Box D

Stress Testing and Australian Bank Resilience

Stress testing is a common tool that policy-makers use to assess vulnerabilities and the resilience of financial systems. The Reserve Bank has recently released details of its 'top down' bank stress testing model, which primarily focuses on the credit side of bank balance sheets to assess possible implications of various macroeconomic conditions for the banking system.[1] It is designed to be simple and transparent, and to help the Reserve Bank identify which aspects of the macroeconomic environment and banking system are driving the results of the test. As was demonstrated early in the pandemic, the adaptability of the model also allows for additional layers of financial stress to be assessed and for a variety of scenarios to be run quickly. This top-down modelling approach complements the 'bottom up' stress testing undertaken by the Australian Prudential Regulation Authority (APRA) that uses results from individual banks to assess the impact of a particular scenario on bank balance sheets.

Stress testing shows the effects of macroeconomic scenarios for bank capital ratios

The Reserve Bank's stress testing model translates a macroeconomic scenario into implications for bank capital ratios through a series of decision rules and accounting identities. The model uses the same set of equations for each of the nine largest banks in Australia and the scenarios are based on projections of four key macroeconomic variables: GDP growth; the unemployment rate; housing prices; and commercial property prices. The main way these variables affect bank balance sheets is through their effect on credit losses, which ultimately feed through to bank capital ratios. For example, in a scenario where macroeconomic conditions deteriorate (say, the unemployment rate increases and housing prices decline), there is an increase in losses on housing credit, which leads to a decrease in bank profits and capital ratios.
Figure D.1 presents a simplified diagram of the general model dynamics.

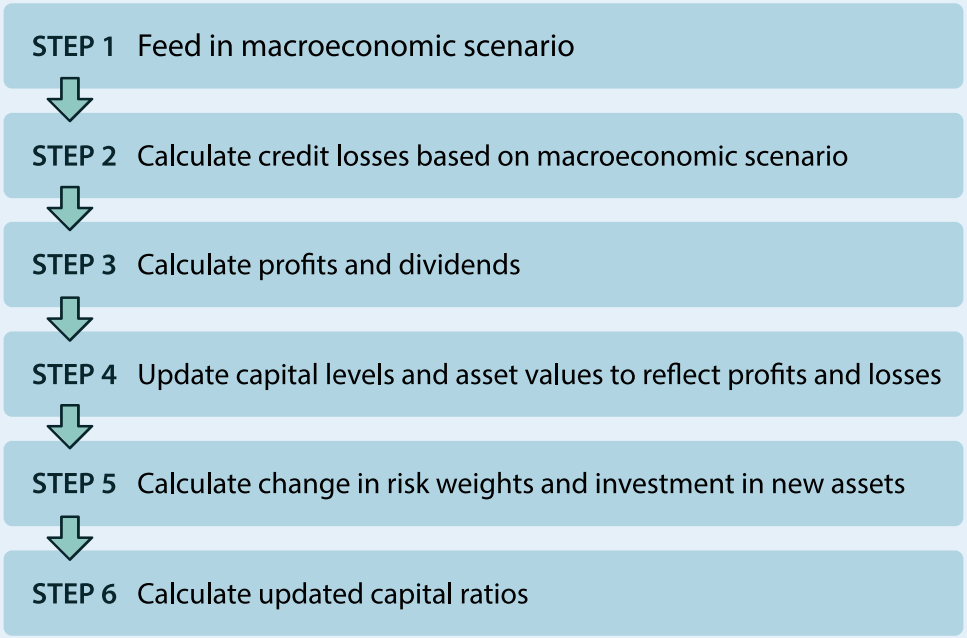
At a high level, once credit losses are calculated, a series of decision rules – which take into account the size of each bank's profits and the strength of their capital ratio – determine dividend payments and the amount spent on new assets. If banks remain profitable and capital ratios are sufficiently above APRA's regulatory requirements, banks pay out dividends in line with their historical norms. The profits that are not used for dividend payments (along with additional borrowing by the bank) fund new assets. The capital ratio measures the amount of capital that a bank has relative to its total risk-weighted assets (RWAs). The amount of profits not paid out in dividends results in an increase in bank capital, while the amount spent on new assets increases total assets, which determine total RWAs.

The credit losses for each bank are calculated by mapping the macroeconomic scenario to the rate of loan defaults – often referred to as the 'probability of default' (PD) – and to the losses that occur when a borrower defaults – known as the 'loss-given-default' (LGD).[2] PDs and LGDs are calculated for the different

types of loans that banks have on their balance sheets. For example: multiplying the PD and LGD for a portfolio of housing loans and then multiplying the result by the dollar value of housing loans outstanding gives the dollar value of expected credit losses on housing loans.

The two most important types of loans for bank credit losses are housing and business loans, which together comprise around 80 per cent of bank loans and around 50 per cent of banks' total assets. In the model, mortgage PDs are determined by two variables: the unemployment rate; and the loan-to-valuation ratio (LVR) of the mortgage. This is consistent with a large body of economic literature both in Australia and overseas that suggests an increase in the unemployment rate and higher LVR loans are key drivers of housing defaults.[3] LGDs for housing loans are driven by changes in housing prices in a given scenario (as the property is used as collateral for the loan) and the current LVR of the mortgage. For business loans, changes in GDP growth affect the profitability of businesses and their ability to cover debt payments. If a firm's ability to cover debt payments falls to a sufficiently low level, it is assumed to default. Similar to housing loans, changes in property prices affect the LGDs of business loans by changing the values of collateral that secure these loans. Interest rates do not have a direct impact on credit losses in the model, rather the effect is indirect. This is so the model can focus on the effects of the macroeconomic environment on bank balance sheets outside of the effects of monetary easing that are likely to occur during economic downturns.

Figure D.1: Stress Testing Model Dynamics



During the COVID-19 pandemic, stress testing was used to assess bank resilience in a highly uncertain environment

At the onset of the COVID-19 pandemic there was an unusually high degree of uncertainty about the economic outlook and the resilience of banks in Australia. The Reserve Bank used stress testing to assess possible implications for the banking system of the pandemic and associated restrictions.

The Reserve Bank simulated a variety of macroeconomic scenarios – including those based on the downside scenarios published in the *Statement on Monetary Policy* – to assess implications for bank capital ratios and banks' ability to continue extending credit to the economy.[4] This analysis helped to inform the Reserve Bank's understanding of whether banks were appropriately capitalised to withstand the effects of the health crisis or whether additional capital raising was needed. These results also provided a useful complement to stress testing undertaken by APRA, allowing for coordinated analysis across the agencies on the Council of Financial Regulators.

An important feature of the stress testing modelling approach was its ability to perform sensitivity analysis on the banking system. For example, stress testing helped the Reserve Bank to explore:

- how credit losses could evolve with worse economic conditions
- how expected credit losses and the depletion of bank capital differed depending on whether a recession was short and sharp or prolonged
- whether capital levels were sufficient to support continued lending growth or could act to amplify the shock.

Such analyses were important for understanding non-linearities in the banking system, where credit losses increase at a faster rate as the economy deteriorates further. The model was also applied to smaller banks (that were not formally part of the model) to examine their potential losses by using estimates of credit loss rates.

Another way the stress testing model was used during the pandemic was to assess how severe economic conditions needed to be for bank capital ratios to breach key thresholds. These 'reverse stress tests' can be especially useful in situations of heightened uncertainty. For example, in reverse stress tests presented in the October 2020 *Financial Stability Review*, it was found that economic conditions would need to be materially worse than the Bank's downside forecasts at the time – and not dissimilar to the Great Depression – for a major bank to breach a Common Equity Tier 1 (CET1) capital ratio threshold of 6 per cent.

Banks are resilient to materially higher interest rates and inflation

In response to high inflation, the Reserve Bank has increased the cash rate target by a total of 250 basis points since May 2022, and market pricing implies the cash rate is expected to increase further.

Higher inflation and higher interest rates could lead to larger credit losses despite continued, albeit slower, economic growth. The stress testing model can provide insights into the magnitude of potential credit losses and how important they could be for the capital positions of large and mid-sized banks. The model applies two principal stresses to examine the resilience of the banking system to higher inflation and interest rates:

1. Higher inflation and higher interest rates on mortgages squeeze households' real incomes, making it more difficult to service debt, which could lead to more defaults and larger credit losses for banks. Similarly, higher input costs and higher interest rates passed onto business loans can make it more difficult for businesses to service their debts, potentially leading to higher default rates (see 'Chapter 2: Household and Business Finances in Australia').
2. Higher interest rates typically reduce the prices of housing and commercial property that are held as collateral by banks against their loans, which increases LGDs as well as PDs on loans.

Based on these avenues for stress, two scenarios are used to analyse the potential impact of higher interest rates on bank capital:

- *Baseline scenario* – the cash rate increases broadly in line with current market pricing, peaking at around 3.5 per cent. GDP growth slows as higher interest rates weigh on spending, and the unemployment rate is assumed to increase slightly but remain low by historical standards.[5] Property prices – both housing and commercial – are assumed to fall by 10 per cent from peak to trough.
- *Severe scenario* – market-based interest rates increase by an additional 300 basis points than in the baseline scenario. This scenario assumes the economy deteriorates substantially: the level of GDP falls by 4 per cent and the unemployment rate increases to around 11 per cent over about three years. Property prices fall by 30 per cent, reflecting the larger increase in interest rates and the more severe decline in economic activity. Bank's net interest margins (NIMs) are assumed to narrow by 50 basis points, reflecting an additional increase in the cost of funds for banks that is not passed on to borrowers.

The severe economic scenario does not allow for an offsetting policy response by the Reserve Bank. This assumption helps to assess whether banks are able to withstand severe shocks without policy support and also compensates for aspects of bank balance sheets that are not captured in the model (particularly the non-credit side of balance sheets).

Since inflation and interest rates do not directly feed into the stress testing model, credit losses on housing loans are estimated using the impact on borrowers' incomes and interest payments from higher inflation and interest rates, based on data from the Reserve Bank's Securitisation Dataset. This dataset provides loan-level characteristics of housing loans, such as incomes of borrowers and the value of the underlying collateral behind these loans at origination. Defaults on housing loans are estimated by adjusting loan repayments with the assumed path of interest rates, adjusting incomes at origination with past and forecast wages growth, and adjusting household expenses to grow in line with forecast inflation. Adjusting the level of collateral at origination by past movements in housing prices and then the assumed fall in housing prices provides estimates of housing losses for those borrowers that default. Losses on business loans are assumed to be proportional to losses on housing loans. This proportion is determined by the average relative profile of housing and business non-performing loans since 2004 and scaled by the size of a bank's business exposures.[6]

In the baseline scenario, the expected *direct* credit losses on housing loans from the effects of higher interest rates and inflation are around $9 billion. These losses are equivalent to around 4 per cent of the around $240 billion in CET1 capital currently on bank balance sheets, and occur before taking into account profits generated by banks over the period. The model's decision rules dictate that banks would raise provisions in anticipation of future expected losses on housing loans. If the effects from slower economic growth and losses that accrue directly from higher interest rates and inflation are aggregated, the combined credit losses and provisions on housing loans lead to a reduction in the aggregate capital ratio of around 50 basis points. The equivalent impact on business loans leads to a further decline in the capital ratio of around 40 basis points. However, the total impact on the CET1 ratio is smaller at around 85 basis points. The total impact includes offsetting increases in the CET1 ratio from the profits that banks continue to generate from their portfolio of loans throughout the scenario (Graph D.1).[7] Overall, in the baseline scenario, the aggregate bank CET1 capital ratio remains well above minimum requirements.

The severe scenario has an additional increase in interest rates of 300 basis points from the baseline scenario. The expected direct credit losses attributable to higher interest rates and inflation on housing loans in this scenario is around $24 billion. These direct losses amount to around 10 per cent of banks' CET1 capital. However, this is before taking into account additional losses from the deterioration in the economic environment. In this case, total losses and associated provisions on housing and business loans reduce the aggregate CET1 ratio by 270 basis points. The overall reduction in the aggregate CET1 ratio is 345 basis points, reflecting credit losses from housing and business loans as well as other credit portfolios and from an increase in risk weights. In this scenario, despite the significant decline, bank capital levels remain well above regulatory minimums, although some banks do breach their regulatory buffers.[8]

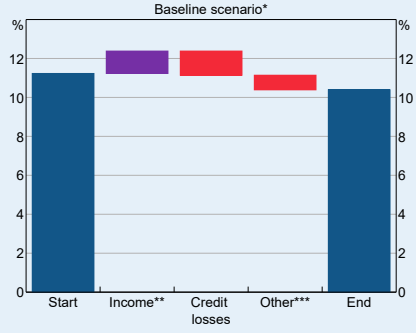
In both scenarios, banks are resilient to estimated additional credit losses that occur from the effects of higher inflation and interest rates. The losses on housing and business loans contribute to declines in bank capital ratios, but the high initial levels of capital and continued income generated on banks' loan portfolios mean that aggregate capital levels still remain well above minimum requirements (Graph D.2).

These stress testing results are subject to considerable uncertainty. This is especially true in the severe scenario where such a sharp increase in interest rates has not recently been experienced in Australia. In

Graph D.1

Banks' CET1 Capital Ratios

Baseline scenario*



* GDP growth and unemployment rate follow consensus forecasts, the cash rate follows a path broadly in line with market expectations, and property prices fall 10 per cent.

** Retained earnings before credit losses.

*** Includes contributions from changes in balance sheet size and risk weights.

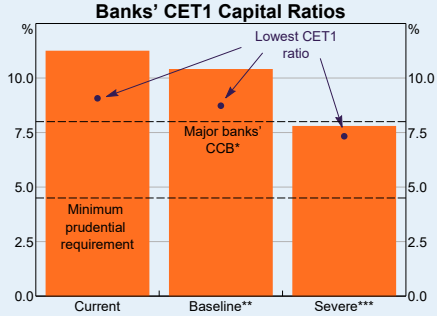
Sources: APRA; RBA

addition, there could be important non-linearities and feedback mechanisms that are not captured in these scenarios, such as a case where credit losses result in banks pulling back on their lending, which leads to a further deterioration in the economic environment and further increases in credit losses. The nature of the shock will also have a bearing on bank resilience. For instance, banks are assumed to have continued access to funding markets – the price of these funds increase but market functioning remains orderly.

The above analysis focuses on credit risks because this is likely to be the most important variable for bank resilience in Australia. However, there are some other variables that could reduce capital ratios. For example, higher interest rates could lead to some losses on banks' trading and banking books. Indeed, the major banks have already experienced declines in their CET1 ratios from higher RWAs related to increases in interest rate risk on the banking book.[9] Conversely, the scenarios do not account for some possible benefits accruing to banks from higher interest rates. For example, market analysts expect rising interest rates to result in wider NIMs for banks (see 'Chapter 3: The Australian Financial System'). While it is possible that NIMs widen in response to higher interest rates, it does not necessarily follow that higher interest rates will lead to an increase in bank profitability because it depends on the pace of loan growth, the extent of competition in funding and lending markets, and asset quality.

Graph D.2

Banks' CET1 Capital Ratios



* Includes the typical 2.5 per cent capital conservation buffer (CCB) and the additional 1 per cent D-SIB buffer.

** GDP growth and the unemployment rate follow consensus forecasts, the cash rate follows a path broadly in line with the market expectations, and property prices fall 10 per cent.

*** GDP falls 4 per cent, unemployment rises to 11 per cent, property prices fall 30 per cent, and interest rates rise an additional 300 basis points with an additional 50 basis points reductions in NIMs.

Sources: APRA; RBA

Endnotes

[1] For more details, see Garvin N, S Kurian, M Major and D Norman (2022), 'Macrofinancial Stress Testing on Australian Banks', RBA Research Discussion Paper No 2022-03.

[2] Losses that occur when there is a default on a loan are not usually equal to the total value of the loan because banks often have collateral, such as housing, that can be sold in the event of a default with the sale proceeds mitigating the loss.

[3] For Australian studies on mortgage defaults, see Read M, C Stewart and G La Cava (2014), 'Mortgage-related Financial Difficulties: Evidence from Australian Micro-level Data', RBA Research Discussion Paper No 2014-13; Bergmann M (2020), 'The Determinants of Mortgage Defaults in Australia – Evidence for the Double-trigger Hypothesis', RBA Research Discussion Paper No 2020-03. For international evidence, see Anastasiou D, H Louri and M Tsionas (2016), 'Determinants of Non-performing Loans: Evidence from Euro Area Countries', *Finance Research Letters*, 18, pp 116–119.

[4] See RBA (2020), 'The Australian Financial System', *Financial Stability Review*, October; RBA (2021), 'The Australian Financial System', *Financial Stability Review*, October.

[5] The scenario uses forecasts from Bloomberg's survey of economists.

[6] The overall effects on business credit losses from higher inflation and interest rates are difficult to estimate due to assumptions around interest rate pass-through and the uneven effects of inflation on business profitability. For this reason, losses are assumed to rise proportionally with the increase in housing credit losses.

[7] Balance sheet growth as well as growth in average risk weights also contribute to the decline in the capital ratio.

[8] Major banks hold a capital conservation buffer (CCB) of 3.5 per cent, which includes the typical CCB buffer of 2.5 per cent and an additional 1 per cent domestic systemically important bank (D-SIB) buffer.

[9] In Australia's case, losses on the trading and banking books are likely to be modest given the underlying exposures and nature of hedging arrangements. For a 200 basis point increase in interest rates, losses on banking and trading books are estimated to lead to a 28 basis point reduction in the CET1 capital ratio for the major banks. See RBA (2022), 'The Australian Financial System', *Financial Stability Review,* April.