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# Outcomes from the 2017 stress test of major banks

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The Reserve Bank uses stress tests to assess the soundness of the financial system. This article summarises results from a recent exercise involving the four largest New Zealand banks. The test modelled a severe macroeconomic downturn scenario and an operational risk event related to mortgage lending misconduct.

Consistent with previous tests, results suggest that strong underlying profitability from repricing actions to maintain their net interest margins would allow these banks as a group to absorb significant losses through the stress scenario without breaching their minimum capital requirements. While the test demonstrates these banks' resilience, there remains uncertainty as to how such scenarios would unfold in reality.

## 1 Introduction

Stress testing is an important part of the Reserve Bank's prudential framework. By exploring severe but plausible hypothetical scenarios, stress tests help the Reserve Bank to improve its understanding of financial system risks, and to assess the adequacy of the prudential requirements designed to mitigate these risks. Stress tests also play an increasingly prominent role in financial institutions' strategic and risk appetite decision-making.

As reported in the November 2017 *Financial Stability Report*, the Reserve Bank recently conducted a regulator-led stress test of the four largest New Zealand banks.<sup>2</sup> This article discusses in greater detail the methodology and outcomes of the 2017 exercise, which covered two scenarios: a severe macroeconomic downturn event and an operational risk event related to mortgage lending misconduct. This article will provide a model for more detailed reporting of future Reserve Bank stress tests. An accompanying *Bulletin* article provides an overview of the Reserve Bank's philosophy and approach to stress testing banks,

<sup>1</sup> The author would like to thank Ashley Dunstan, Lewis Kerr, David Hargreaves, and Bernard Hodgetts for their assistance and comments on the paper.

<sup>2</sup> ANZ Bank New Zealand, ASB Bank, Bank of New Zealand, and Westpac New Zealand.

a discussion of some limitations of stress tests, and how the Reserve Bank interprets test results when assessing the stability of the financial system.<sup>3</sup>

The article begins by outlining the methodology and scenarios covered by the 2017 exercise (section 2). After presenting the headline outcomes for banks' capital and profitability (section 3), the three key drivers of the results are examined: credit risk and loan losses, underlying earnings, and operational risk losses from the misconduct event (sections 4 to 6). Section 7 concludes.

## 2 Scenarios and methodology

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Similar to an exercise in 2014, in 2017 the Australian Prudential Regulation Authority (APRA) and the Reserve Bank coordinated a regulator-led stress test of the banking industry in both countries. APRA was responsible for the overall design and organisation of the test, while the Reserve Bank was in charge of calibrating the scenario for the participating New Zealand banks, assessing their submissions, and providing feedback to APRA on the test's design. The results from the New Zealand banks fed into the consolidated results of their respective Australian parent banks. The test was based on data and regulatory requirements as of March 2017, and ran for the five years to March 2022.

Two scenarios were assessed. In the first, a downturn in the Chinese economy spreads through trade channels to other emerging markets, with flow-on effects to other parts of the global economy, including

Europe and Japan. A collapse in demand for commodity exports and negative investor sentiment towards the Australian and New Zealand economies triggers domestic recessions and the temporary closure of offshore funding markets for banks. New Zealand's unemployment rate quickly rises, house prices fall 35 percent, and the Fonterra dairy payout remains below \$5/kgMS for three years. The scenario assumes that macroeconomic conditions begin to improve by the fourth year, though property prices do not recover. Banks receive a two notch credit rating downgrade, and face elevated funding costs in both wholesale and retail deposit markets.<sup>4</sup>

This macroeconomic scenario is similar in severity to stress tests undertaken by the Federal Reserve, and more severe than recent tests of European banks (table 1). The scenario is less extreme in most dimensions than experiences in other small, developed countries that have had financial crises in recent decades, though is significantly more severe than the downturn experienced in New Zealand after 2007.

In the second scenario, the macroeconomic conditions described above were overlaid with an operational risk scenario, exploring the implications of an industry-wide misconduct event related to residential mortgages.<sup>5</sup> Operational risk has become more prominent in overseas regulators' stress tests, and is an area not previously explored in detail in Reserve Bank tests. The inclusion of an operational risk event partly offsets the slightly less severe macroeconomic scenario in the 2017 test, when compared to the Reserve Bank's 2014 stress test. Section 6 discusses the operational risk event in more detail.

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3 Dunstan (2018).

4 The full time series of the variables provided for the 2017 macroeconomic scenario are in the online data appendix.

5 Operational risk refers to the risk of loss arising from inadequate or failed internal processes, people and systems, or from external events.

**Table 1**  
**Key macroeconomic variables in recent regulator-led stress tests and historical episodes**

	Unemployment		Real GDP	Residential property price index (nominal)	Commercial property price index (nominal)
	Peak level (%)	Change (ppt.)	Peak to trough decline (%)		
<b>Stress tests</b>					
<b>RBNZ (2017)</b>	<b>11</b>	<b>+6.1</b>	<b>-3.6</b>	<b>-35</b>	<b>-39</b>
RBNZ (2014 Scenario A)	13.2	+7.6	-5.5	-40	-35
IMF (2016 FSAP stress test of New Zealand)	10.2	+4.9	-3.4	-35	-30
Bank of England (2017 Annual Cyclical Scenario)	9.5	+4.7	-4.7	-33	-40
European Banking Authority (2018)	9.7	+1.0	-3.4	-19	-20
Federal Reserve (2018 Severely Adverse)	10	+5.9	-7.3	-30	-40
<b>Historical episodes</b>					
Finland 1990 – 1995	16.7	+13.5	-9.7	-37	n.a.
Ireland 2007 – 2012	14.7	+10.0	-8.4	-55	-70
Sweden 1990 – 1995	11.2	+8.9	-3.9	-20	-53
New Zealand 1987 – 1992	11.2	+7.1	-2.2	-3	-60
New Zealand 2007 – 2011	6.7	+3.4	-2.6	-10	-28

Source: Reserve Bank of New Zealand, Bank of England (2017a), European Systemic Risk Board (2018), Board of Governors of the Federal Reserve System (2018), International Monetary Fund (2017a, 2017b), Woods & O'Connell (2012).

While the four participating banks are required to periodically undertake internally run stress tests, in a regulator-led test the Reserve Bank takes a prescriptive approach to the scenario and assumptions banks are allowed to use, and has greater oversight of the generation of test results. One area of focus is on defining the treatment of mitigating actions, which are actions that a bank's management could take to mitigate the impact of the scenario on the bank's financial position. Typical mitigating actions include operating expense reductions, tightening of origination standards, reductions in the size of credit portfolios, and increases in interest margins. In regulator-led tests, banks report their results before and after mitigating actions, with the Reserve Bank imposing common constraints on banks' results before mitigating actions (table 2).

The 2017 test also imposed a number of conservative assumptions that placed further pressure on banks' capital positions, including:

- A requirement to pay out dividends for the first six months of the scenario at the same rate they had planned to do so in the absence of the stress, on the premise that bank directors may not have sufficient foresight of impending losses.
- Banks assumed the default of a large overseas counterparty, excluding their parent, following adverse movements in foreign exchange, interest rate, and credit default swap markets designed to create large open positions on their hedging arrangements.

**Table 2**  
**Instructions for treatment of mitigating actions in the 2017 stress test**

Results before mitigating actions	Examples of what must be reported as a mitigating action
<ul style="list-style-type: none"> <li>• May include reductions in expenses already in a bank's business plan that are still seen as achievable in the stress scenario</li> <li>• Banks must grow their credit portfolios in line with the scenario parameters</li> <li>• Reasonable repricing of interest rates is allowed to offset increased funding costs</li> <li>• No change to underwriting standards</li> <li>• Non-performing loans are written off after one year*</li> </ul>	<ul style="list-style-type: none"> <li>• Not proceeding with a planned expense (e.g. a planned upgrade to an IT system)</li> <li>• Issuance of new capital</li> <li>• Asset/portfolio sales and/or lower credit growth than the scenario parameters</li> <li>• Significant repricing beyond the likely competitive market reaction to higher system funding costs</li> <li>• Changes in origination standards to reduce the average risk profile of new credit</li> <li>• Changes in the approach to defaulted assets to improve loan recoveries</li> </ul>

\* This assumption improves the tractability of the modelling and comparisons across banks. The loss of interest income a bank would face if non-performing loans were instead kept on the bank's balance sheet is accounted for through increasing the loss rate applied to defaulted exposures.

These shocks also lead to trading risk losses. The default of the large counterparty occurs immediately after the adverse movements and banks assume they do not receive any additional collateral from the overseas bank to offset the positions created. This aspect of the test aimed to explore banks' exposure to concentration risk.

- Banks were required to grow their lending portfolios through the stress scenario in line with provided parameters. Since banks need additional capital to support this growth, this assumption placed additional stress on banks' financial position towards the later years of the test.

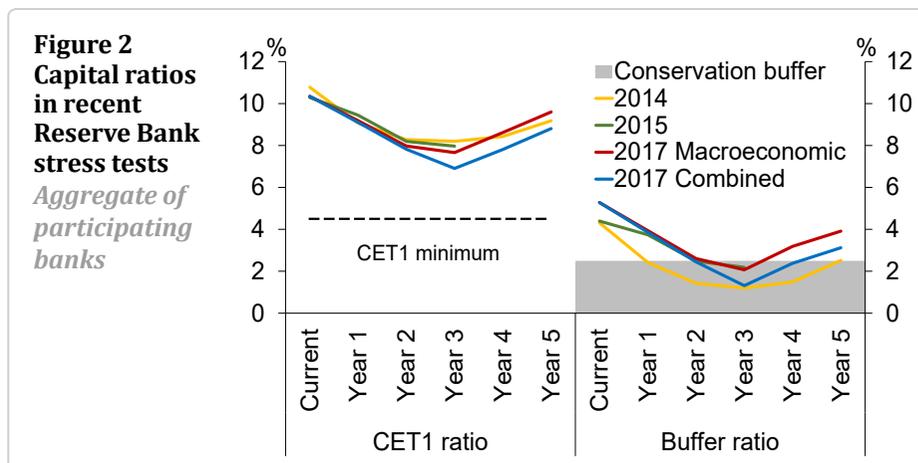
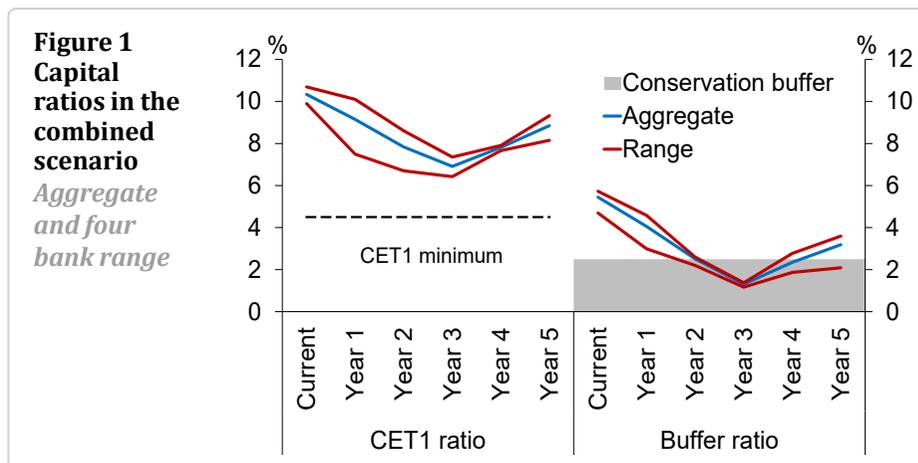
diverse views, and informing the phase 2 calibration. For phase 2 the Reserve Bank introduces a range of common inputs across banks, such as loan default and loss rates for different portfolios. This helps to reduce methodologically driven variation in the results, with the aim of enabling better benchmarking of the resilience of individual banks. The use of common estimates across banks will, however, tend to mask some sources of genuine variation in the phase 1 outcomes. This article primarily focuses on the phase 2 outcomes.

A key feature of Reserve Bank-led stress tests is that they are run over two phases. In phase 1 banks use their own risk models to project the impact of the stress scenario on their financial position. Results from phase 1 will reflect a combination of the underlying risk profile of the bank and the methodology the bank used to model the scenario. Phase 1 plays an important role in benchmarking industry capability, encouraging

### 3 Headline outcomes

The four participating banks started the stress test with an aggregate Common Equity Tier 1 (CET1) capital ratio of 10.3 percent,<sup>6</sup> and an aggregate buffer ratio of 5.4 percent.<sup>7</sup> After phase 2, key outcomes in the combined scenario (macroeconomic downturn and operational risk event) were:

- The aggregate CET1 ratio declined by 3.4 percentage points, to a low of 6.9 percent in the third year (figure 1). Individual banks' CET1 ratios declined to between 6.4 to 7.4 percent.
- Buffer ratios fell to between 1.2 and 1.4 percent at their low points, placing banks into the middle of the capital conservation buffer. Most banks moved out of the conservation buffer by the fifth year due to accumulated earnings.
- The aggregate CET1 ratio fell to a lower point than in the 2014 stress test (figure 2). The outcome for the buffer ratio was comparable to the 2014 test, reflecting that the starting point has increased in recent years.
- Cumulative pre-tax profit over the five years declined from \$36bn in a baseline projection, which assumes no stresses occur, to



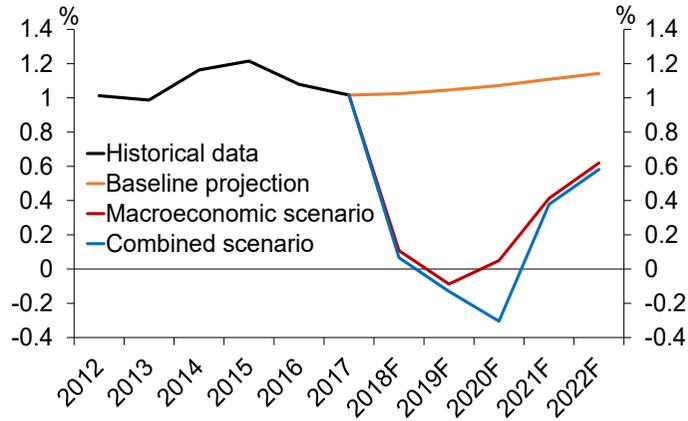
\$4bn in the stress scenario. The aggregate return on assets turned negative in years two and three, before recovering as credit losses abated (figure 3).

- On average, banks' buffer ratios declined to similar points in both phases of the test, though there was significant variation in outcomes in the first phase (figure 4). The spread of buffer ratios reduced significantly in phase 2 as a result of the standardisations

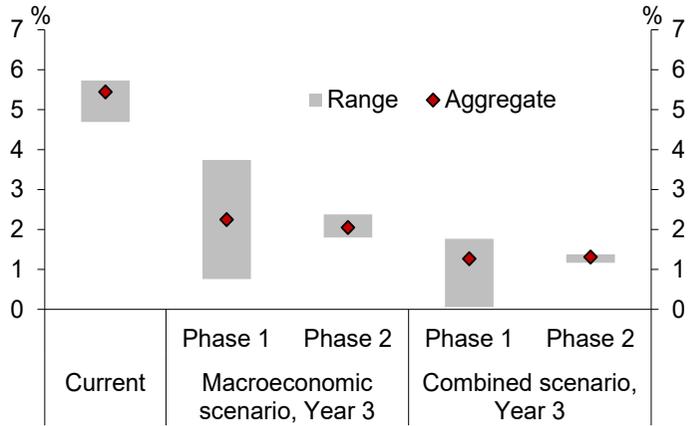
<sup>6</sup> Aggregate ratios are calculated as the summation of the four participating banks' capital and risk-weighted assets.

<sup>7</sup> The buffer ratio represents the excess CET1 capital a bank has above its minimum capital requirements, expressed as a percentage of risk-weighted assets. A bank with a buffer ratio below 2.5 percent (the "capital conservation buffer") faces restrictions on earnings distributions such as dividends and share repurchases, and must prepare a capital restoration plan approved by the Reserve Bank. A bank with a buffer ratio below 0 percent would be in breach of one of its minimum capital requirements, and hence its conditions of registration.

**Figure 3**  
Return on assets  
*Aggregate net profit after tax / total assets*



**Figure 4**  
Buffer ratios, current and year three of the 2017 test  
*Aggregate and four bank range*

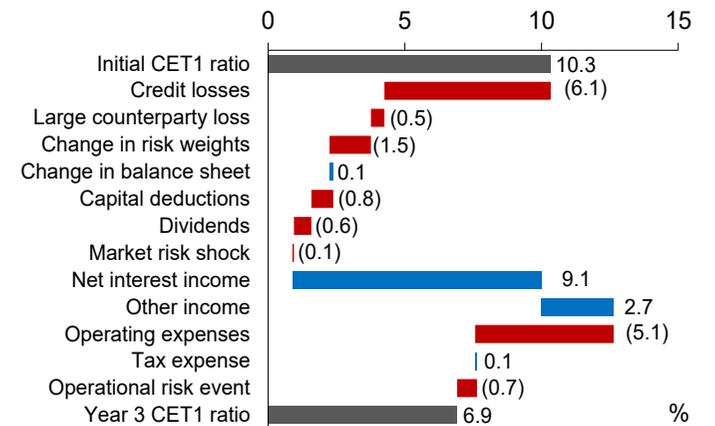


applied. The box on page 10 discusses the standardisation process in more detail.

Figure 5 decomposes the change in the aggregate CET1 ratio over the first three years of the test:

- Credit losses, including the large counterparty loss (6.6 percentage points), growth in risk-weighted assets (1.4), and dividends and

**Figure 5**  
Contributions to aggregate CET1 ratio in the combined scenario, from the starting point to year 3



other capital deductions (1.4) drove the decline in the aggregate CET1 ratio in the first three years of the macroeconomic scenario. Underlying profits offset the decline by 6.7 percentage points, largely due to banks' net interest income on performing loans. The relative contribution of these key drivers to the change in the CET1 ratio has been stable in recent Reserve Bank stress tests.

- The operational risk event saw the CET1 ratio fall a further 0.7 percentage points by year three in the combined scenario, to 6.9 percent. Redress payments for misconduct contributed two thirds of the impact, with the balance accounted for by higher funding costs and other expenses related to the event.

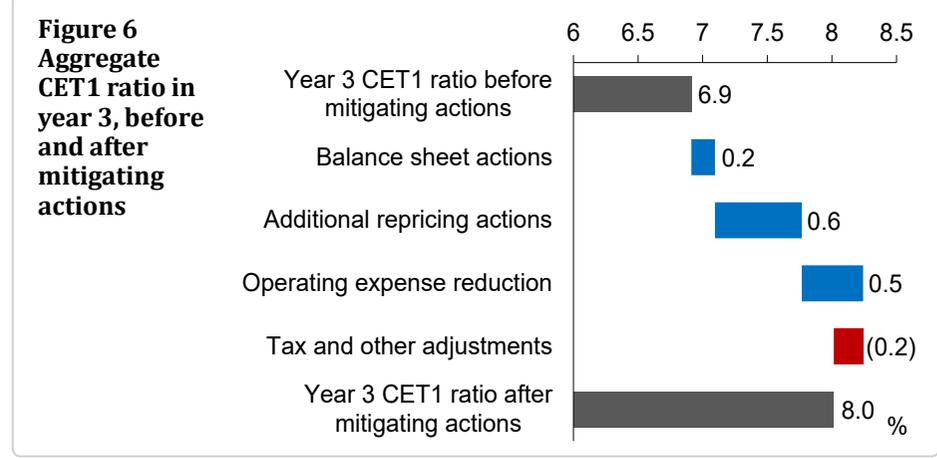
Overall, these outcomes suggest that, as a group, the large New Zealand banks could absorb material losses in a downturn event while remaining solvent. The test shows that the strong underlying profitability that the banks are presumed to maintain through the scenario acts as a significant buffer, offsetting their credit losses and allowing them to generate sufficient capital to stay above their minimum requirements in each year of the test. There are, however, uncertainties around

the impact of a severe stress event, as demonstrated by the range of outcomes banks submitted in phase 1 (figure 4). For example, underlying profits may not provide as much of a buffer if there is a more rapid recognition of credit losses earlier in the scenario. Dunstan (2018) discusses additional risks not modelled in this test, which could result in more adverse outcomes for both individual banks and the banking system.

### *Mitigating actions*

In response to the scenario, banks reported they would undertake mitigating actions that improved the aggregate CET1 ratio by 1.1 percentage points by year three to 8 percent, including reductions in lending, additional interest rate repricing, and operating expense reductions (figure 6). Allowing for these mitigating actions, only two banks reported that they would fall into the capital conservation buffer, for a one-year period.

When assessing the implications of stress test results for financial system resilience, the Reserve Bank primarily focuses on results before mitigating actions, given the additional uncertainty and complexity involved in judging how achievable some mitigating actions would be. Additionally, certain mitigating actions such as a significant tightening of lending standards, may appear to improve the solvency position of individual institutions. However, these actions can generate negative feedback effects on asset prices and economic activity, undermining the health of the rest of the financial system. As such, it is uncertain to what extent banks could collectively rely on these actions in a real downturn.



## 4 Credit risk and loan losses

### *Credit losses*

Banks reported that around 14 percent of their total credit exposure would default over the five years of the test. Total loan impairment expenses were \$21 billion, which equates to a cumulative loss rate of 4.3 percent of their total credit exposure. Credit losses were broadly spread across banks' portfolios, with residential mortgage lending (\$5.1 billion, 24 percent of total losses), farm lending (\$4.4 billion, 21 percent) and general corporate lending (\$4.4 billion, 20 percent) the three main sources of losses, reflecting these categories' large share of banks' total exposures. Though they represent a low share of banks' total lending, the higher risk nature of commercial property lending, and credit cards and other consumer lending, meant these categories each accounted for 11 percent of losses (table 3, figure 9).

## Box

### Standardisation between phases of the test

This box discusses the objectives and outcomes of the Reserve Bank's standardisation of key parameters between phases 1 and 2 of its regulator-led stress tests.

The stress testing models banks use in phase 1 will typically estimate a portfolio's credit losses as a function of the scenario's macroeconomic parameters. For example, a residential mortgage model might estimate how many borrowers would default given the path of unemployment and interest rates in the scenario, using information the bank has on the debt servicing buffers of its borrowers. For those mortgage borrowers projected to default, banks might estimate the losses they would face by assessing how the decline in house prices in the scenario would deplete the equity that those borrowers had in their property.

Beyond these conceptual similarities, the detail of banks' models may vary significantly. For example, there will be differences in the weights placed on internal and external credit loss data, and between the use of statistical methods and the expert judgement of experienced credit managers. Banks will also take different views about how severely a scenario will feed through to other key drivers of their financial performance, such as the impact of the scenario on their funding costs and interest margins. As a result, differences in the phase 1 outcomes will reflect both genuine differences in banks' risk profiles as well as differences in their modelling methodologies and assumptions.

To improve the comparability of results across banks, the Reserve Bank conducts a second phase, issuing a revised set of instructions and templates with additional standardisations. The submissions from phase

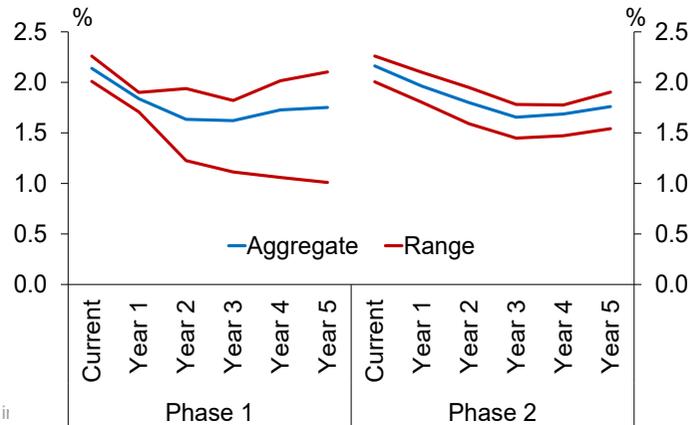
1 are one input to the standardised risk estimates, as are data from historical crisis episodes, internally developed models, and benchmarks from previous Reserve Bank and other regulators' stress tests. For example, the Reserve Bank typically determines an appropriate aggregate credit loss rate in a given sector taking these sources of information into account. In this context, the standardisations in phase 2 should be seen as leading to a central estimate of the plausible outcomes of a given scenario, with the understanding that there are upside and downside risks to how the scenario would unfold in reality.

The two main areas of standardisation in the 2017 test were the use of common credit risk estimates (default and loss rates for portfolios, and movements in credit grades), and the interest rates for common lending and deposit products. With some simplifying assumptions, the standardisation process sought to preserve observable differences in the underlying risk profile of participating banks. For example, the standardised loss rates for residential mortgages made allowances for the LVR, payment type (interest only or amortising) and buyer type (investor or owner-occupier) profiles of banks' portfolios. For corporate portfolios, phase 2 prescribed how the credit gradings of banks' borrowers would change through the stress scenario, including the transition into default.

Figures 7 and 8 demonstrate the impact of these standardisations on net interest margin and CET1 ratio outcomes in 2017. Banks' assumptions on the extent to which higher funding costs would be able to be passed on to borrowers were a key source of variation in the phase 1 outcomes, with the dispersion of the results in the left panel of figure 7 demonstrating the uncertainties inherent in stress testing exercises. The impact of this variability in net interest margins on underlying profitability contributed to the dispersion in CET1 ratios shown in figure 8. In phase 2 the Reserve Bank provided specific loan and deposit rates that assumed

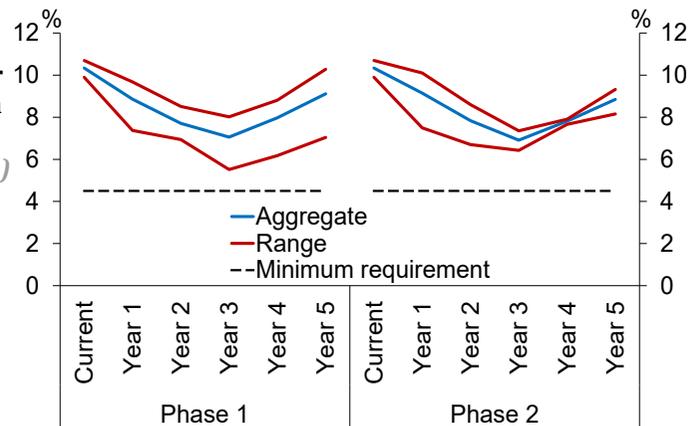
banks would pass on around half of their increased funding costs to borrowers over the first two years of the test. This resulted in a narrower range of net interest margins, with the remaining differences in margins largely due to differing maturity profiles and funding compositions.

**Figure 7**  
Net interest margin, before mitigating actions  
(Aggregate and four bank range)

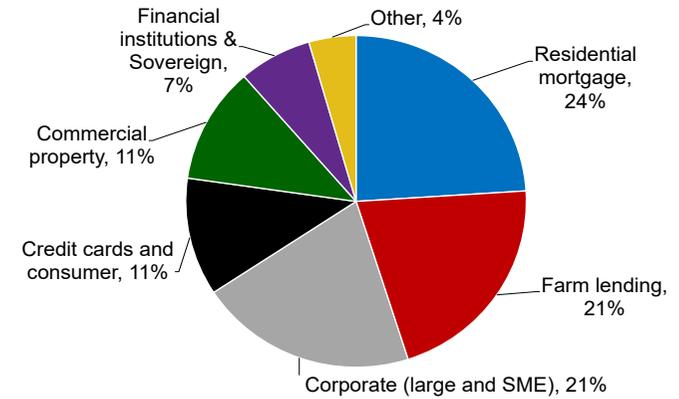


Net interest margin = net i

**Figure 8**  
CET1 ratio before and after standardisation  
(Aggregate and four bank range)



**Figure 9**  
Credit losses by category  
(share of total)



The total loss rate of 4.3 percent was lower than the 5 percent reported in the Reserve Bank's 2014 stress test, which is consistent with the slightly less severe macroeconomic scenario in the 2017 test. Within portfolios there were some material changes to loss rates:

- The loss rate on residential mortgages fell from 2.9 to 2.2 percent, reflecting a decline in the average loan-to-valuation ratio (LVR) of outstanding mortgages due to the Reserve Bank's LVR policy. Lower LVRs reduce the average loss a bank faces on a defaulting mortgage. Investment and owner-occupier mortgages had a similar overall loss rate, as a higher default rate on investment mortgages was offset by a lower average loss-given-default. This is because defaulting investment mortgages had lower average LVRs than defaulting owner-occupier mortgages.
- Losses on farm lending rose from the 2014 test, from 6 to 8.7 percent. The 2017 test saw many borrowers starting from relatively vulnerable financial positions due to the stresses experienced

**Table 3**  
**Aggregate default and loss rates by portfolio, after Phase 2**

Portfolio	Exposure (\$b, 2017)*	Cumulative default rate (%)**		Cumulative loss rate (%)***	
		2014 test	2017 test	2014 test	2017 test
Residential mortgage	226.8	10.3	<b>12.0</b>	2.9	<b>2.2</b>
<i>Of which: investment</i>	<i>96.0</i>	-	<b>12.8</b>	-	<b>2.3</b>
<i>Of which: owner-occupier</i>	<i>130.7</i>	-	<b>11.5</b>	-	<b>2.2</b>
Corporate (large)	47.5	12.6	<b>7.6</b>	5.4	<b>4.2</b>
Corporate (SME)	30.9	24.9	<b>19.7</b>	7.8	<b>7.7</b>
Commercial property	32.0	30.6	<b>27.2</b>	7.8	<b>7.5</b>
Farm lending	51.1	17.1	<b>25.1</b>	6.0	<b>8.7</b>
Financial institutions & Sovereign	53.1	2.1	<b>4.8</b>	1.1	<b>2.8</b>
Credit cards	14	21.7	<b>14.0</b>	19.5	<b>11.4</b>
Other consumer	3.4	36.8	<b>27.1</b>	27.3	<b>23.8</b>
SME retail	10.7	31.8	<b>19.8</b>	9.9	<b>4.7</b>
Other	18.9	3.3	<b>6.7</b>	3.4	<b>2.3</b>
<b>Total</b>	<b>488.3</b>	<b>13.7</b>	<b>13.8</b>	<b>5.0</b>	<b>4.3</b>

\* Exposure refers to the total 'Exposure at Default', a regulatory concept which measures both the on balance sheet value of a bank's credit exposure plus an estimate of off balance sheet amounts that are likely to be drawn down prior to a default, such as the unutilised portion of a line of credit. For comparison, at the balance date the four participating banks reported total gross loans and advances of \$349 billion, and total accounting assets of \$424 billion.

\*\* The default rate is measured as the cumulative defaulted exposure over the five year scenario as a proportion of the corresponding exposure at the start of the scenario.

\*\*\* The loss rate is measured as the cumulative impairment expense over the five year scenario as a proportion of the corresponding exposure at the start of the scenario. Impairment expense includes specific and collective provisions, and credit losses directly written off.

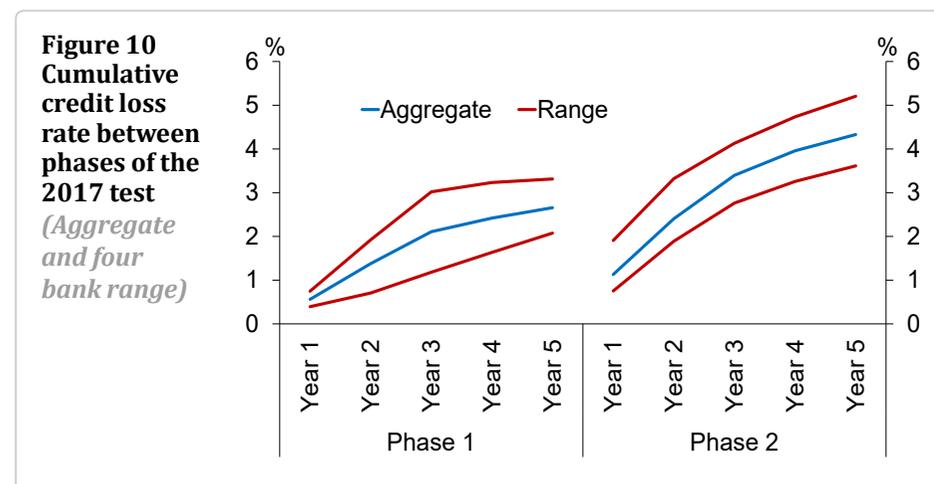
in the dairy sector in recent years. The scenario's sustained low Fonterra payout, averaging \$4.90, was below many farmers' break-even levels and saw the annual default rate peak at 12 percent in the second year. These outcomes were comparable with the severe scenario in the Reserve Bank's 2015 stress test of banks' dairy lending portfolios, discussed in Dunstan (2016).

- Losses on exposures to financial institutions and sovereigns also rose due to the prescribed default of a large overseas counterparty

in the 2017 test, which banks estimated would result in losses between \$100m and \$480m. The defaulted exposures were associated with transactions banks enter into to hedge foreign currency and interest rate risk, with the sharp fall in the New Zealand dollar significantly increasing the exposure at the point of the assumed default.

Compared to banks' estimates in phase 1 of the test, credit losses in phase 2 were both higher overall and more consistently allocated across

the different years of the test (figure 10).<sup>8</sup> This is because the Reserve Bank imposed more severe credit loss assumptions in the second phase, particularly for residential mortgages and farm lending. While the total default rate rose only marginally, the average loss on defaulted exposures increased from 21 percent to 32 percent. This reflected the Reserve Bank's more adverse view of how the scenario's property price declines would limit recoveries on defaulted mortgages and farm lending, compared to banks' phase 1 estimates.



Imposing a high loss on defaulted exposures helps to address the stress test's lack of explicit modelling of 'second round' interaction effects resulting from the actions of individual banks in a systemic crisis. In a real downturn scenario, banks may not collectively be able to work through a large volume of non-performing loans without further depressing asset prices, reducing loan recoveries. Alternatively, banks may face significant

<sup>8</sup> See the online data appendix for complete tables of default and loss rates between the two phases of the test.

haircuts if they instead dispose of non-performing loans through their sale to a third party.<sup>9</sup>

Reflecting similarities in their portfolio compositions, total credit loss rates in phase 2 ranged between 3.6 and 5.2 percent across the four banks. At a portfolio level, the loss rates were comparable with outcomes in recent Federal Reserve and Bank of England supervisory stress tests.<sup>10</sup>

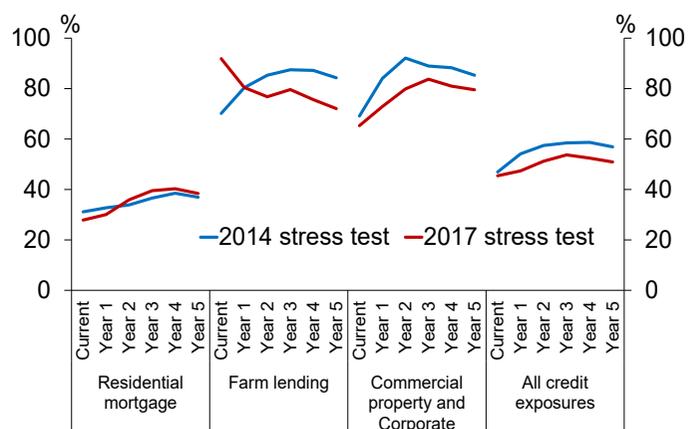
### *Risk-weighted assets*

Risk-weighted assets for credit risk grew 20 percent over first three years of the scenario, primarily driven by an increase in the average risk weight on banks' credit exposures from 45 percent to 54 percent. Rising risk weights reflected reductions in both the value of borrowers' collateral and the long-term viability of some borrowers. Farm lending exposures were an exception to this trend, as the stresses the dairy sector has faced over recent years meant banks' portfolios started with high average risk weights. Many of the highest-risk borrowers defaulted early in the scenario, meaning the average credit quality of the remaining borrowers improved over subsequent years. This led to a decline in the average farm lending risk weight (figure 11).

<sup>9</sup> Transfer to a 'bad bank' entity is a common method of dealing with large volumes of non-performing loans. This aims to improve the financial health of the remainder of the bank, allowing it to focus on its core business with less uncertainty, while the maximum value of the non-performing loans can be realised over time. In doing so, however, the bank faces an upfront loss reflecting the decline in the economic value of the loans being transferred.

<sup>10</sup> Compare the rightmost column of table 3 with table 7 in Board of Governors of the Federal Reserve System (2017) and table A5.A in Bank of England (2017b), though note slight differences in the definition of loss rate.

**Figure 11**  
**Aggregate**  
**average risk**  
**weights by**  
**portfolio**  
*(defaulted*  
*and non-*  
*defaulted*  
*exposures)*  
*2014 and 2017*  
*stress tests*



## Sensitivity analysis

In phase 1, the Reserve Bank required the participating banks to undertake sensitivity analyses of their mortgage loss rates under three adverse variations to the macroeconomic scenario: a rise in mortgage interest rates (+400 basis points increase), further falls in house prices (-10 percentage points) and a higher level of unemployment (+2 percentage points). The aim of including sensitivity analysis was to better understand banks' modelling methodologies and to assess the effect that small changes in scenario parameters could have on the overall results.

Compared to the main scenario, banks projected that mortgage loss rates would increase by a median of 0.7, 0.8, and 0.1 percentage points in the interest rate, house price and unemployment sensitivity analyses respectively. While the results provided useful insights into how these variables contributed to credit losses, banks acknowledged that the exercise highlighted some limitations of current stress test models, with modelling in some cases showing very low sensitivity to one or more of these key drivers. The Reserve Bank is encouraging banks to continue

to improve their capability to undertake sensitivity analysis in future tests, and to highlight the sensitivities around stress test results when using them in strategic decision-making.

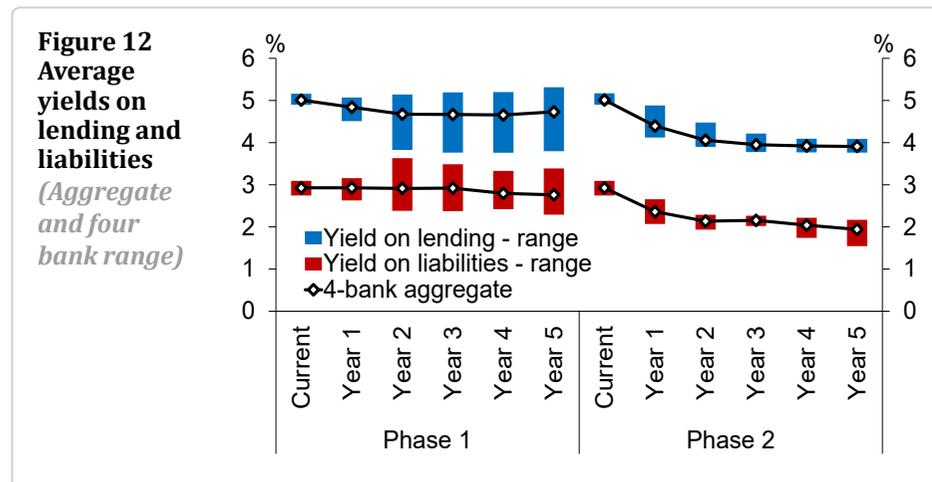
## 5 Funding and underlying profitability

Recent stress tests have shown that strong underlying earnings are an important buffer for the large New Zealand banks. The combination of low cost-to-income ratios, generally short repricing profiles, and resulting stable net interest margins, suggests that these banks would be able to internally generate capital in the form of retained earnings to offset significant credit losses in a stress scenario.

To test the resilience of this buffer, the 2017 test imposed funding stresses on banks with limited scope to pass those rising costs on to customers. Specifically, the scenario prescribed the closure of offshore funding markets for a six-month period, a sustained uplift in wholesale credit spreads, a minimum two notch credit rating downgrade, and competitive pricing of retail deposits. While the monetary policy response to the economic downturn sees the Official Cash Rate quickly lowered from 1.75 to 0.25 percent, banks' higher funding spreads mean that this decline is not fully passed through to customers' interest rates.

In phase 1, banks' own modelling of this scenario produced a wide range of outcomes, for both the level of customer interest rates and banks' net interest margins (figure 12). While underlying differences in banks' repricing profiles and product mix would justify some differences, the results also reflected a range of assumptions as to how higher wholesale interest rates would be reflected in competition for retail funding, and how

aggressively banks would compete on lending rates to retain existing customers.



To reduce some of this variability, in phase 2 the Reserve Bank specified how new customer interest rates for key products would adjust in response to the scenario (residential mortgages, business loans, term deposits, and other interest-bearing deposits). The calibration of these product-level interest rates was based on a combination of banks' estimates from phase 1 and the Reserve Bank's judgement, and were calibrated so that around half of the total increase in banks' funding costs would be passed on to borrowers. Based on these specified paths for new customer interest rates, banks then estimated their net interest margin, taking into account the re-pricing profile of their assets and liabilities.

The prescribed interest rate movements saw the net interest margin fall from 2.2 percent to 1.7 percent in the third year, before recovering to 1.8 percent by the end of the scenario. Though this reduced banks' cumulative pre-tax net interest income to \$38b from \$49b in the baseline

projection, the size of these earnings on performing loans, combined with these banks' generally low operating cost structure, still provided a significant buffer of underlying profits with which to absorb credit losses.

The closure of offshore funding markets in the first six months of the test did not place significant pressure on banks' liquidity positions, as the lengthening maturity of their offshore wholesale funding in recent years meant only a modest quantity was expected to mature over this period. Banks expected strong growth in retail deposits, in line with their experience during the Global Financial Crisis. As a result, all banks met their core funding ratio and mismatch ratio requirements during the test.

## 6 Operational risk outcomes

While Reserve Bank stress tests have typically focused on credit risk, operational risk has featured prominently in recent tests by other prudential regulators. Costs associated with legacy misconduct events continue to affect the financial performance of some large North American and European banks, and regulators have had to incorporate sensitivity analysis around the potential costs of resolving outstanding issues in their recent stress tests.

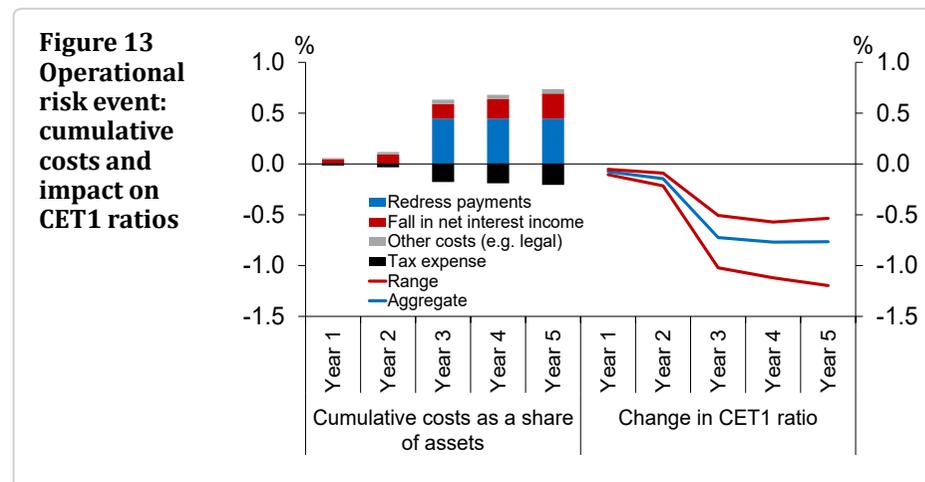
In phase 1, banks were instructed to develop and model what they considered to be the least implausible scenario involving industry-wide conduct risk and/or mis-selling in the origination of residential mortgages that would have a material impact on their solvency, and lead to a further downgrade of their credit rating. Submissions explored the consequences of systematic errors in automated property valuations, government-imposed moratoria on mortgage foreclosures, and flaws

in origination practices, such as systematic miscalculations of loan affordability and inappropriate sales practices. The scenarios led to CET1 ratios falling a further 0.4 to 2.4 percentage points in year three of the test, compared to the macroeconomic scenario.

Banks identified several channels of impact. For example, a scenario where the government imposed a moratorium on mortgage foreclosures would mainly affect banks by increasing the loss they faced on defaulted mortgages. This reflects that banks would need to fund non-interest earning defaulted assets on their balance sheet for the period of the moratorium, and that mortgagee sales would be delayed while house prices continued to decline. Systematic errors in origination practices could lead to regulatory fines and redress payments, higher defaults and credit losses during the downturn, and an increase in banks' risk-weighted assets once they discovered the higher credit risk of their mortgage portfolios.

In phase 2, the Reserve Bank developed a standardised event, drawing on elements of banks' initial submissions. The event involved a class action lawsuit for breaches of standards for loan origination set out in the Credit Contracts and Consumer Finance Act 2003 and the Responsible Lending Code, and prescribed a redress calculation methodology. Redress payments depended on the buyer type, payment type, and LVR, for the gross value of mortgages originated while the Responsible Lending Code had been in place (June 2015 to March 2017, covering \$99bn in gross lending). The payment is assumed to take place in the third year of the test. The scenario prescribed a further notch downgrade in banks' credit ratings, which is assumed to lower their net interest margin by 5 basis points for all five years of the test. Banks were also required to model other costs they considered would be likely given the scenario narrative, which included legal expenses, one-off project resourcing costs, and reputation management campaigns. The total cost

of the event across the four banks was \$2.2bn, split between redress payments of \$1.9bn, lower net interest income of \$1bn, and other costs of \$180m, and offset by \$870m in reduced tax expense. The event reduced banks' CET1 ratios by between 0.5 and 1 percentage point in the third year, compared to the macroeconomic scenario (Figure 13).



It is difficult to calibrate the impact of an industry-wide misconduct event for New Zealand banks, given the limited number of relevant precedents. Many simplifying assumptions were needed for the 2017 exercise. While the outcomes are therefore rather speculative, the Reserve Bank considers the inclusion of a broader range of risks in stress tests to be an important area for ongoing development.

## 7 Conclusions and lessons from the 2017 exercise

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The Reserve Bank uses stress tests to understand how severe but plausible hypothetical scenarios would affect the stability of the financial system. This article described a recent stress test of the four largest New Zealand banks, which covered a severe macroeconomic downturn scenario, and an operational risk event related to mortgage lending misconduct.

Outcomes from the test suggest that the four banks would be able to maintain capital levels above their minimum requirements during these scenarios. Repricing actions to maintain relatively stable net interest income and low operating expenses mean that these banks would be able to offset large losses on their credit portfolios and from the misconduct event with their underlying earnings. There are, however, uncertainties around the magnitude of losses banks may face in a real downturn scenario, and the extent to which banks would be able to restore their interest margins. As a result, the outcomes remain sensitive to the modelling assumptions used in the test.

The Reserve Bank sees regulator-led stress tests as an important part of supporting the ongoing development of banks' risk management practices. To this end, the 2017 test explored a wider range of risks than previous tests, including conduct and concentration risks. The test introduced a more sophisticated approach to modelling the link between net interest income and capital outcomes, and the Reserve Bank observed continued enhancements in banks' credit loss modelling capabilities. In feedback on their performance in the 2017

test, the Reserve Bank encouraged further improvements in banks' ability to assess how stress test results vary depending on modelling assumptions, and emphasised the importance of providing sufficient context around these sensitivities when discussing stress test outcomes with senior management and directors.

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