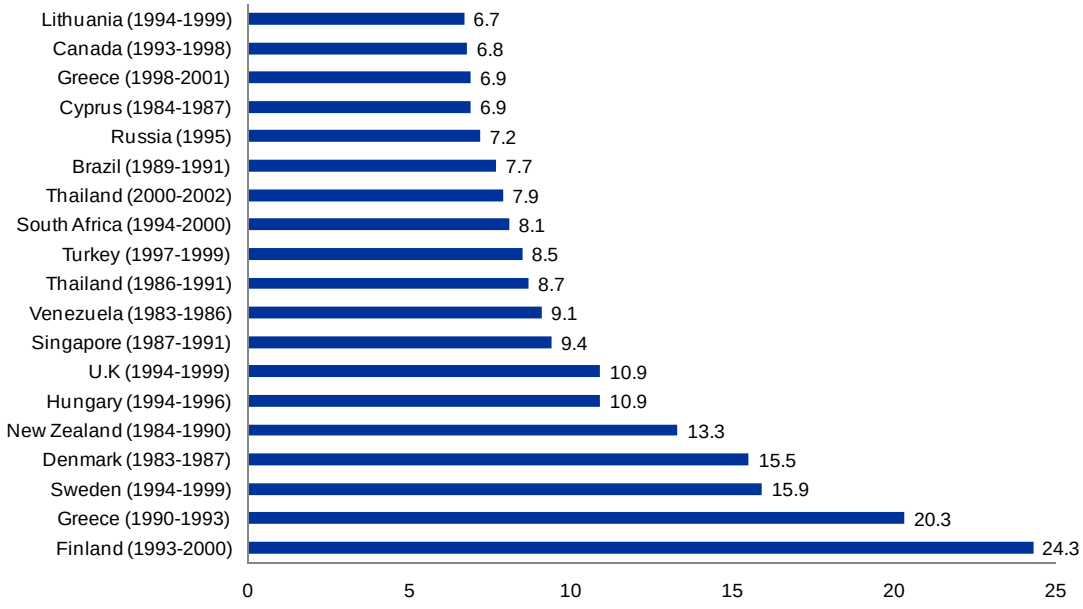
	Starting level of gross sovereign debt (% GDP)				
Expected change in the level of debt	0%-20%	20%-40%	40%-80%	80%-90%	90% plus
Debt declining	Low	Low	Low	Moderate	High
Debt stabilises early in the projection period	Low	Low	Moderate	High	High
Debt stabilises late in the projection period	Moderate	Moderate	High	Very high	Very high
Debt rising or accelerating over projection period	High	High	High	Very high	Very high

The risk scale in Table 2 has been based on the experience of countries with comparative NIIPs. This illustrates that the New Zealand government could experience funding difficulties at lower levels of sovereign debt than many other OECD countries. For example, heavily indebted countries have experienced liquidity pressures at sovereign debt levels well below the average OECD level of debt – 62% of GDP in 2009. Under the framework used in this paper, sovereign debt beyond 40% of GDP is considered risky and sovereign debt above or beyond 80-90% is treated as unsustainable. The IMF (Ostry *et al*. 2010) suggest that New Zealand could not sustain debt beyond 90% of GDP as, beyond this threshold, unfavourable debt dynamics could start to set in. The IMF's threshold cannot be taken as an absolute measure or as a debt ceiling of how much New Zealand could borrow because the IMF analysis explicitly ignores liquidity risk. In practice markets would respond if New Zealand's projections merely suggested sovereign debt could rise as high as 90% of GDP. With this in mind, the IMF note that "prudence suggests that countries target a level of debt well below this limit".

3.3.2 The operating balance and consolidation

The second risk indicator used in this paper is the amount of consolidation necessary to stabilise debt after a shock occurs. Large fiscal contractions are painful, politically difficult, and may detrimentally impact on domestic growth. Two metrics illustrate the difficulty of stabilising debt. The nominal value of baseline spending cuts necessary to stabilise debt over five years provides an indication of the absolute size of the change. However, nominal values are not comparable between countries. The change in the operating balance as a percentage of GDP is used to contextualise the size of the fiscal contraction. The operating balance as a percentage of GDP can then be compared to large fiscal contractions from around the world (refer Figure 4).

Figure 4: Large historic contraction (% GDP)



Source: IMF Fiscal Adjustment Database[7]

[7] The IMF fiscal statistics are based on a different accounting base. Slight differences exist between these figures and domestic figures prepared for the same period (refer discussion on page 26).

Figure 4 shows that only two countries have ever reduced the primary balance by more than 20% of GDP. A further five countries (including New Zealand) have accomplished changes in the primary balance of more than 10% of GDP. For this reason, any contraction more than 10% is treated as largely unprecedented and only 'potentially achievable'. Success or failure would be heavily contingent on the underlying state of the economy and the final impact on economic growth. Beyond 15% of GDP a contraction would be even more difficult, especially if attempted over a short timeframe. Beyond 20% of GDP we expect that markets would treat the largely unprecedented contraction as lacking credibility, unless attempted over a very long timeframe.

Table 3: Credibility risk associated with large fiscal contractions

Size of consolidation	Difficulty	Credibility risk in a crisis event
>20%	**Extremely difficult** – extreme adjustment costs, contingent on favourable economic conditions	Largely **historically unprecedented** – unlikely that markets would treat a planned contraction of this size as credible
15%-20%	**Very difficult** – extremely difficult without above trend growth	**High** – credibility would depend on market conditions
10%-15%	**Hard** – associated with large adjustment costs	Seen as **potentially achievable** but success in the first two years would be important
< 10%	**Achievable** – but still difficult to implement	Likely to be treated as **credible** based on New Zealand's strong reputation for fiscal discipline

4 Scenario 1: A one-off spending shock

The New Zealand economy faces a range of one-off risks that could lead to a spike in spending. These could include natural disasters, an outbreak of disease, or events brought about by political decisions. We model a size 7.8 Richter scale earthquake centred close to Wellington. A Wellington earthquake has been chosen as an example of a one-off shock because: its impact on growth is muted over a reasonable timeframe; its effects on spending are, for the most part, short-lived; and, in terms of magnitude, a large earthquake exceeds the cost of many other one-off shocks.

Box 2: Canterbury Earthquake

The Earthquake scenario was chosen prior to either Canterbury earthquake. As a result, no attempt has been made at this stage to update this modelling based on events in Canterbury. The estimates sourced from Savage (1997) are based on a 7.8 Richter scale Wellington quake. This amounts to a quake 11 times the size of the September 2010 Canterbury earthquake. We have taken Savage's estimates of losses based on limited insurance cover to get a large downside scenario. The presence of reinsurance, as shown by the Canterbury quake, would make the final cost of a quake even more manageable from a fiscal perspective.

Actual damage is a factor of magnitude, depth, and distance from the epicentre. Wellington's proximity to a large number of fault lines, steep hillsides, and limited access routes suggest a quake in Wellington could cause significant damage. Savage expected that the quake damaged 80% of all commercial buildings, 15-20% of plant and equipment is destroyed, and up to 85% of private dwellings would have some damage. Of these only 12% of houses would have extensive damage.

An earthquake would impact on government expenses through publicly provided EQC insurance for residential property, damaged infrastructure, and higher benefit payments. The estimated cost[8] to the government of $15 billion (Savage, 1997) is assumed to lift debt over the three years after the quake, although, costs after a large quake could show more persistence. The resulting investment boom (replacing damaged assets) offsets the loss of output through the Wellington region over the short term. Much of the earthquake repairs and investment frontload maintenance: thus regional GDP drops over the medium term as investment declines into a trough. Longer term, the net impact on growth, as measured by GDP[9] over the projection period, is largely negligible.

Table 4: GDP impacts of an earthquake scenario (nominal % deviation from forecast)

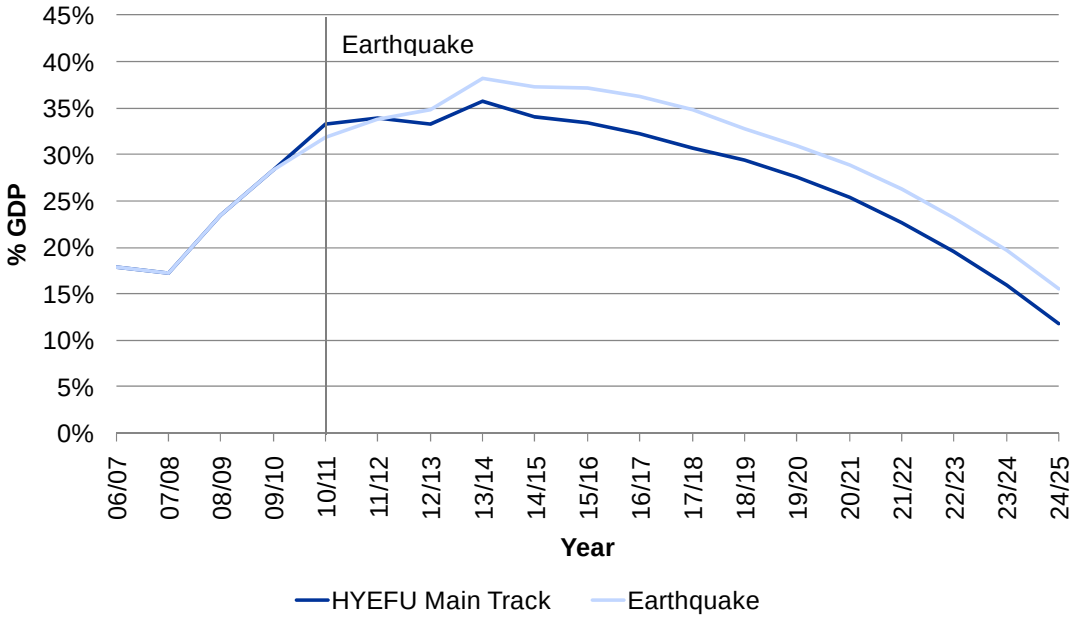
Year after quake	Quake	+ 1	+ 2	+ 3	+ 4	+5	+ 6	+ 7	+ 8	+ 9	+ 10
GDP impact (% change)	+5.9	+3.6	+2.6	0.0	-0.8	-1.5	-1.7	-1.3	-0.7	-.3	0.0

Source: Savage 1997

Note: +1 implies the deviation from forecast one year after the year in which the quake occurred.

In terms of the government accounts, the net impact on the balance sheet is a decline in net worth as debt increases by $15 billion (refer Figure 5). Beyond the immediate cost of the quake, spending is assumed to continue to grow at the same rate based on the operating and capital allowances outlined in the 2010 HYEFU. The increase in debt increases debt servicing costs by $1 billion per annum (0.4 % of GDP). This increase in debt servicing costs is not large enough to overcome the projected decline in debt as the economy recovers. Thus, the resulting debt track is largely a level shift upwards with a minimal change in the trajectory.

Figure 5: Gross debt following an earthquake in Wellington



Source: The Treasury, HYEFU 2010

[8] Savage estimates that quake costs could range from $2.9 billion to $11.6 billion as a downside scenario we take his upper estimate and gross it up to cover inflation over recent years.

[9] Gross domestic product measures economic activity but largely ignores the fact that much of this activity will be focussed on replacing damaged material. Thus, the proposition that GDP, which affects government revenue, is largely unchanged should not be taken to imply that welfare is not reduced by a quake.

These estimates of the costs of a Wellington earthquake are purposely severe and could vary significantly. While extreme, these estimates serve to illustrate that the liquidity risks around a one-off increase in debt are not particularly significant. $15 billion is a large number, but as a percentage of GDP the impact is less pronounced. Markets may be concerned about the increase in debt, but would likely be satisfied that the downward trend beyond 2013/14 signals that the fiscal position remains sustainable. A slight increase in bond rates is possible, especially if the credit rating suffered.

Table 5: Earthquake scenario summary statistics

Risk indicator	Summary	Liquidity Risk	Adjustment cost
Stock of debt	Debt peaks under 40% of GDP four years after the quake then declines thereafter. This peak is still below either Spain or Ireland in the OECD comparison chart (Figure 3).	Liquidity risk is still elevated at 40% of GDP, but would depend on market conditions.	Reducing debt from 40% of GDP would only require government to stick to $1.1 billion operating allowance.
Direction of the projected debt track	Debt peaks in 2014/15 at 41% of GDP and declines towards the end of the projection period.	The decline in debt towards the end of the projection period signals limited liquidity risk.	N/A
Amount of consolidation to stabilise debt track over five years	Unlikely to be required by markets, but the government may choose to try and reach its 20% net debt target by the end of the projection period.	N/A	N/A
Change in the structural balance	A one-off spike in spending is not treated as structural.	N/A	N/A
Change in the NIIP	Growth in the NIIP slows as reinsurance claims lower the current account temporarily.	A lower NIIP, all else equal suggests a moderation in liquidity risk.	N/A
Conclusions	Limited liquidity risk as although debt peaks at 40%, debt declines to a more prudent level by the end of the projection period. Adjustment would still be desirable to bring debt down quicker and to lower the level at which debt peaks.		

Based on this illustrative analysis we conclude that the growth in Crown net worth (lower debt) over the past couple of decades has put the government in a fairly healthy position with respect to most one-off shocks. The government may decide to rebuild its fiscal buffers faster, but it would have some flexibility about when this occurs. A combination or series of shocks would still signal concern, but, for the most part, a strong balance sheet provides the fiscal headroom necessary to be able to handle a fairly large natural disaster (or similar) with limited financial distress.

5 Scenario 2: Weaker growth

A small open economy, such as New Zealand, is subjected to a large range of shocks. The final impact of these shocks on taxation revenue will depend on the extent to which activity in the private sector is affected. New Zealand, as previously discussed, has high levels of private sector debt, which could lead to a significant shift in private sector savings, consumption, and investment decisions. If households find themselves overextended, perhaps as a result of a fall in asset prices, they may increase savings, which would reduce consumption. This widespread change in behaviour, referred to as rebalancing, would be reflected as a temporary decline in GDP growth.

Spain, Ireland and an average OECD scenario have been chosen as comparators, due to their recent process of rapid economic rebalancing. It is worth noting up front that while each country, based purely on macro statistics, in some respects looks similar to New Zealand, there are a range of factors that set New Zealand apart from either country. The comparator countries are used purely to calibrate a set of illustrative GDP shocks based on one, two, and three years of negative growth respectively.

5.1 Economic shocks

Different shocks will affect different sectors within the economy in slightly different ways. The fiscal strategy model used in this paper cannot model specific adjustment mechanisms or sectoral dynamics as it primarily runs off a nominal GDP track, which is exogenous to the model[10]. Thus, our modelling cannot pick up idiosyncratic factors, such as the nature of our vulnerabilities or a floating exchange rate, that may set New Zealand apart.

Despite this, a high level discussion about the potential economic shocks and channels for adjustment is still useful to contextualise the material in this section. New Zealand is linked to international markets that allow us to access resources. These markets also allow New Zealand to specialise, stimulate competition, and increase productivity. Stronger international connections will, over a reasonable timeframe, act to lift our economic welfare. However, over shorter timeframes global markets can undergo gyrations that unsettle the domestic economy. No domestic slowdown in the past 40 years has been triggered by domestic factors alone (Reddell and Sleeman, 2008).

The Treasury's past work on productivity identified our international linkages as being primarily through flows of people, capital, trade, and ideas (Treasury, 2009). These linkages act to lift productivity, but can also act as channels for economic shocks. Trade, especially the terms of trade, has been an especially important channel for real shocks through most of New Zealand's modern history (Bordo *et al*. 2009).

Globalisation has also acted to increase the incidence of financial shocks (Bordo *et al*. 2010). Financial crises can affect the fiscal position through direct liquidity pressures, a potential loss in confidence, or indirectly via a contraction in GDP. In recent years, there has been a steady progression of international financial crises including the Asian financial crisis (1997), the Russian debt default (1998), and, most recently, the global financial crisis. New Zealand has fared relatively well through most of these crises.

[10] The GDP track comes from the New Zealand Treasury Model, a general equilibrium model that forecasts how a wide range of economic variables move simultaneously (refer Ryan & Szeto, 2009)

In this paper, we purposely avoid identifying any specific triggering event. The main focus is on how a decline in GDP would affect the accounts. Our scenario involves an unspecified shock and a significant change in household behaviour. One hypothetical scenario, which is similar to what has occurred in Spain, is that the shock leads to a decline in the value of assets such as housing. A decision by households and firms to increase savings lowers consumption and investment, leading to a decrease in growth. In practice, New Zealand's external debt position represents only one risk to growth.

5.2 Adjustment mechanisms in the economy

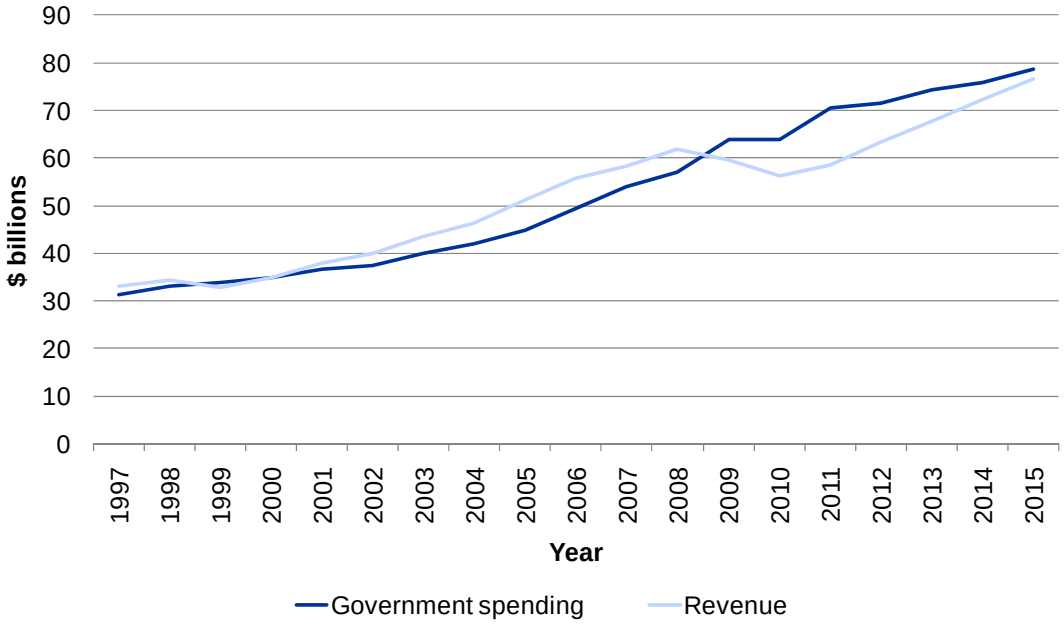
An economy will usually recover from a shock and, over time, return towards a 'steady state' or equilibrium growth path. However, if a shock is severe enough, the economy could undergo a structural shift to a different equilibrium growth path. In this study, the economy is assumed to return to a trend nominal growth rate of 4% in between one to three years. While growth returns to a trend, this growth occurs off a lower base implying that government revenue follows a lower parallel trajectory than originally forecast.

A return to trend growth is largely justified by New Zealand's flexible exchange rate and monetary independence. A falling exchange rate increases the competitiveness of the export sector. This competitiveness can offset lower domestic consumption as households start to save. In comparison, individual troubled economies in the Euro area would get relatively less relief from an exchange rate devaluation. Thus, any growth in external competitiveness aimed at offsetting sluggish domestic demand would need to come through a decline in domestic prices. New Zealand also benefits from monetary independence, which allows the central bank to tailor interest rates to the country's current economic conditions.

5.3 Changes in trend spending or tax

Slowing growth impacts on the fiscal position through changes in either tax revenue and, to a lesser degree, spending. The difference between the sensitivity of tax and spending to changes in growth presents a structural weakness in all sovereign accounts (refer Figure 6). Tax responds fairly mechanically to declining economic activity, while many cost pressures, such as health spending, tend to persist through the economic cycle. A level shift in trend revenue relative to trend spending opens up a structural deficit, as occurred in New Zealand in 2008/09. The persistence of the structural deficit attributable to growth off a lower revenue base creates a persistent impact.

Figure 6: New Zealand structural deficits followed a decline in revenue



Source: The Treasury, HYEFU 2010

5.4 Other debt reduction mechanisms

Other adjustment mechanisms such as inflation, exchange rates, or a debt restructure can aid consolidation efforts, but these measures come with significant costs. For this reason, fiscal austerity measures have historically remained the predominant channel for adjustment in over half the international cases where there has been a significant period of deleveraging (McKinsey 2010).

Deleveraging involves decreasing debt as a percentage of GDP. This can be accomplished through fiscal austerity or enacting structural reforms that may increase GDP over time. However, markets are unlikely to treat a package of structural reforms as a solution to a debt crisis. Only three economies have ever managed to grow their way out of debt and in each case the above trend growth followed a war or a commodities boom (McKinsey, 2010)[11].

Inflation can also theoretically be used to reduce the real value of debt outstanding (a soft debt default), but triggering inflation may prove difficult in a deflationary environment. Authorities may be able to increase the supply of money, but demand for additional borrowing may still remain muted (Carpenter & Demiralp, 2010), especially if leverage is part of the problem. The benefits of inflation may also be limited as markets would demand a higher nominal return as debt falls due. Thus, the ultimate burden of consolidation still falls on the taxpayer through inflation, lower growth, and higher debt servicing costs over time.

Default is the final alternative mechanism. Countries often accumulate debt during periods of relatively low interest rates. As rates rise, the cost of paying down debt may eventually overwhelm the cost of a default. The costs associated with default include limited access to credit, a punitive risk premium on lending, and high domestic interest rates. Few countries have used default as a realistic alternative, although defaults have occurred in, for instance, Argentina (2002-2008) or Mexico (1982-1992). Other countries have used

[11] These included the US after WWII which involved a recovery from a war, excess capacity, and export boom to rebuild Europe. Nigeria from 2001-05 and Egypt in 1975-79. Both cases involved a resources boom (McKinsley, 2010)

soft defaults to gain traction on debt repayments. A soft default includes inflation, repayment holidays, reduced interest rates, or other any debt restructure that reduces the net present value of future repayments.

5.5 Comparative OECD countries

Subject to the caveats advanced in earlier sections, the growth impacts of a crisis are calibrated using the experience of comparable OECD countries. Prior to the crisis, some macro variables in Ireland and Spain looked quite similar to New Zealand (refer Table 6). The macroeconomic situation before the crisis in both countries was characterised by low government debt partly offset by a large and growing negative net international investment position (NIIP).

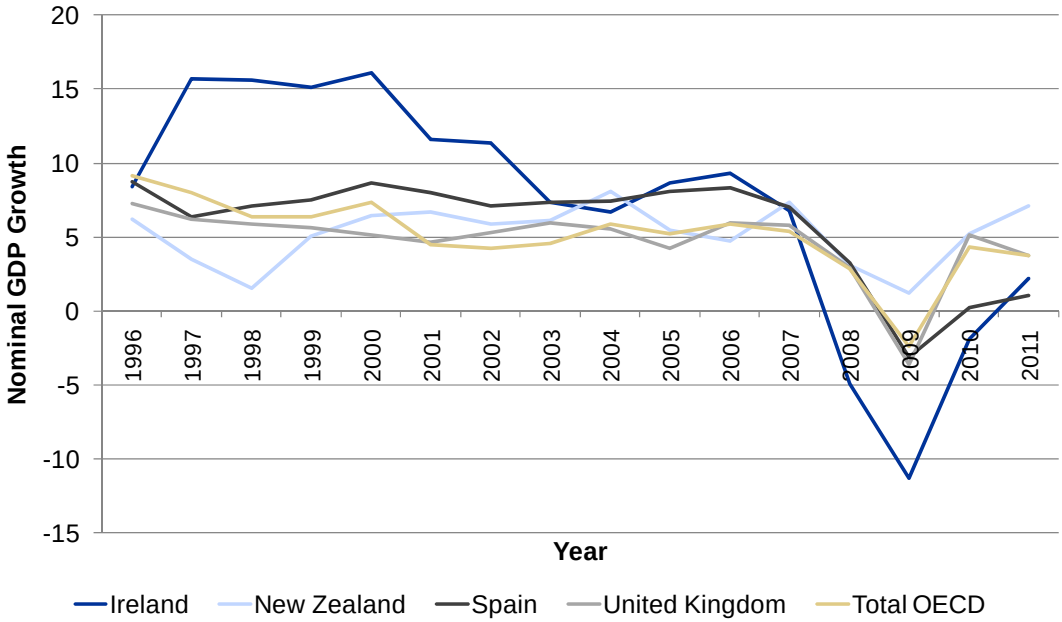
Table 6: Country imbalances prior to the crisis (2007)

	New Zealand	Ireland	Spain
Net govt debt	-13%	-0.3%	+19%
Gross govt debt	25%	28%	42%
Net international investment position	-80%	-71%	-80%

Source: OECD Outlook 87

In all cases, heavy borrowing from abroad was intermediated through prominent financial institutions. A large proportion of this debt made its way, through mortgages, onto household balance sheets. Asset prices rose through the boom and declined rapidly when the crisis hit both Ireland and Spain. Falling asset prices and a spike in private sector leverage contributed to a sharp reduction in spending and investment. In practice, New Zealand fared much better than either Spain or Ireland (refer Figure 7). Low government debt, a growing exposure to fast growing export markets, sound financial institutions, and the fact that our imbalances did not start to unwind in a disorderly fashion favoured New Zealand. This, however, does not exclude New Zealand from ever facing a crisis, especially if imbalances continue to grow.

Figure 7: Comparative OECD growth rates



Source: OECD Outlook 87

To illustrate how a crisis could look in New Zealand, growth is calibrated on the 2008-2011 growth rates for Ireland and Spain published in the OECD Economic Outlook (#87). These growth rates are projected out from New Zealand's 2010/11 nominal GDP (refer Table 7). A more moderate scenario based on the average OECD growth experience over the same period has also been included (refer Table 7). Beyond a period of five years, growth rates return to trend (4% nominal growth) for the remainder of the 15 year projection period.

Table 7: Nominal GDP growth rates used to model each scenario

	09/10	10/11	11/12	12/13	13/14
Ireland	7.3%	-4.2%	-10.0%	-3.2%	3.2%
Spain	7.0%	3.4%	-3.4%	-0.1%	1.2%
U.K	5.5%	3.5%	-3.6%	3.7%	3.7%
OECD average	7.1%	4.7%	-2.2%	4.2%	4.6%
New Zealand (HYEFU)		7.6%	5.8%	4.7%	5.2%

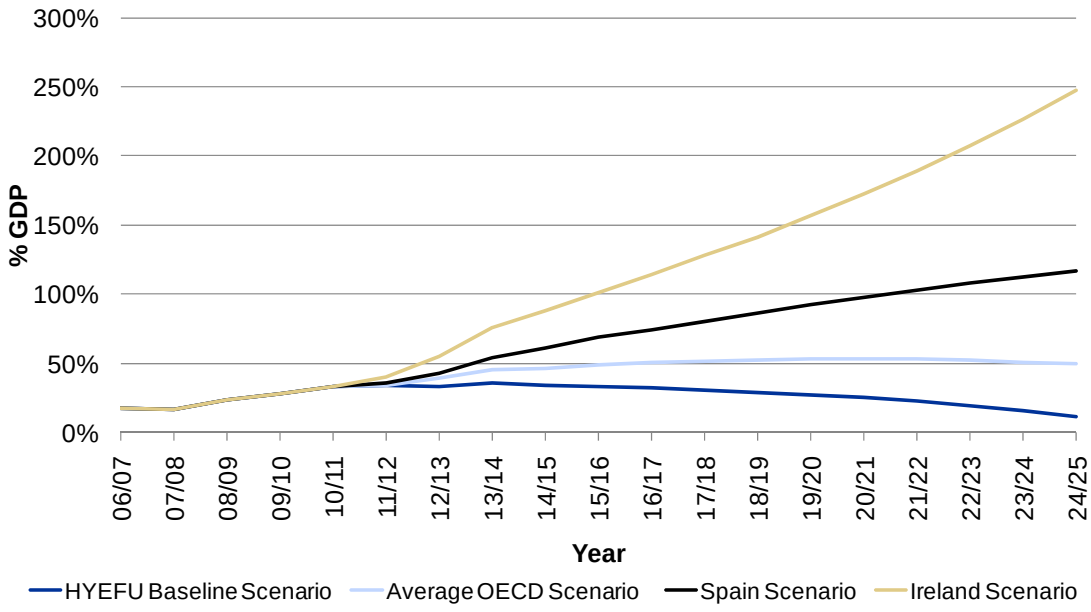
Source: Based on OECD & Treasury estimates

5.6 Impact on the New Zealand fiscal position

5.6.1 Rising debt and pressure to change policy

The impact on debt under all three scenarios is severe (refer Figure 8). Even under our most modest (average OECD) scenario, where New Zealand experiences a single year decline in GDP of 2%, debt rises to 54% of GDP. In our more extreme scenarios (Spain and Ireland), debt grows rapidly and does not stabilise by the end of the projection period. In all cases, policy has been held constant and spending growth is based on the Government's fiscal strategy as of HYEFU.

Figure 8: Gross sovereign issued debt under OECD growth scenarios (excluding changes in spending)



Source: The Treasury, HYEFU 2010

To replicate the size of changes experienced in countries such as Ireland our figures need to also consider increased spending. However, this analysis is complicated as spending depends on the policy decisions of the government of the day. Nevertheless, for the purpose of illustration, we model a half percent reduction in productivity growth, which reduces trend growth under the Irish scenario by an equivalent amount. One-off increases in spending were also included to cover the cost of a banking crisis (13% of GDP[12] as laid out in Box 3) and the cost of recapitalising falling government asset values ($14 billion)[13].

The results indicate that, while tax still makes up the majority (58%) of the change in debt, the outcome of our scenarios could be up to 69 percentage points worse than Figure 8 if the policies laid out above are incorporated. This compares to the IMF's study of sovereign debt (IMF, 2010) which suggested that average debt levels in developed countries are projected to increase by 39 percentage points. Of this increase over 19 percentage points (48%) will come from declining revenue. Despite common perceptions, only 3.2 percentage points (8%) are expected to come from financial sector support and 4.5 percentage points (11%) from fiscal stimulus measures[14]. New Zealand studies looking at tax volatility (Irwin and Parkyn, 2009) estimate that the impact of tax changes account for 52% of the past volatility in Crown net worth. However, given spending changes are contingent on future government decisions, we retain the usual modelling assumption used in the government's long-term projections – that policy remains constant – for the remainder of the paper.

5.6.2 Post crisis fiscal consolidation

Regaining access to external funding would require steps to re-establish faith in the government's long-term solvency. This section investigates the size of consolidation necessary to stabilise the budget under each scenario within a five year timeframe. In nominal dollar terms, zero operating and capital allowances for five years would likely be sufficient to stabilise debt at around 40% of GDP under our most moderate scenario (refer Figure 9), but would be insufficent to stabilise debt under the more severe scenarios. In each of the more severe scenarios, the government must make additional cuts to existing spending. The budget cuts necessary to stabilise debt within five years would range from $1.1 billion (Spanish scenario) to $3.3 billion per annum (Irish scenario). Debt under each scenario peaks uncomfortably high at between 55% and 73% respectively.

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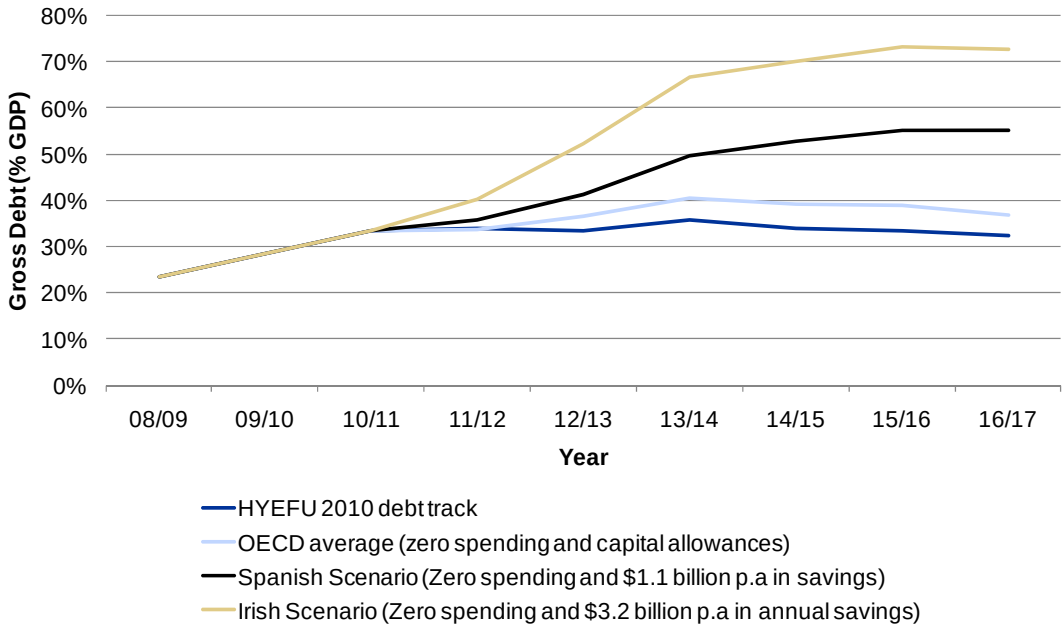
12 This % GDP is based on World Bank estimates (Honohan & Klingbiel, 2002).

13 Our assumption is that a small proportion of assets may require additional government funding following a decline in value. An obvious example would be ACC, where funding may fall well short of the organisation's liabilities. This allows us to discuss valuations changes in terms of the final impact on debt. The cost changes are based on a 1.5 standard deviation change in value of SOEs and Financial assets (Irwin and Parkyn, 2009).

14 This analysis predated the bailout of Ireland's major financial institutions.

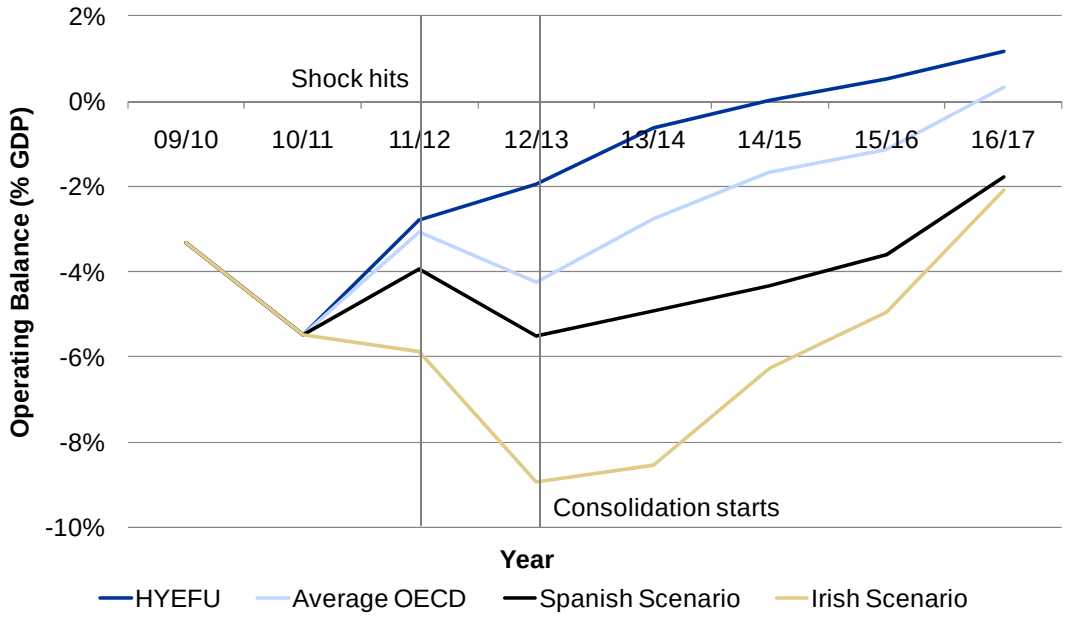
Figure 9: Level of debt when baselines are cut to stabilise debt within five years



Source: The Treasury, HYEFU 2010

The change in the operating balance as a percentage of GDP associated with these cuts can be compared to changes in the budget balance in other countries. The change in the operating balance under our Irish consolidation scenario is about 12% of GDP[15] (refer Figure 10). This equates to a 10.8% move in the primary balance (deficit excluding interest payments). Under the more moderate Spanish scenario, the move in the operating balance as a percent of GDP is 8%. In comparison, the largest consolidation of all time (refer Figure 4) at over 20% of GDP (Finland, 1993-2001) was larger, but occured over a longer timeframe of eight years.

Figure 10: Change in the operating balance as a % of GDP



Source: The Treasury, HYEFU 2010

[15] The change in the operating balance has been taken from the lowest point, which normally occurs two years after the growth shock, to the end point in our five year consolidation scenarios.

New Zealand's fiscal performance between 1984 and 1990 based on IMF statistics was a total move of 10.5 percentage points, which looks comparable to the figures presented in our scenarios. However, using New Zealand figures, the largest improvement in the reported operating balance was closer to 6% (-2.8% in 1984 to +3.4% in 1990). The IMF's treatment of net financial investment, which includes net loan advances and equity investments, explains much of the difference. In 1984 net invesment represented a net outflow, changing to a net inflow by 1990. In contrast, our analysis assumes zero net capital spending over the five year period. The underlying economic conditions also differ. In 1984 New Zealand had low unemployment and real growth that was stagnating, but remained, for the most part, positive through the consolidation period. In contrast, our Irish scenario has three years of negative GDP growth peaking at -10% and unemployment of over thirteen percent of GDP. The pain associated with a fiscal contraction in this environment would be an order of magnitude larger.

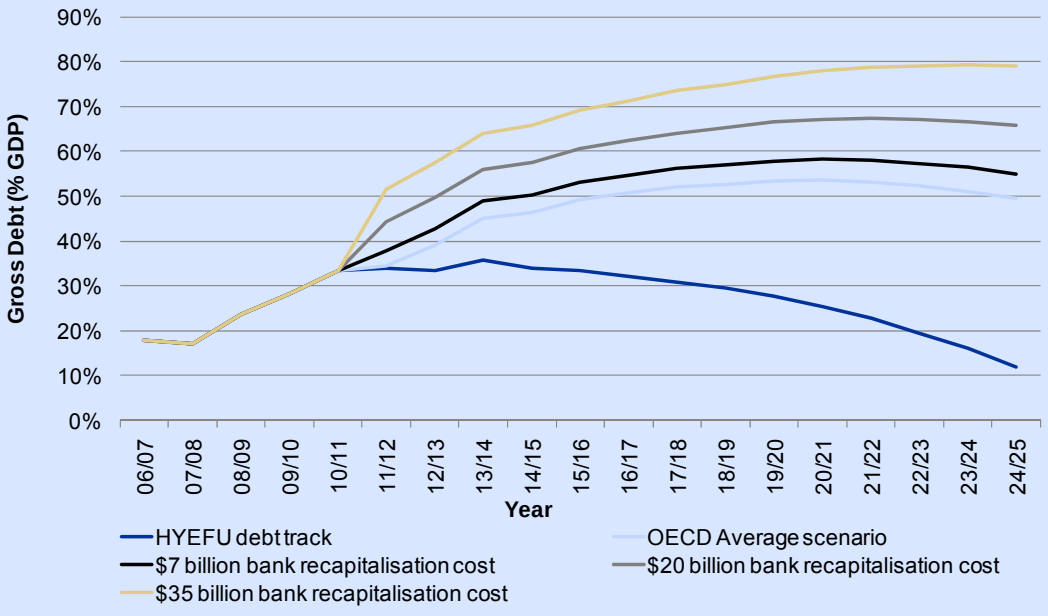
Box 3: Policy options in a crisis

Liquidity may affect a government's ability to enact costly policy measures in a crisis especially if spending is short lived requiring a short term spike in the issuance of debt. Governments hold cash and foreign currency reserves as a precaution. Other short term forms of assistance are also available. Bilateral agreements may provide formal credit lines or swap agreements. Failing that assistance could be sourced from one of the multilateral international financial institutions, such as the IMF.

By way of example, we model the cost of a hypothetical bank bailout akin to those undertaken in other OECD countries. We model a range of costs associated with recapitalising the equity of single bank (around $7 billion) and of recapitalising the entire banking sector. The average cost of a full bailout is 13% (Honohan & Klingbiel, 2002) of GDP (approximately $20 billion). A $35 billion cost is also modelled by way of example. These figures represent a large crisis. In comparison, the cost of the 1990 bailout of BNZ was comparatively small at only 1% of GDP (Hunt, 2010).

All costs are modelled on top of our most moderate 'average OECD' scenario. Figure 11 shows that most of the increase in debt relative to our HYEFU debt track still comes from the decline in growth (the difference between the HYEFU and average OECD lines. A spike in costs largely leads to a level shift in debt. However, liquidity risk may still be an issue as the entire cost must be sourced in one financial year. In comparison, deficits may gradually increase debt over an extended period of time.

Figure 11: The impact of a bank default under the average OECD growth scenario



Source: The Treasury

5.7 Risk summary for each scenario

In all three scenarios, the final level of risk will depend firstly, on how risk averse markets are at the time and secondly, on how the government responds. Almost anything is "survivable" in the sense that governments cannot become insolvent and the decision to default is, first and foremost, a political decision. The question is, would the government prioritise debt repayments, and what impact would the required consolidation have on the nation as a whole? A sharp consolidation in a crisis situation will have welfare effects. At some point populations may prefer the delayed cost of a debt default (higher borrowing costs or lack of access to markets) over the immediate pain of a fiscal contraction.

Table 8 summarises the results of our three scenarios. In our average OECD scenario the shock creates limited liquidity risk, as the size of consolidation is manageable. Debt would also stabilise without any action, although at 54% of GDP debt would place a heavy toll on future resilience. It would be preferable to reduce debt, although the government would have a range of options around how this is phased.

In the Spanish scenario, debt continues to grow and reaches 117% of GDP within 15 years. Markets may give the New Zealand Government limited leeway, but, given the continued growth in debt at the end of the projection period, some degree of policy change would likely be necessary at some point. Moves to stabilise debt over five years would require zero additional spending and cuts of $1.1 billion per year for five years. This equates to a change of 5.5% in the operating balance – a change that is large, but not historically unprecendented. Cuts of this size would create adjustment costs if enacted in a crisis environment. However, to the extent that markets are willing to extend some leeway, the government may still be able to delay some adjustment until the private sector starts recovering.

The Irish scenario, our most severe, would likely require immediate adjustments to stabilise debt. Debt reaches 248% of GDP and is still growing exponentially after 15 years. Under this scenario, policy is clearly no longer sustainable and the government would have to act quickly to retain the faith of markets. This paper investigates a scenario with zero additional spending and spending cuts of $3.2 billion per annum to stabilise debt at 73% of GDP after five years. It is conceivable that a one-off cost, such as a banking crisis, could, increase this figure to nearly 90% of GDP (the point at which the IMF suggest that debt dynamics could become unsustainable). Markets may question the size of consolidation needed or the level at which debt stabilises. Thus, under this scenario, depending on how markets react, New Zealand may still need to seek emergency funding until credibility could be reestablished.

Table 8: Liquidity risk summaries for OECD scenarios

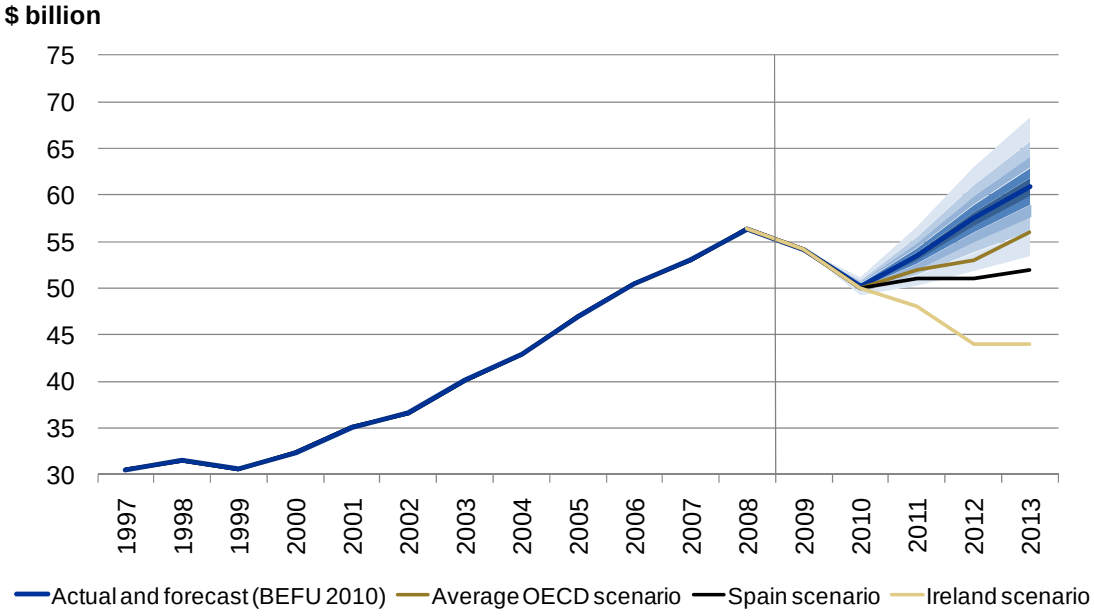
Risk Indicator	Summary	Liquidity Risk	Impact
Average OECD Scenario			
Stock of debt (no consolidation)	Debt peaks at 54%, which is comparable to OECD countries experiencing liquidity pressures.	Some liquidity risk, although an increase in interest rates is more likely.	Unlikely to affect growth, but could impact on borrowing costs.
Direction of the projected debt track (no consolidation)	Growth in debt slows and starts to stabilise late in the projection period.	Stabilising debt, albeit late in the period, is positive.	The government would have limited ability to absorb shocks or additional spending pressures.
Amount of consolidation to stabilise debt track over five years	Removing operating and capital allowances (zero spending) would stabilise debt towards the end of the projection period.	N/a	Any new spending would need to be met from savings elsewhere.
Change in the operating balance	The operating balance peaks at just over 5% of GDP under the consolidation scenario.	A consolidation of this size is credible.	While achievable, consolidation is likely to be difficult – significant adjustment costs.
Conclusions	*Liquidity pressures could emerge unless policy changed. However, the government has discretion on the timing of consolidation*		
Spanish Scenario			
Stock of debt (no consolidation)	Debt peaks at over 117%, which is comparable to many OECD countries currently experiencing liquidity pressures.	Suggests a high risk that liquidity pressures could emerge if policy does not change.	Would impact on both growth and borrowing costs.
Direction of the projected debt track (no consolidation)	Debt continues to grow at the end of the projection period.	Suggests a high risk that liquidity pressures could emerge if policy does not change.	The government will be forced (sooner or later) to consolidate.
Amount of consolidation to stabilise debt track over five years	Zero spending and $1.1 billion baseline cuts per year for five years.	N/a	N/a
Change in the operating balance	The operating balance changes by 8% of GDP.	Credible based on historic experience.	Significant adjustment costs in achieving a consolidation of this size in a crisis.
Conclusions	*The size of the shock is large and would require early policy changes. Consolidation ($1.1 billion per annum) would be difficult to achieve, but based on historic consolidations is achievable. The adjustment cost of an early consolidation in a recession could be significant.*		
Irish Scenario			
Stock of debt	Debt peaks at over 248%, which is higher than all OECD countries currently experiencing liquidity pressures.	Unsustainable, suggests a very high risk that liquidity pressures could emerge.	Debt at this level (if possible) would start to impact severely on growth and borrowing costs.
Direction of the projected debt track	Debt accelerates at the end of the projection period.	Suggests a very high risk that liquidity pressures could emerge.	The government will need to implement consolidation immediately.
Amount of consolidation to stabilise debt track over five years	Zero spending and $3.2 billion baseline cuts per year for five years.	Potentially achievable based on historic experience	Current government expenditure reduced by 20% to stabilise debt over five years.
Change in the operating balance	The operating balance changes by 12% of GDP.	Potentially achievable based on historic experience.	Enormous adjustment costs in achieving a consolidation of this size in a crisis situation.
Conclusions	*The size of the shock would require immediate policy change at very significant cost to the economy.*		

5.8 Probability assessment

Calculating the probability of a crisis when New Zealand's level of indebtedness is at a historically unprecedented level is difficult. Based on the past 16 years (since New Zealand started publishing five-year forecasts), the 95% confidence interval for a change in revenue compared to one year forecasts is plus or minus $1.6 billion. Over a four-year period, this adds up to a 95% confidence interval of plus or minus $7.6 billion (Parkyn, 2010).

Figure 12 illustrates the likelihood of each scenario based on this confidence interval. The average OECD scenario falls within a 95% confidence interval and could be expected to occur within the next 20 years. In contrast, the Irish and Spanish scenarios fall outside the 95% confidence interval. The distance from the 95% confidence interval highlights how severe the Irish shock is compared to any New Zealand shock over the past 16 years.

Figure 12: Scenarios in the context of tax forecast uncertainty over the last 16 years



Source: The Treasury

Prudence dictates that, at the very least, the government make arrangements to deal with historically observed volatility. Responding proactively to larger events is more difficult. It could have seemed reasonable in 2007 for Irish authorities to conclude that the current crisis was improbable. However, historical estimates may understate a conditional probability if the underlying factors driving it are fundamentally changing. For Ireland, the risk of a crisis was primarily driven by historically unprecedented large capital inflows, an increase in house prices, and a growing reliance on continued inflows of capital.

6 Future work

The New Zealand fiscal management framework is set out in the *Public Finance Act 1989*. The importance of a predictable and sustainable fiscal strategy is already recognised in five principles for prudent fiscal management[16]. The government is required to state whether its fiscal strategy is consistent with these principles:

- reducing total debt to prudent levels to provide a buffer;
- once debt is at prudent levels ensuring that, on average, total operating expenses do not exceed total operating revenues;
- achieving and maintaining levels of total net worth that provide a buffer against factors that may impact adversely on total net worth in the future;
- managing prudently the fiscal risks facing the government; and
- pursuing policies that are consistent with a reasonable degree of predictability about the level and stability of tax rates for future years.

There are significant difficulties in determining what constitutes a 'prudent buffer' when underlying factors giving rise to risk are without historic precedent. Nobody knows when New Zealand's imbalances will unwind, whether the process will be disorderly, or how large the cost could be.

Scenario-based analysis forms a useful input into precautionary fiscal decisions. As a first step, this paper has focussed on the effectiveness of low debt as a potential buffer against large unforeseen shocks (bullet point one). However, rebuilding a buffer will take time, so an obvious immediate use for this work would be to apply our understanding of downside risk to analysis looking at the appropriate level for long-term budget targets.

The work in this paper could also be extended in three other ways. Firstly, work could be extended to take into account the maturity profile of the government's existing debt portfolio. Liquidity risk relates to the amount of debt issuance at a point in time, which includes funding requirements at a given point in time plus repaying pre-existing debt as it matures. To date, this scenario analysis has only focused on the net increase in debt[17].

Secondly, analysis could be extended to cover assets, especially liquid sources of cash (bullet point three). Liquid assets can reduce liquidity risk over the very short term. Longer-term less liquid assets can also be sold to pay down debt. Our focus on gross sovereign-issued debt provides a useful source of international comparability. However, once a risk scale based on international comparability has been derived, analysis could be expanded to include liquid assets. This analysis could provide an indication of how long the government could self-fund should markets temporarily be closed. The role of foreign currency assets is especially important.

Finally, the concept of liquidity risk could be applied to other government policy. The concept of liquidity risk is a useful input into other advice on our broad fiscal policy settings and the many micro-focussed interventions that may be used in a crisis situation.

16 Section 26G of the Public Finance Act 1989

17 The Debt Management Office already manages spikes in debt maturities. This risk work has not featured in our scenarios.

7 Conclusions

New Zealand has come through the worst global financial crisis since World War II relatively well. This illustrates that there are a lot of positives standing in the country's favour. Notably, New Zealand has low government debt, a relatively strong financial sector, and macro institutions, such as a floating exchange rate, that provide flexibility in a crisis situation.

Despite this, New Zealand, as an indebted country, potentially remains exposed to sovereign liquidity pressures. Namely, a reliance on a continued inflow of capital leaves us exposed to significant changes in investor sentiment. Liquidity crises are notoriously difficult to predict as they are, to a large measure, psychological phenomena. Predicting a trigger point is difficult, although, through comparative analysis of historic consolidations, a rough risk scale can be derived. The new modelling techniques used in this paper suggest that, all being equal, a significant natural disaster or cyclical tax volatility similar to the levels seen over the past 16 years are unlikely to be large enough (in their own right) to trigger a crisis, although some government action may be required to maintain confidence. A more prolonged or persistent growth shock would carry higher liquidity risk. However, regardless of whether a crisis eventuates, other detrimental effects, such as higher borrowing costs or a credit rating downgrade, could still impact on the fiscal position.

The scenarios in this paper are purely hypothetical. While we use an earthquake in Wellington as indicative shock, no attempt has been made to take into account lessons following the tragic 22 February earthquake in Canterbury. With respect to rebalancing, we avoid identifying any triggering event. In this regard, we use new modelling to highlight the preconditions for a sovereign crisis. Firstly, a surprise decline in growth would have to reduce government revenue. Secondly, market participants would need to believe that this loss was permanent. Finally, the decline would need to have been of sufficient size that the adjustment necessary to close the government's structural deficit is deemed difficult or improbable.

A key lesson from this paper is that a stronger Crown balance sheet provides a buffer allowing the government more room to act in a crisis. However, in a more significant crisis the adjustment could still fall heavily on taxpayers through fairly rapid changes to tax or government spending.

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Appendix 1: Debt dynamics

Sovereign debt dynamics relate to a range of interrelated variables.

To remain solvent a government must ensure that the net present value (NPV) of government revenue net of any initial indebtedness exceeds the NPV of its primary expenditure. Primary expenditure is expenditure less debt servicing costs.

$$\sum_{t=0}^{\infty} \frac{E_{t+1}}{\prod_{j=1}^{i}(1+r_{t+j})} \leq \sum_{t=0}^{\infty} \frac{R_{t+i}}{\prod_{j=1}^{i}(1+r_{t+j})} - (1+r_t) \quad \textbf{(1)}$$

Where *E* is government expenditure, *r* is the real interest rate, *R* is revenue, and *D* is debt.

The solvency constraint binds the government over long time periods. In the interim the change in government debt as a proportion of GDP (Y) can be modelled as a function of interest rates (*r*), growth rates (*g*), initial debt levels as a percent of GDP, and the primary balance (*pb*). The primary balance is revenue less spending net of interest payments.

$$\Delta\left(\frac{D}{Y}\right)_t = \left(\frac{r-g}{1+g}\right)\left(\frac{D}{Y}\right)_{t-1} - pb \quad \textbf{(2)}$$

To stabilise debt as a proportion of GDP a government requires a primary balance that covers the growth adjusted interest payments on debt. If growth is positive debt can still grow in nominal terms, while remaining stable as a proportion of GDP.

$$pb = \left(\frac{r-g}{1+g}\right)\left(\frac{D}{Y}\right)_{t-1} \quad \textbf{(3)}$$

The calculation can be rearranged to calculate the primary balance needed to stabilise debt over a specific time frame. Let:

$$\gamma = \frac{r-g}{r+g} \quad \textbf{(4)}$$

To reach a specific primary balance (pb^*) in a specific (n) number of periods the government would need to run a primary balance sufficient to satisfy equation (5)

$$pb^* = \frac{-\gamma}{(1+\gamma)((1+\gamma)^n - 1)}\left((1+\gamma)^n d_n^* - d_0\right) \quad \textbf{(5)}$$

The impact of growth can be seen in equation (2). Growth increases the denominator (Y) which lowers debt as a proportion of GDP. Conversely policies that decrease growth can create potentially explosive debt dynamics.

$$Y = C + I + G + Ex - Im \quad \textbf{(6)}$$

GDP in equation (6) is defined as the sum of consumption, investment, net government spending, and exports less imports. An economic shock as occurred in 2007/08 can lower consumption, investment, and net trade receipts. As a result government debt as a percent of GDP increases as output declines.

A government response, all else equal, that reduces net government spending (G) further decreases economic output. The final impact of fiscal consolidation on growth depends on the extent to which fiscal consolidation drives changes in other variables in equation (6). For example, lower government spending may reduce crowding out creating an offsetting increase in net investment.