
Measuring systemic risk: the role of macro-prudential indicators

Tony Wolken¹

This article outlines some of the key indicators the Reserve Bank uses to help inform macro-prudential policy decisions. Macro-prudential indicators (MPIs) play an important role in the identification of financial system risk; the assessment of the banking system's capacity to weather periods of financial stress; and in signalling periods of financial stress. The indicators inform decisions to both deploy and remove macro-prudential instruments. The article explains how the MPI framework helped to frame the recent decision to impose residential mortgage loan-to-value (LVR) restrictions.

1 Introduction

In May 2013, the Governor of the Reserve Bank and the Minister of Finance signed a Memorandum of Understanding setting out the objectives, governance, and instruments for macro-prudential policy.² The memorandum stipulates that the Reserve Bank will publish information on its risk assessment framework, including the indicators that it uses to guide its macro-prudential policy settings (RBNZ, 2013).³ Accordingly, the Reserve Bank has been developing its indicators in this area as part of the development of the macro-prudential framework.

This article provides an overview of the role of macro-prudential indicators (MPIs) currently used in assessing 'systemic risk' – the risk of disruptions to financial services caused by an impairment of all or parts of the financial system, that can have serious negative consequences for the real economy (IMF, 2011). It presents some of the key MPIs the Reserve Bank analyses to assess the build-up of risk across the New Zealand financial system, including those indicators that helped frame the recent decision to implement residential mortgage loan-to-value (LVR) restrictions. The article concludes with a brief discussion of the role of some

indicators in determining when to remove or release macro-prudential policy.

2 Macro-prudential indicators – an overview

2.1 *Role of MPIs in the Reserve Bank's macro-prudential policy framework*

Good policy needs sound data. The collection and reporting of MPIs mark the first step in the Reserve Bank's macro-prudential decision framework (figure 1, overleaf). MPIs are an integral part of a systemic risk assessment which includes consideration of emerging risks such as whether debt levels are becoming 'excessive', asset prices 'over-valued', or lending standards becoming too loose.

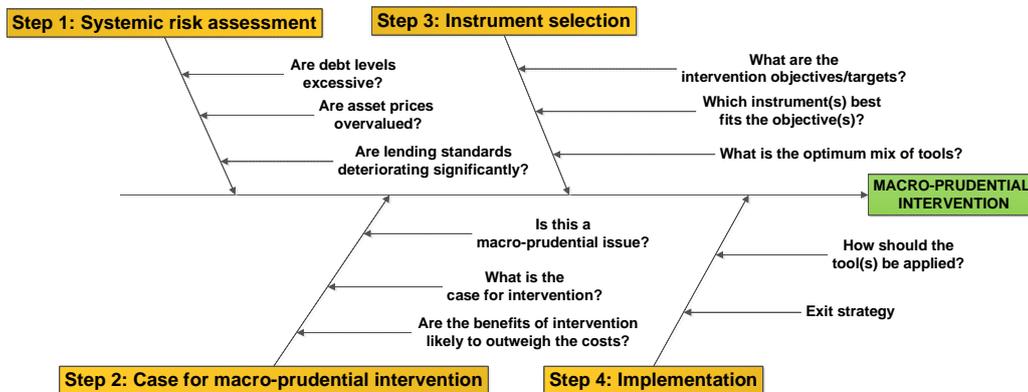
Individual MPIs can offer a general guide based on the past historical experience of the indicator concerned, but the indicators are not used mechanically to implement macro-prudential policy. Risks can build up in the financial system from different sources and in many different ways. Consequently, judgement is required in considering the case for macro-prudential intervention, selecting the appropriate instrument to deploy, and in deciding when to remove any instrument (steps 2-4). Nevertheless, robust and reliable indicators provide the basis for better decision making.

¹ The author would like to thank Chris Hunt, Anella Munro, Roger Perry and other colleagues at the Reserve Bank for their helpful comments.

² See Rogers (2013) for an overview of the macro-prudential policy framework.

³ The Reserve Bank will begin publishing a full set of MPIs in March 2014. The data for MPIs discussed in the main text of this article are available here: http://www.rbnz.govt.nz/research_and_publications/reserve_bank_bulletin/2013/2013dec76_4wolken_data.xls

Figure 1
The macro-prudential decision framework



2.2 Types of indicators

Systemic risk indicators can be grouped into two main categories (Borio and Drehmann, 2009a):

- 'Time-dimension' indicators, which measure how systemic risk evolves over the financial cycle.
- 'Cross-sectional' indicators, which measure how systemic risk is distributed within the financial system at a point in time.

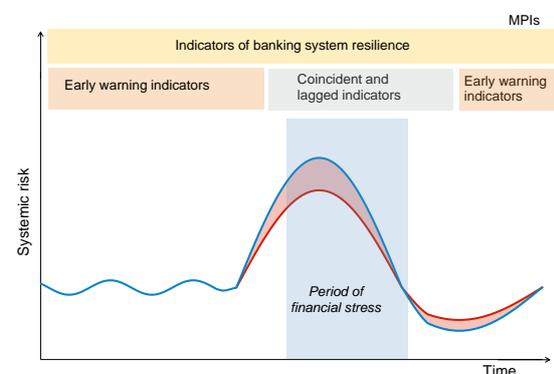
The time dimension is linked to the idea that there is a strong tendency for both financial intermediaries and borrowers to take on excessive risk in the upswing of a financial cycle, and become overly risk averse in a downturn. This procyclicality as a source of systemic risk arises from a number of features of the financial system such as information frictions, and incentive and coordination problems.⁴ MPIs in this dimension aim to give a sense of the degree of procyclicality and benchmark at what point risk-taking, debt levels or asset price developments are becoming excessive or unsustainable.

Cross-sectional systemic risks arise from institutional concentration (the 'too-big-to-fail' phenomenon); the interconnectedness of different financial institutions, and; common exposures, where different institutions are exposed to the same risk. Cross-sectional risk can provide an important amplification mechanism for cyclical developments. In New Zealand, many of these

aspects of cross-sectional risk are addressed through the underlying prudential framework, rather than through the use of specific macro-prudential instruments per se.

The Reserve Bank's Macro Financial Committee (MFC) examines a set of indicators in a quarterly *MPI Report* (primarily focused on indicators across the time dimension). Some indicators in the *Report* help identify the build-up of risk (early warning indicators); benchmark the capacity of the banking system to absorb risk; or signal when a period of financial stress has materialised (near-coincident indicators, figure 2). The latter set of indicators can help to assist decisions concerning the removal of macro-prudential policy.

Figure 2
Stylised financial system risk and MPIs



Note: The red shared area illustrates cyclical amplification arising from cross-sectional risks.

⁴ For further discussion see Bank of England (2009) and Nicolò, G *et al* (2012). See Craigie and Munro (2010) for a discussion of procyclicality in the New Zealand financial system.

2.3 What is a good indicator?

The Reserve Bank's macro-prudential decision framework suggests several desirable features of a good indicator that help to identify the build-up of systemic risk, the subsequent materialisation of stresses in the financial system, and the capacity of the system to absorb risk.

Relevant

Some risks to financial stability, such as excessive credit expansion, are characteristic of all financial systems and therefore imply a common set of MPIs. Other risks might be more country-specific and relate to the particular structure of the financial system (see section 3), or the way the economy is exposed to the global environment. For example, the New Zealand financial system is exposed to risks arising from the importance to the economy of the agricultural sector and, in recent years, of the dairy sector in particular.

Collectable

While New Zealand has many of the core indicators used overseas, some indicators used in other jurisdictions might be unavailable in New Zealand. For example, most New Zealand banks are not listed on the domestic stock exchange, so indicators that use market pricing of bank equity risk are unavailable.

Comprehensive and dynamic

Macro-prudential indicators should aim to cover the whole financial system. Attention has naturally focused on banks as the largest participants in the financial system, but the GFC drew attention to the risks concentrated in parts of the 'shadow' or non-bank system (Adrian, Covitz and Liang, 2013). Even though the non-bank lending sector is currently very small in New Zealand, it is important to monitor developments there as the sector could be a source of systemic risk in the future. Regulators need to be dynamic to keep abreast of building risks, particularly if the implementation of macro-prudential tools directed at the banking system results in

'regulatory leakage'.⁵ We expect the indicator set to evolve over time.

Forward looking

Indicators are required that provide an early warning of building financial stress in sufficient time for policy action to be taken. In practice, different indicators give warnings at different time horizons, and therefore it will be necessary to assess a mix of indicators, including 'contrarian' indicators that might suggest when current financial conditions look 'too benign'.

Accurate

The signal from early warning indicators will never be exact. If an indicator warns of a crisis that does not eventuate, then efficiency costs may be incurred that reduce overall welfare. If no signal is issued and a period of financial stress or, worse still, a crisis occurs, then there may be large social costs of the kind seen in many economies during and after the GFC. Policymakers have to assess the probability of both types of 'errors' occurring as part of a cost-benefit analysis of macro-prudential action (or inaction). An accurate indicator should therefore minimise 'noise' or the extent of false calls.

3 Structural features of the New Zealand financial system and the choice of MPIs

Four key features of the New Zealand financial system influence the specific choice of MPIs.

Banks play a large role

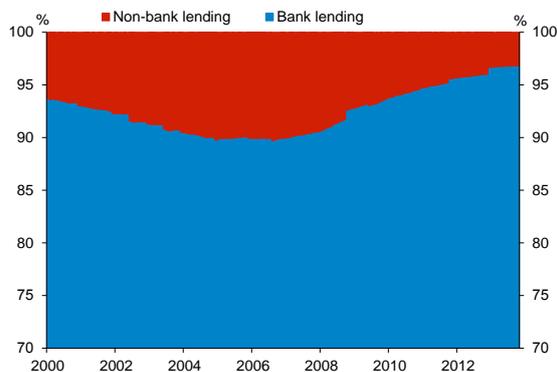
New Zealand banks account for around 80 percent of total financial system assets and around 97 percent of lending from domestic financial institutions.⁶ Total bank lending is around \$320 billion, or 148 percent of annual gross domestic product (GDP).

⁵ See box C of the November 2013 *Financial Stability Report* for a discussion of regulatory leakage.

⁶ Lending from financial institutions located offshore is another potential source of credit for New Zealand households and firms. Data from the Balance of Payments accounts suggest, however, that this direct cross-border lending is very small. This contrasts with many other jurisdictions where direct cross-border lending plays a greater role.

Lending outside of the banking sector is small by comparison (figure 3).⁷ Non-bank lenders accounted for 10 percent of total lending just before the GFC, but receiverships, mergers and exit to the banking sector have meant the sector now accounts for a much smaller share of total lending. In addition, equity and corporate bond markets play a much smaller role as a source of business finance in New Zealand than in most other developed economies.

Figure 3
Domestically intermediated private credit by sector
(share of total lending)



Source: RBNZ *Standard Statistical Return* (SSR).
Note: Non-bank lenders comprise non-bank deposit-takers regulated by the Reserve Bank, and non-deposit taking finance companies.

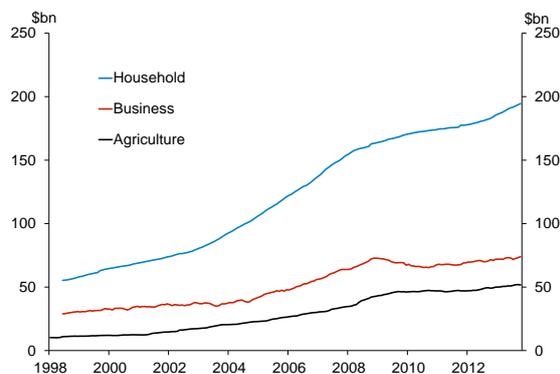
Housing lending is a large proportion of bank lending

Half of domestic bank lending is residential housing (figure 4). Although housing lending is typically less risky than business or agricultural lending, a sharp decline in house prices could force many households into negative equity and financial difficulty, and weaken bank balance sheets. An increase in unemployment could also place households under financial strain, and increase the likelihood of default. An increase in systemic risk concentrated in the housing sector lay behind the Reserve Bank's decision to impose restrictions on high-

⁷ There is also very little 'off-balance' activity by New Zealand banks used to fund lending (such as that involved in the 'securitisation' of residential mortgages), compared to banks elsewhere.

LVR residential mortgage lending in October 2013 (see box B, page 25).

Figure 4
Bank lending by sector

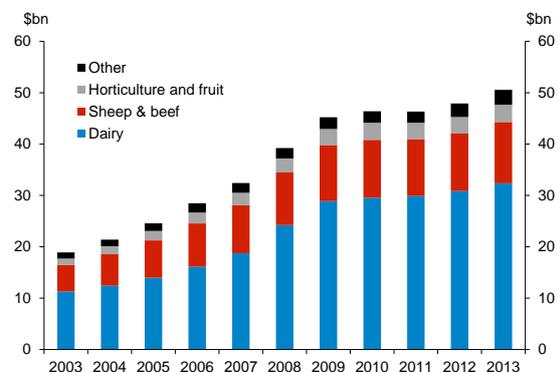


Source: RBNZ SSR.

Dairy sector lending is a large proportion of agricultural lending

Risks in the agriculture sector stem from drought, or a sharp decline in commodity prices which could negatively affect rural incomes and land values. A decline in rural incomes and land values would fall hardest on those farms most in debt. Agricultural lending amounts to around 15 percent of total bank lending, and of this, around 60 percent is lent to the dairy sector (figure 5).

Figure 5
Agricultural debt by sector
(June years)

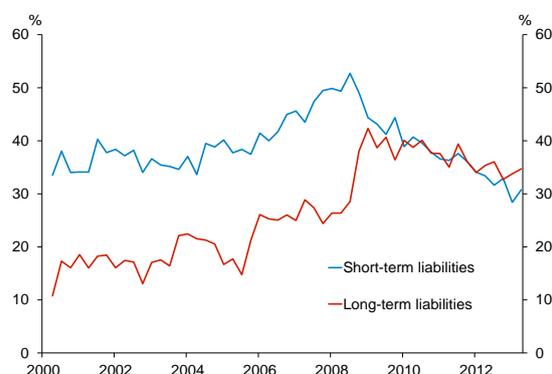


Source: RBNZ *Annual Agricultural Survey*.

Offshore funding has been a high proportion of bank funding

In recent decades the banking system has relied heavily on offshore wholesale funding. This has reflected inadequate domestic savings relative to the investment needs of the economy, and hence persistent current account deficits and a large net external liability position. A key source of financial system risk has been the roll-over risk associated with this reliance on global funding sources – much of which was previously very short-term (figure 6). The introduction of the core funding ratio (CFR) requirement in 2010, designed to increase the stability of banks' funding, has moderated that risk. Nevertheless, the banking system still relies on a greater share of offshore funding relative to banks in other jurisdictions.

Figure 6
Offshore bank funding
(percent of GDP)



Source: Statistics New Zealand.

Note: Series derived from Balance of Payments data. Short-term is less than one-year to maturity.

The features of New Zealand's financial system described above imply a set of MPIs heavily weighted to assessing the risks specific to the banking system as well as the banking system's capacity to weather a shock to balance sheets. Given the nature of banks' exposures, a broad set of indicators related to developments in both the housing and agricultural sector are important, as are funding-related indicators.

4 Constructing MPIs for New Zealand

This section explains some of the key indicators used in the Reserve Bank's *MPI Report*, and the risk factors they each aim to capture. The MPIs in the *Report* can be categorised into those indicators that:

1. Identify the build up of risk (early warning indicators), including those related to:
 - an 'excessive' build up in credit;
 - ability to repay debt;
 - inflated asset prices, and;
 - deteriorating lending standards.
2. Signal when a period of financial system stress has materialised.
3. Assess the banking system's capacity to absorb risk.

Each group of indicators is briefly explained below, with a fuller set of MPIs the Reserve Bank currently considers listed in the appendix.

4.1 Identifying the build up of risk

Assessing whether a build up in credit is 'excessive'

During a financial cycle, rising business and household optimism leads to an increased demand for loans to fund projects and asset purchases. Credit growth may be amplified by a relaxation in lending standards as banks respond to a decline in non-performing loans and the rising value of borrowers' collateral. This makes credit measures some of the most important indicators of rising systemic risk.

The Reserve Bank examines a range of credit measures for the financial system as a whole, and for each of the major sectors – household, business and agriculture.

- The *rate of growth of credit*. While not all credit booms end with a period of financial stress, severe financial crises are almost always preceded by a rapid increase in credit. By itself, however, the rate of growth is an unreliable indicator as credit may be expanding for a range of reasons, including productivity growth in the economy. The rate of credit growth may provide lead information on

developments in the credit-to-income 'gap' (see below).

- The *ratio of credit relative to income*. At the economy-wide level this is the ratio of total system credit relative to GDP. At the sectoral level a proxy measure for income is used. A rise in credit relative to income can be a concern with international experience showing that rapid increases in the ratio often precede financial crises. However, there can also be reasons unrelated to system risk for increases in credit-to-income measures. For example, emerging countries have found that financial system liberalisation has been associated with a significant rise in the ratio. A

similar effect may have occurred in New Zealand after the financial deregulation of the 1980s.

- The *credit-to-income 'gap'*. This measure shows the difference between the level of credit-to-income and its trend, and therefore allows for other influences on the trend such as financial deepening within the economy. The Bank for International Settlements (BIS) recommends credit-to-income gaps as a useful early warning indicator of future periods of financial system stress.⁸ The Reserve Bank calculates credit-to-income gaps for the system (the credit-to-GDP gap), and for each of the major sectors (see figure 7).

Figure 7
Sectoral credit gaps

Figure 7a

Household credit-to-disposable income

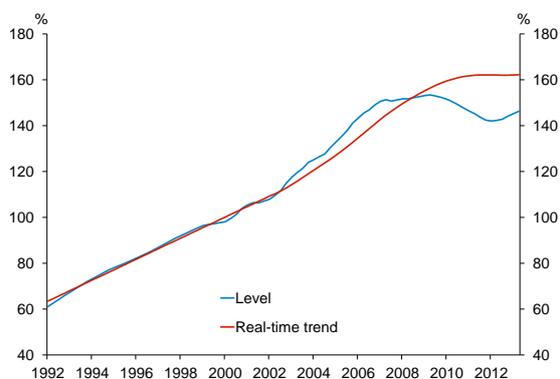


Figure 7b

Household credit gap and credit growth

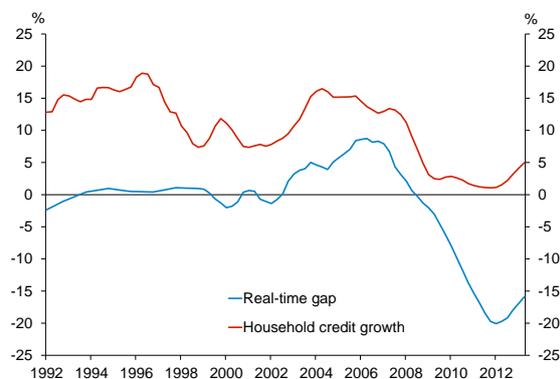


Figure 7c

Business credit-to-operating surplus

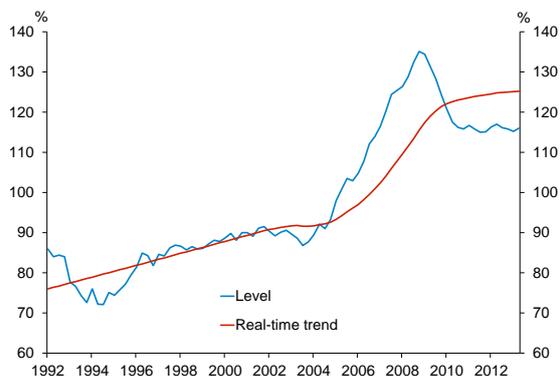
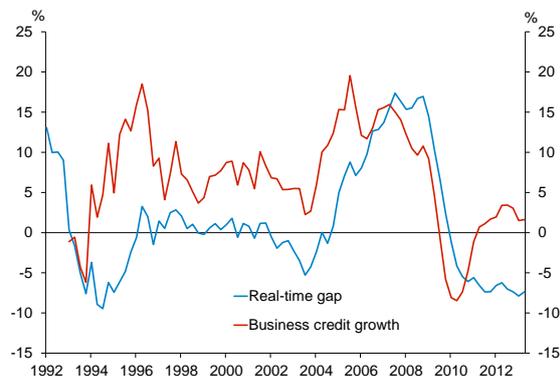


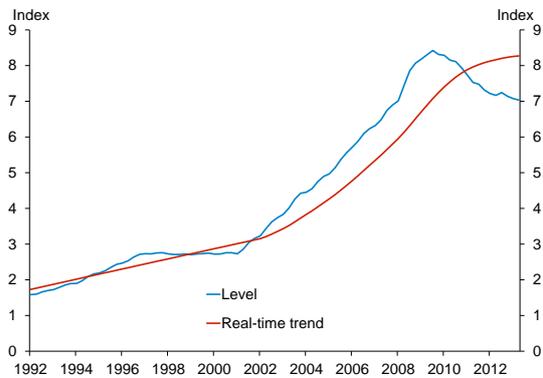
Figure 7d

Business credit gap and credit growth



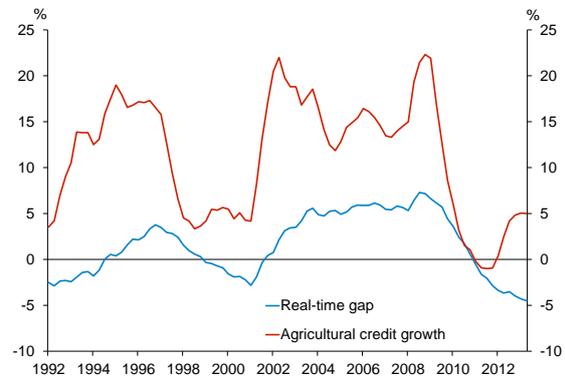
⁸ See, for example, Borio and Drehmann (2009b), Drehmann *et al* (2011) and Drehmann and Juselius (2013).

Figure 7e
Agricultural credit-to-agricultural GDP



Note: See the appendix for explanations of each indicator.

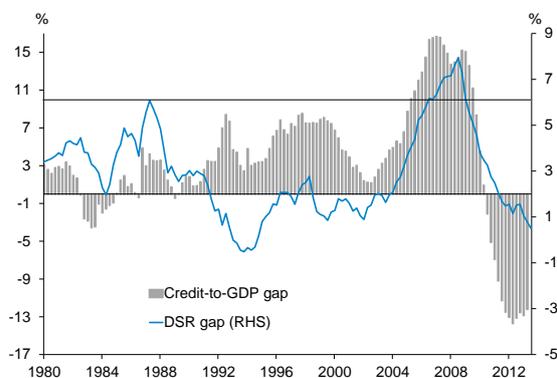
Figure 7f
Agricultural credit gap and credit growth



Deteriorating ability to repay debt

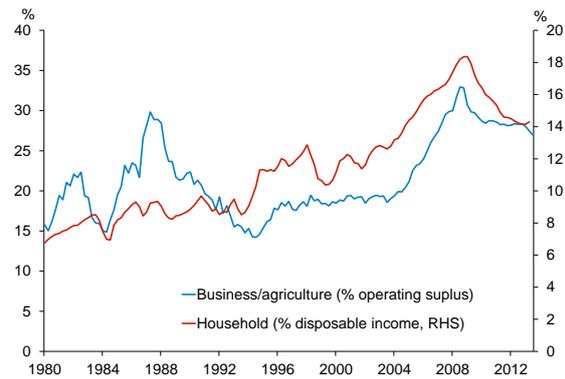
A significant deterioration in borrowers' ability to repay debt increases the fragility of the financial system. The debt service ratio (DSR) measures the proportion of income that is required to service both principal and interest costs. This indicator can be calculated as a 'gap' or level measure for the system as a whole (figure 8), and for the major sectors (figure 9).⁹ An elevated DSR suggest borrowers have less spare income after debt repayments to absorb an unexpected rise in debt service costs or other expenses, or a loss of income.

Figure 8
Credit-to-GDP and DSR gaps
(percent of GDP)



Source: Statistics New Zealand, RBNZ SSR, RBNZ calculations.
Note: The horizontal line indicates the upper threshold of the credit-to-GDP gap range for when a crisis signal is issued at the three-year horizon, aligned with the six percent DSR threshold at a one-year ahead horizon.

Figure 9
Sectoral DSRs levels
(principal and interest as a share of income)



Source: Statistics New Zealand, RBNZ SSR, RBNZ calculations.
Note: Where available, the average interest rate paid is used to compute interest payments. Principal repayments are estimated assuming a constant average time to maturity.

Financial liberalisation and innovation have facilitated a structural increase in the DSR over time. Interest rates have declined steadily over the past 20 years, increasing firms' and households' capacity to borrow. However with lending rates now at 30-year lows, a higher debt burden makes the economy more vulnerable to a rise in interest rates and rising servicing requirements. To take account of long-term trends in the structure of the financial system, the DSR is calculated using deviations from a 15-year moving average.

⁹ For more information, see box B of the November 2013 *Financial Stability Report*.

Box A

The credit-to-GDP gap – technical discussion

BIS researchers have recommended the use of the credit-to-GDP gap as an early warning indicator of periods of financial stress. In cross-country empirical studies, the gap measure was found to increase substantially three to five years before a financial stress event. When combined with other indicators such as the debt servicing ratio and asset price information (discussed in the main text), it has been found to predict many episodes of impending financial stress. Few such stress events occurred without a preceding signal from the credit-to-GDP gap, but not all signals from the credit-to-GDP gap have been followed by an episode of serious financial stress in the country concerned. Changes in the credit-to-GDP gap can be particularly useful because they allow policymakers time to consider policy responses to growing financial imbalances while looking for corroborating information from other indicators.

The credit-to-GDP gap suggests credit growth can be considered 'excessive' when the ratio rises significantly above its long-term trend, creating a large positive 'gap'. The long-term trend is calculated using a smoothing technique that removes the cyclical component from the data – a Hodrick-Prescott (HP) filter, with a lambda of 400,000. The trend is calculated in real-time, using only information available up until that point in time.¹⁰ This choice of lambda implies the credit cycle is longer than the business cycle, consistent with significant financial contractions occurring about every 20 to 25 years. This shows what policymakers at the time were seeing when making decisions, without these being revised as the end-point changes.

Thresholds are used to indicate when a positive gap might prompt policymakers to consider macro-prudential intervention. The BIS suggests the use of a range rather than point thresholds for policy purposes –

2-10 percent for the gap, depending on the country and policymaker's preference (Borio and Drehman, 2009b). For an economy that is already highly indebted on a credit-to-GDP basis, a threshold closer to 2 percent is recommended.

In the New Zealand context the credit-to-GDP gap would have provided a reasonable signal of growing financial imbalances leading into the GFC (Hunt, 2013). Had a macro-prudential framework been in place prior to the GFC, the elevated gap measure (figure A2) would have prompted policymakers to seriously consider the deployment of macro-prudential policy measures during 2004/05 to address the increase in systemic risk.

Figure A1
Private sector credit-to-GDP

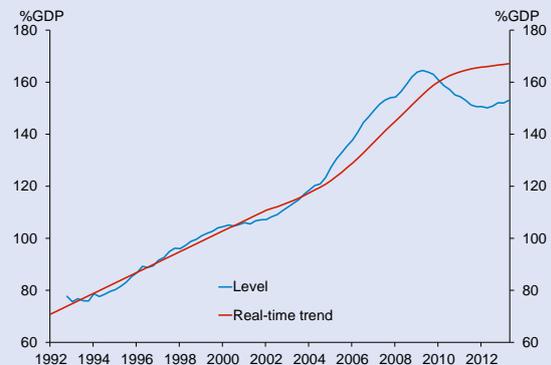
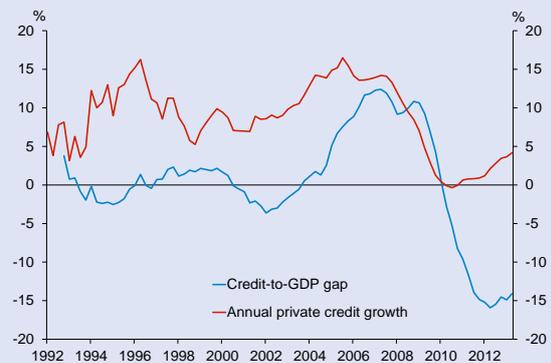


Figure A2
Private sector credit gap and growth



¹⁰ For a critique of the BIS approach based on problems calculating credit gaps in 'real time', see Edge and Meisenzahl (2011). For the BIS rejoinder see Drehmann *et al* (2011).

The credit-to-GDP gap can be less useful in the aftermath of a large credit boom, such as the one New Zealand experienced during 2002-2007. Following such periods, the statistical estimate of the trend credit-to-GDP will typically continue to increase. This implicitly assumes that the risks from the previous credit boom dissipate rapidly, so that a further period of very elevated credit growth is required to generate another early warning signal. This assumption is particularly questionable in the current environment, where, for example, the level of indebtedness is historically high, house prices remain overvalued, and where there has been no recent

structural change, such as a financial liberalisation or an acceleration in underlying productivity growth, that could rationalise further trend increases in indebtedness. As a result, our judgement has been that a credit-to-GDP gap indicator does not adequately capture the increase in systemic risk currently associated with rapid house price growth and the recovery in housing-related credit. This underscores that it is necessary to examine a range of indicators, avoiding any sort of mechanical approach, when assessing a build-up of systemic risk.

International research has suggested that the DSR is best suited to providing a warning around one year in advance of a period of financial stress.¹¹ Consequently, the DSR can be a useful indicator of the rising probability of future periods of financial system stress, if used to corroborate information from the credit-to-GDP gap and other credit measures. In line with the international research, the aggregate DSR for New Zealand issued warnings later than the credit-to-GDP gap in the run-up to the 2008 financial crisis (figure 8).

Inflated asset prices

Credit growth often supports asset price inflation, which in turn can support further credit growth by easing 'collateral constraints' on borrowers. This amplification process works in reverse in a downturn. For that reason, deviations of asset prices from long-term trends have proved useful in helping to predict periods of financial system stress (Borio and Drehman, 2009b). In particular, property prices tend to show exceptionally strong growth ahead of a financial stress event. Property prices can also fall rapidly in a period of financial stress, as borrowers' ability to repay declines, collateral constraints become binding and a 'fire sale' dynamic sets in.

The Reserve Bank monitors asset price developments in the residential, commercial, and agricultural sectors (figure 10, overleaf). Property prices for these sectors are compared to a proxy for sectoral income to guide the level of 'over' or 'undervaluation'. The use of asset price-to-income 'gaps' helps to corroborate the information coming from credit-based MPIs in assessing the scope for financial system stress.¹²

Deteriorating lending standards

During the upswing in the credit cycle, lending standards within the financial system often relax in response to a fall in formal measures of risk, helping to support overall credit growth. Conversely, lending standards can tighten significantly during a period of stress as measures of risk rise, making it difficult for otherwise creditworthy borrowers to obtain credit. Consequently lending standards can amplify the financial cycle, both in the price and non-price terms at which banks are willing to provide credit to borrowers.

¹¹ A DSR above six percent (relative to its 15-year moving average) provides this one-year ahead signal of future financial stress (see Drehmann and Juselius, 2012 and 2013).

¹² These asset price gaps are only as good as the underlying asset price series. A commercial property 'gap' is not shown in figure 10 due to the absence of a reliable commercial property price series that covers a long time span. This is unfortunate, as exposure to commercial property assets has been an important factor in many previous financial stress events, including recent finance company failures and the financial crisis in the late 1980s.

Figure 10
Asset prices

Figure 10a
House price-to-disposable income

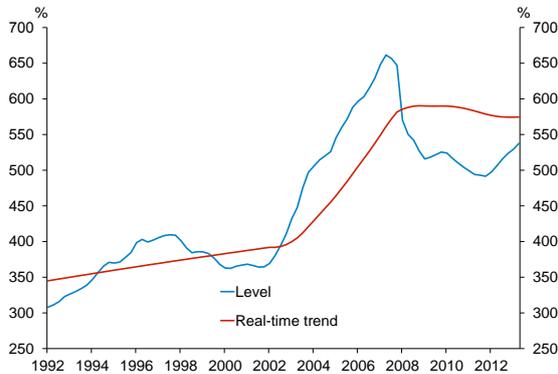


Figure 10b
House price gap and inflation

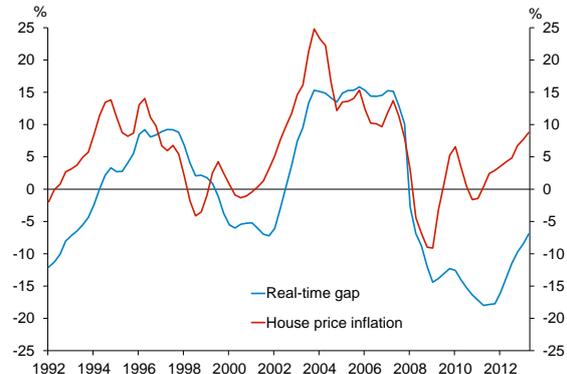


Figure 10c
Farm prices-to-agricultural GDP

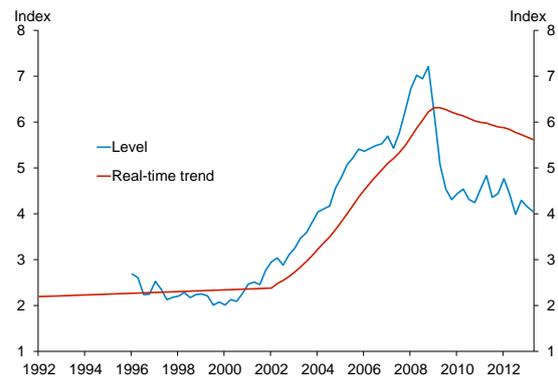
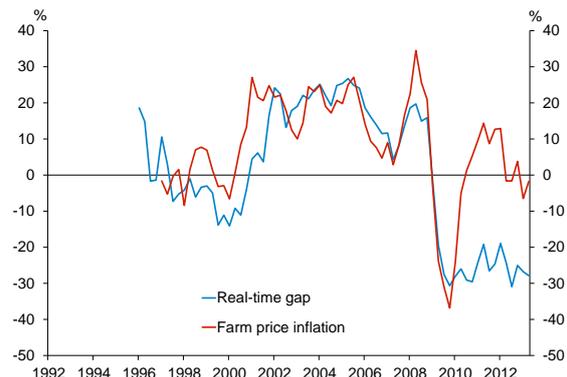


Figure 10d
Farm price gap and inflation



Note: See appendix for an explanation of each indicator.

During the late stages of a credit boom overall lending standards may become excessively loose for two reasons. First, banks may extend lending to less creditworthy borrowers – for example borrowers with very little equity. Second, the shadow banking system, which typically lends to riskier projects – for example commercial property development – may expand significantly.

The Reserve Bank monitors a range of lending standard indicators. These measures include residential mortgage LVRs, and bank net interest margins. Twice a year the Reserve Bank surveys bank lending standards, both in terms of price and non-price lending intentions. A judgement as to whether lending standards are becoming

too loose (for lending as a whole, or for specific sectors) and contributing to excessive risk-taking, can help inform whether macro-prudential intervention should be considered.

4.2 Signalling financial system stress

Financial market stress

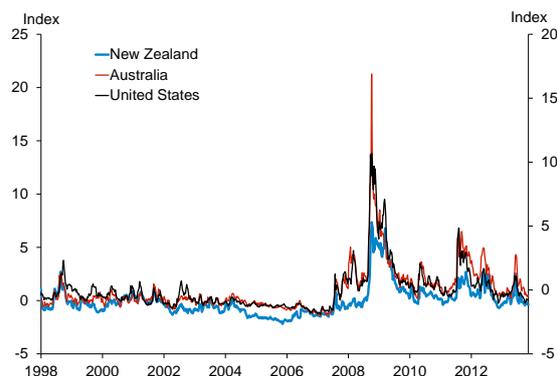
Market indicators can be useful 'near coincident' indicators of financial system stress or crises. While early warning indicators measure the build-up of systemic risk, market indicators show that this stress is materialising.

The market price of risk tends to increase sharply during periods of financial stress. Typical indicators

include the risk premia on riskier assets such as corporate debt relative to safer assets such as government debt (although as the GFC demonstrated, not all government debt is safe). Volatility-based measures of risk typically escalate during times of market stress. 'Stress indices' can be used to aggregate across a number of financial market variables (figure 11).

The paradox of financial stability is that financial market conditions can look at their most benign just before a period of stress materialises. So while financial market MPIs are not early warning indicators per se, they can be valuable as contrarian measures of risk-taking. If financial market volatility, or the pricing of traditionally risky assets, is very low by historical standards, the market may be under-pricing risk.

Figure 11
Domestic and international stress indices



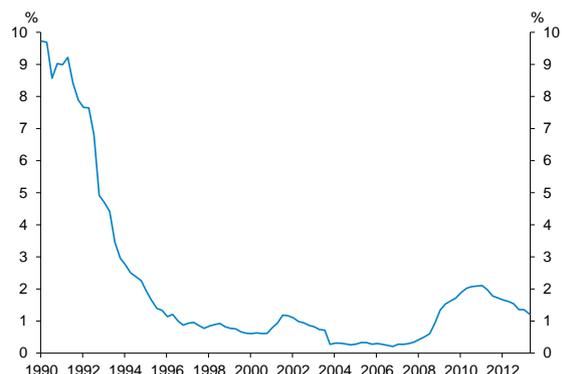
Source: Bloomberg, RBNZ calculations.
Note: The stress index for each country is calculated using principal components. This captures the covariance from a set of financial market series and attributes this simultaneous movement as 'stress' within financial markets (see appendix for further information).

Deteriorating asset quality

Asset quality indicators typically lag the financial cycle. Asset quality is measured across the key lending portfolios of banks and in aggregate (figure 12), and include non-performing loans (NPLs) and bank 'watch list' loans. During the upswing in the cycle these indicators typically look healthy as borrowers easily meet repayments. However, as the economic cycle goes into decline, NPLs increase, potentially eroding banks' capital.

In severe events, a financial institution's solvency could be threatened. Watch list loans – loans banks expect will become impaired – can be a leading indicator of NPLs.

Figure 12
Banking system non-performing loans
(percent of lending)



Source: Registered bank *Disclosure Statements*.

Asset quality MPIs are most useful in assessing the removal of macro-prudential policy (see section 5). Depending on the macro-prudential instrument, a sharp increase in NPLs might suggest removal of a policy instrument, such as a counter-cyclical capital buffer (CCB), while a more modest deterioration in asset quality could prompt a gradual and more considered release.

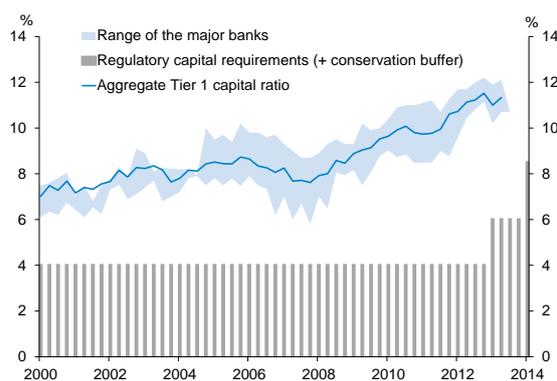
4.3 The banking system's capacity to absorb risk

The banking system should have appropriate buffers to weather difficult conditions in a crisis. If buffers are low, or being run down during the upswing of the credit cycle, then the ability of a bank to carry on its normal functions may be impaired during a subsequent period of stress. In an extreme case, the solvency of the bank could be threatened.

The two main buffers that the Reserve Bank can influence are the regulatory requirements associated with capital and liquidity. Regulatory capital requirements enable banks to absorb losses in a downturn without threatening their underlying solvency. Capital requirements are set at a specific permanent level through the cycle,

defined as a minimum level of capital relative to risk-weighted assets, and a capital conservation buffer.¹³ The Reserve Bank may also impose an additional regulatory capital requirement – the CCB – which can be built up in good times and drawn down in times of stress.

Figure 13
Tier 1 capital
(percent of risk-weighted assets)



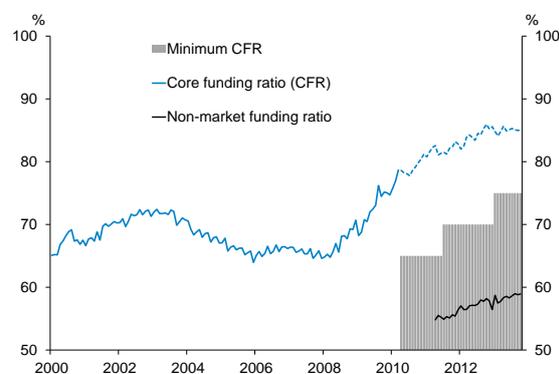
Source: Registered bank *Disclosure Statements*.

When systemic risk is rising, the Reserve Bank will assess the level of banking system capital against potential needs and determine whether a CCB should be introduced to improve banking system resilience. Additional indicators, such as banking system profitability and net interest margins, are used to supplement the use of capital ratios as indicators of banking system resilience. Profits are the first line of defence against losses, and the use of retained earnings can help build capital buffers. A healthy margin between the cost of banks' funding and the return on its interest-earning assets helps profits to be made without excessive risk-taking.

As part of the prudential liquidity requirements introduced in 2010, the CFR protects against the problems that might arise if banks' access to funding markets is disrupted. Banks must hold a minimum level of stable or core funding – currently 75 percent of lending – at all

times. The Reserve Bank may also implement a time-varying overlay to this minimum requirement as part of the macro-prudential policy framework. The Reserve Bank will examine the level of banks' core funding in the context of overall funding conditions, and assess whether imposition of a CFR overlay is necessary. Helping to inform this assessment of funding conditions will be a number of financial market MPIs (see section 4.2).

Figure 14
Banking system core and non-market funding
(percent of loans and advances)



Source: RBNZ SSR, RBNZ liquidity statistics.

Note: The solid section of the CFR is an approximation based on SSR data. The non-market funding ratio shows the contribution of non-market funding (mainly retail deposits) to core funding.

¹³ Regulatory capital is defined in relation to total capital, Tier-1 capital, and common equity Tier 1 capital. Minimum capital requirements have been increased following the GFC as part of the new global Basel III regulatory regime. The capital conservation buffer is a new feature of the Basel standards and will be introduced 1 January 2014 in New Zealand. For further details see: http://www.rbnz.govt.nz/regulation_and_supervision/banks/prudential_requirements.

Box B

MPIs and the decision to implement LVR restrictions

On 1 October 2013, the Reserve Bank introduced restrictions on banks' residential mortgage lending above an 80 percent LVR. The decision is a good example of how a range of measures need to be assessed by policymakers to form a view on whether systemic risk is increasing and a policy response is required.

In early 2013, the credit measures discussed in section 4.1 showed a mixed picture. The level of household debt-to-disposable income was high by historical standards despite this metric moderating somewhat since 2008, suggesting that households had a limited capacity to absorb risk should a financial shock occur. The rate of credit growth was rising but was still relatively low compared to the mid-2000s. The credit-to-GDP gap was negative but as discussed in box A, this measure is less reliable as an early warning indicator in the immediate aftermath of a substantial increase in credit, of the sort that occurred during the past financial cycle.

At the same time measures of banking system resilience appeared robust. Banks have strengthened both their capital and liquidity buffers since the GFC, and reduced their reliance on offshore funding.

However, rising asset prices were a source of concern, given that house prices relative to fundamental measures such as income or rents were already considered 'overvalued' (figure 10a). House prices were rising at an annual rate of 9 percent nationwide, and 17 percent in Auckland.

Of additional concern was evidence of easier credit and aggressive lending to borrowers who are

typically higher risk and associated with higher loan losses. In early 2013 bank lending to home borrowers who had less than 20 percent equity reached around one third of total new housing lending (figure B1).

Taken as a whole, the Reserve Bank considered that the increase in riskier lending, and the possibility of a sharp correction in house prices, was creating an unwarranted increase in overall financial sector risk. Therefore the decision was taken to slow lending to low-equity mortgage borrowers by introducing 'speed limits' on new high-LVR lending. Other macro-prudential instruments were considered, but these were determined to have less effect on the demand for housing-related credit growth and house price inflation.

Figure B1
High-LVR residential mortgage lending
(new origination flows, percent of mortgage lending)



Source: RBNZ private reporting, RBNZ Loan to Valuation Ratio Survey.

5 Removing macro-prudential instruments

Decisions on the release or removal of macro-prudential instruments will typically be based on a different set of indicators than those used to guide the implementation of the instrument. The range of indicators used to guide removal will also be influenced by how financial system stress materialises. The following three scenarios indicate the considerations that would be involved in the withdrawal of a policy measure.

In the first scenario, an increase in systemic risk does not result in any obvious negative impact on the financial system or the economy. Financial imbalances unwind in a benign and orderly fashion, perhaps in part due to the macro-prudential instrument in place. The Reserve Bank would look at indicators of financial imbalances to guide removal. In the current context where LVR restrictions have been implemented, the Reserve Bank would expect to see house price and housing credit growth moderating, and more prudent bank lending practices – all of which would be necessary to return household indebtedness and house prices towards historic norms.

In the second scenario, an increase in systemic risk results in a mild stress event, perhaps typical of 'normal recessions' or slowdowns in economic activity. Financial imbalances accumulated during the upswing are unwound in a more or less orderly fashion, but some degree of deleveraging by borrowers and financial intermediaries contributes to a slowdown in economic activity. The Reserve Bank would examine coincident and lagged indicators of financial stress to gauge the speed and magnitude of the slowdown, and how this was flowing through to bank balance sheets. Some macro-prudential tools, such as temporary capital and liquidity buffers, could be removed gradually in this scenario.

In a third scenario, an increase in systemic risk during a credit upswing materialises in a financial crisis (perhaps precipitated by an international shock), forcing the economy to contract sharply and imbalances to correct in a painful or disorderly fashion. Again, coincident MPIs would help to guide removal of the macro-prudential instrument, which would be likely to more timely than in either of the other two scenarios.

The current *MPI Report* contains a number of indicators that will help guide the release of macro-prudential policy. The Reserve Bank will be looking to further develop the indicators.

6 Conclusion

This article has provided an overview of the indicators currently used to guide macro-prudential policy. Macro-prudential policy is still in its infancy and the Reserve Bank will continue to develop all aspects of the framework. For example, the calibration of macro-prudential policy settings will evolve as experience is gained with specific tools. The Reserve Bank will also continue to refine the set of indicators used to help guide the macro-prudential decision-making process, including both the deployment of tools and their eventual release.

The Reserve Bank expects that an understanding of the 'best' indicator (or set of indicators) will develop over time, and the knowledge of the thresholds at which the indicators point to a stress event will become more accurate. Nonetheless, because of the complex nature of systemic risk and periods of financial system stress, there will always be considerable scope for policymaker judgement in the macro-prudential decision-making process.

Appendix New Zealand MPIs

MPI	Definition	What it is useful for?	Source
Early warning indicators			
(i) Credit measures			
Private sector credit-to-GDP level	Ratio of intermediated credit (bank and non-bank lending), to annual nominal GDP	Indicator of vulnerability, may be influenced by trend changes such as changes in neutral interest rates or financial liberalisation	Statistics New Zealand, <i>RBNZ Standard Statistical Return (SSR)</i>
Real-time credit-to-GDP trend	Trend is calculated using a one-sided Hodrick-Prescott (HP) filter, with a lambda of 400,000. Each data point for the trend is estimated using the data that would have been available to policymakers at that time	Used in calculating the 'gap' measure	Statistics New Zealand, RBNZ SSR, RBNZ calculations
Credit-to-GDP real time gap	Difference between credit-to-GDP level and trend	Three-year ahead signal of financial stress. Indicates a sustained period (over a number of years) of strong growth in the credit-to-GDP ratio	Statistics New Zealand, RBNZ SSR, RBNZ calculations
Total credit growth	Annual percent change of bank and non-bank intermediated credit	Simple, transparent indicator measuring the increase in imbalances over a given time frame. Can be a leading indicator of the credit gap	RBNZ SSR
Private sector credit cross-country	Private sector credit divided by nominal GDP	Compare the stock of outstanding intermediated credit on an international basis	Statistics New Zealand, RBNZ, Haver
Household credit-to-disposable income (level, trend, gap, credit growth)	Replicates credit-to-GDP methodology	Identifies sectoral specific vulnerabilities and risks	See above
Business credit-to-gross operating surplus (level, trend, gap, credit growth)	Replicates credit-to-GDP methodology	Identifies sectoral specific vulnerabilities and risks	See above
Agricultural credit-to-agricultural GDP (level, trend, gap, credit growth)	Replicates credit-to-GDP methodology	Identifies sectoral specific vulnerabilities and risks	See above
Share of non-bank lending	Non-bank lending divided by total financial system lending	Measure of structural change and 'leakage' into the non-bank sector (as a result of policy)	RBNZ SSR
Public debt cross-country	General gross government debt as a share of GDP	Compare the level of public debt on an international basis	The Treasury, Statistics New Zealand, Haver
Public and private debt ratios	Total private debt (including corporate bonds) and public debt as a share of nominal GDP	Measures change in composition of total financial system debt over time	The Treasury, RBNZ, Statistics New Zealand
Net foreign liabilities	Foreign assets less liabilities divided by nominal GDP	Measure of net external indebtedness. Can be broken down by sectors (banks, government)	Statistics New Zealand

(continued)

MPI	Definition	What is it useful for?	Source
(ii) Asset price measures			
House price-to-disposable income level	Ratio of average house prices to average disposable income	Measure of overvaluation	Property IQ, Statistics New Zealand
Real-time house price to disposable income trend	Long-term trend of the house price-to-income. Same procedure as for credit-to-GDP trend	Used in calculating the 'gap' measure	Property IQ, Statistics New Zealand, RBNZ calculations
House price to disposable income gap	Percentage difference between the house price-to-income level and trend	Additional early warning indicator supplementing the credit gap. A positive gap indicates that asset price growth has outstripped incomes for a sustained period	Property IQ, Statistics New Zealand, RBNZ calculations
House price inflation	Annual percentage change in house prices	Simple, transparent indicator of asset price exuberance over the past year	Property IQ, REINZ
Commercial property prices to gross operating surplus (level, trend, gap, asset price growth rate)	Replicates house price-to-income methodology	See above	IPD, Statistics New Zealand
Farm prices to agricultural GDP: (level, trend, gap, growth rate)	Replicates house price-to-income methodology	See above	Statistics New Zealand, REINZ, RBNZ calculations
(iii) Capacity to service debt			
Debt servicing ratio	Principal and interest servicing costs divided by income. Principal costs assume average time-to-debt maturity is 15 years	One-year ahead signal of financial stress. Captures balance sheet stretch of the economy	RBNZ SSR, Statistics New Zealand, RBNZ calculations
Debt servicing ratio gap	Difference between debt servicing ratio level, and the 15-year moving average of the series	Measuring whether the increase in DSR has been excessive, rather than picking up long term trends	RBNZ SSR, Statistics New Zealand, RBNZ calculations
Analysis replicated for the household and business/agricultural sector (level, gap)	See above	See above. Highlights sectoral vulnerabilities	RBNZ SSR, Statistics New Zealand, RBNZ calculations
(iv) Lending standards			
Bank lending standards for retail borrowers	Change in price and non-price lending standards (net percentage)	Indicates how lending standards have changed over the previous 6-months, and how they are expected to change in the coming 6-months	Private reporting from 13 registered banks
Bank loan-to-value ratio (LVR) monthly flow	High LVR lending (>80%) as a share of total mortgage lending	Indicates change in proportion of bank lending to higher-risk borrowers	RBNZ Loan-to-value ratio survey
Net interest margins	Bank net interest income as a percentage of average interest earning assets	Highlights the level of competition within the banking system. Low margins can indicate that banks are competing aggressively on price	Registered banks' Disclosure statements

(continued)

MPI	Definition	What is it useful for?	Source
Indicators of banking system's capacity to absorb risk			
Tier-1 capital ratio	Tier-1 capital as a share of risk-weighted assets	Shows level of buffer against potential losses in the banking system	<i>Disclosure statements</i>
Core funding ratio	Retail funding, long-term wholesale funding, and equity as a share of total loans and advances	Measure of core or stable funding	RBNZ liquidity statistics
Bank wholesale funding profile	Proportion of wholesale funding at different maturities	Profile highlights stress points if funding markets closed	RBNZ
Indicators of financial system stress			
(i) Coincident stress measures			
Financial stress index (comparable indices constructed for New Zealand, Australia, and United States)	Principal component analysis is used to extract covariance between 5 financial market series (FX market volatility, equity market volatility, bond volatility, bank bill – OIS spread, and bond spreads). Each series is also reported individually	Measures onset of stress within financial markets. Individual series can highlight pockets of stress or market dysfunction	Bloomberg
Basis swap spreads	Cost of swapping overseas borrowing back to NZD	Shows the hedging costs for banks on overseas wholesale funding deals. Dysfunction in this market could result in increased funding costs for banks or reduced ability to hedge exchange rate risk	Bloomberg
Australian bank CDS spreads	Credit default swap (CDS) spreads for Australian banks	Proxy for wholesale funding costs of the parents of the big-4 banks in New Zealand	Bloomberg
(ii) Asset quality			
Non-performing loans	Impaired and 90-day past due assets divided by total lending	Lagged response to a period of financial stress, as borrowers struggle to repay debt	<i>Disclosure statements</i>
Sectoral non-performing loans	Impaired and 90-day past due assets divided by total lending for each sector	Identify specific sectors that have been affected by a period of financial stress	Private reporting from 13 registered banks
Sectoral watchlist loans	Watchlist loans divided by sectoral lending	Precursor to a loan becoming non-performing. Useful as a leading indicator of asset quality	Private reporting data from 13 registered banks
Impaired asset expense	Impaired asset expense divided by total lending	Shows impact of provisioning for a deterioration in asset quality on profitability	<i>Disclosure statements</i>

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