

## WHITEPAPER

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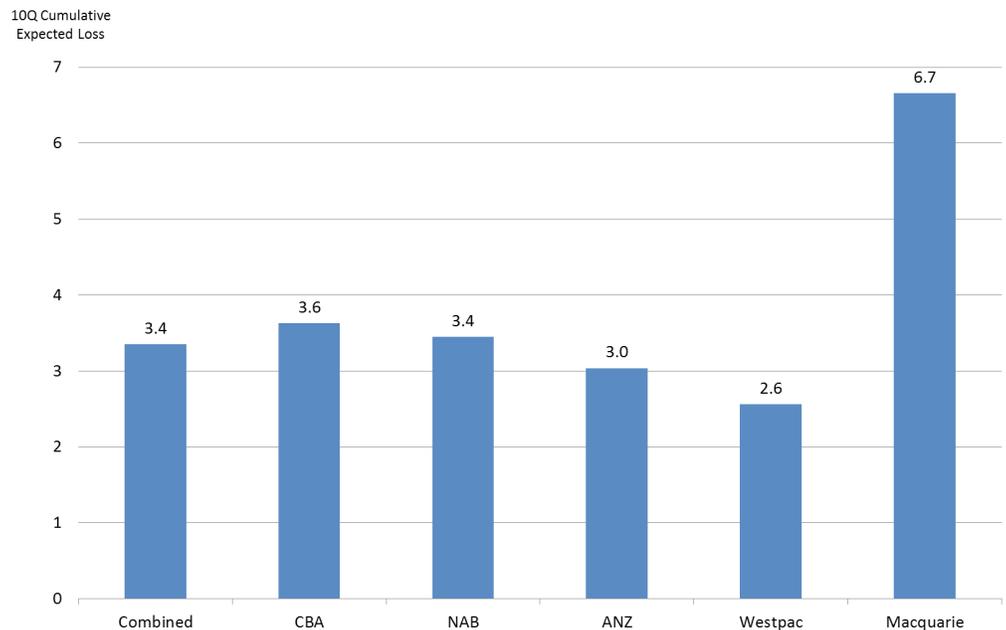
# A Simulated Stress Test of the Corporate Loan Portfolios of Australia's Largest Banks

### Abstract

Although Australia's banking system is one of the strongest in the world, the harsh lessons of the global financial crisis have led the country's regulators to require that banks develop and implement a rigorous stress testing process to prepare themselves for the next crisis. In this paper, we conduct a simulated stress test of the corporate loan portfolios of Australia's five largest banks (by asset size): Westpac Banking Corp, Commonwealth Bank of Australia, National Australia Bank, Australia and New Zealand Banking Group, and Macquarie Bank.

Our simulations are based on publicly available information on the characteristics of the banks' commercial loan portfolios together with Moody's Analytics' library of Alternative Economic Scenarios and Stressed Expected Default Frequency measures. Cumulative corporate loan expected loss rates for these five Australian banks range from 2.6% to 6.7%, with an average 3.4% over a time horizon of ten quarters in the most severe economic scenario.

### Simulated Corporate Loan Expected Loss Rates (%) Under a Severely Adverse Economic Scenario for Australia's Five Largest Banks (by Assets)



## 1. Introduction

Australia's banks are among the most well capitalized, soundly managed, and highest rated in the world.<sup>1</sup> The country's economy has enjoyed nearly a quarter century without recession, and the sound risk management practices at its banks helped them largely avoid the economic damage caused by the global financial crisis.

Yet, the harsh lessons of the global financial crisis have led Australia's regulators to require that banks develop and implement a rigorous stress testing process to prepare themselves for the next crisis. Regulators are concerned with whether banks are adequately capitalized to survive a severely stressed economic downturn without external support, as well as having strong governance frameworks and sound risk management.

Recent macroeconomic trends in Australia, notably concerns about the existence of a bubble in commercial and residential real estate, have heightened the focus on stress testing.

The Australian Prudential Regulation Authority (APRA) has been conducting stress tests of authorized deposit-taking intermediaries since at least 2003.<sup>2</sup> Like those conducted by authorities in the US and Europe, APRA's stress tests seek to assess whether banks are adequately capitalized under prescribed adverse economic scenarios: banks pass or fail the stress test depending on whether their capital ratios fall below the regulatory minimum under an adverse scenario.<sup>3</sup>

Unlike the stress tests in the US, however, they are not conducted on an annual basis, and the bank-level results of APRA's stress tests are not publicly disclosed.<sup>4</sup> Although no Australian bank has failed the stress tests to date, the stress testing experience in the US and Europe shows that the potential costs of failure are high indeed. Banks that have failed stress tests in these regions have been required to raise fresh (sometimes costly) capital and to expend considerable resources and effort on remediation. Banks' shareholders are not exempt from the pain, either, particularly when a failure surprises the market.

The experience in the US shows that banks consistently underestimate expected losses under the Federal Reserve's severely adverse scenario in its annual Comprehensive Capital Analysis and Review (CCAR) stress test. Exhibit 1 compares banks' projected losses for commercial and industrial (C&I) loans to the Federal Reserve's projections for the past three years. The size of each bubble is proportional to bank size (by assets). The charts show that the majority of CCAR banks under-predict projected C&I loan losses in the severely adverse scenario relative to the Fed's reported results. Another feature of the results in Exhibit 1 is that larger banks tend to show the largest difference between their expected loss calculations and those of the Fed. Other asset classes, such as commercial real estate, exhibit a similar pattern of under-prediction.

1 As of August 2015, the weighted average rating of Australia's banks was Aa2, on par with banks in Canada and second to Singaporean banks, which have a Aa1 weighted average rating. Serov, et al. (2015) is a thorough credit and rating assessment of the Australian banking system.

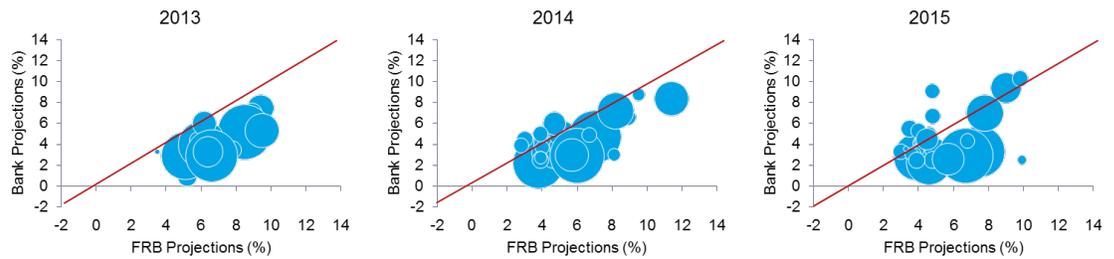
2 Aylmer (2007).

3 Banks can fail stress tests for other important reasons. Citibank, for example, failed the 2014 CCAR stress test because the Fed objected to its capital plan.

4 The most recent publicly-available results are the 2014 stress tests. See Byres (2014).

**Exhibit 1: CCAR Banks Consistently Underestimate Expected Losses Relative to the Federal Reserve**

Commercial and Industrial Loan Losses Under the CCAR Severely Adverse Scenario, 2013-2015



Source: Moody's Analytics calculations using the Federal Reserve's published CCAR results

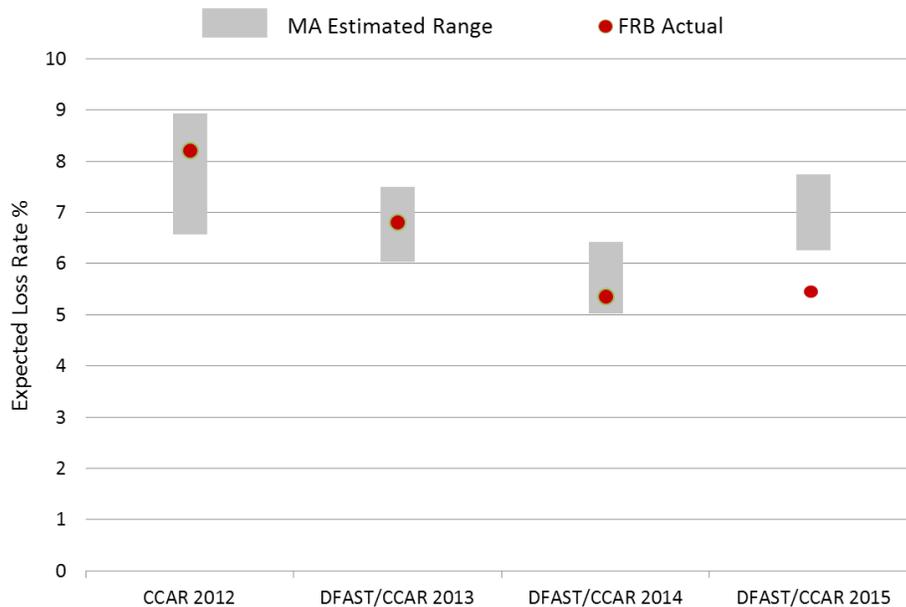
The ability to anticipate the results of a supervisory stress test, even in part, would therefore be of enormous value. But given the complexity, time, and resources required to do a stress test, is such a thing possible (or economically feasible)? In previous research, Moody's Analytics has shown that it is.

Since 2011, Moody's Analytics has performed simulations for the C&I portfolios of CCAR bank holding companies and foreign banking organizations, the summary results of which are shown in Exhibit 2 below.<sup>5</sup> The grey boxes represent Moody's Analytics' high-low range of estimates for C&I expected loss rates under the Fed's severely adverse scenario. The red dots represent the Fed's actual results.

In a later section, we will describe in greater detail the simulation process that generated these results. The important point is that the range of expected loss rates that Moody's Analytics estimated was done shortly after the Fed released its CCAR macroeconomic scenario definitions and *before* the Fed announced its results several months later. We emphasize that these simulations were done only with publicly available information and Moody's Analytics' models and data.

**Exhibit 2: Moody's Analytics' Simulated C&I EL Rates Have Closely Tracked the Fed's Actual Results**

Aggregate Expected Loss Rates Under the Fed's Severely Adverse Scenario, Predicted vs. Actual, 2012-2015



Source: Moody's Analytics and Federal Reserve Board

<sup>5</sup> Ferry (2012), Ferry (2013), Ferry (2014), Ferry (2015). Moody's Analytics has also conducted other stress test simulations. See Levine and Gibson (2014) and Hughes, et al. (2014).

In this paper, we apply the same simulation exercise to the corporate loan portfolios of Australia's five largest banks (by asset size): Westpac Banking Corp, Commonwealth Bank of Australia (CBA), National Australia Bank (NAB), Australia and New Zealand Banking Group (ANZ), and Macquarie Bank. These five banks represent 82% of the total assets in the Australian banking system.<sup>6</sup>

Our intention in conducting this simulation is not to shine a spotlight on any particular bank, nor is it intended to pull the curtain back on APRA's confidential (for which there are good reasons) stress testing exercise. The purpose of this research is to demonstrate that the predictive simulations we used for CCAR banks in the US can also be effectively used for Australian banks. It is not enough for a bank to do its own stress test in isolation – it must anticipate the outcome of its regulator's stress test as well. Surprises, especially of the negative sort (as Exhibit 1 showed), can and should be avoided when possible.

A few caveats are in order. It is important to state up front that, unlike the CCAR exercises we have conducted previously, we have no way of verifying how accurate our simulations for the Australian banks are ex post. The results of APRA's bank stress tests are not publicly released. We also do not attempt to answer the question of whether the five largest Australian banks are adequately capitalized.<sup>7</sup> Our analysis is completely unrelated to the Moody's Investors Service credit research and ratings of the five banks included herein. Lastly, the results of our corporate loan portfolio stress tests need to be interpreted not as precise point estimates, but rather as statistical estimates made with error. Keynes's maxim that it is better to be roughly right than precisely wrong holds here. Differences in the results for the five banks included in this simulation should be interpreted with this mind.

In the next section, we describe our stress test simulation methodology. Section three discusses the data we used in our simulations. We present the results of our mock stress test in section four. Section five concludes.

## 2. Simulation Methodology

The stressed corporate loan expected loss rates we estimate in this report for each bank are the result of Monte Carlo simulations. Each simulation has three key steps that are repeated in each iteration:

### 1. PSEUDO PORTFOLIO CONSTRUCTION

For each bank, we form a pseudo portfolio of corporate loans. We randomly draw an appropriate number of corporate names from firms in Moody's Analytics' CreditEdge data set to form a portfolio whose characteristics match descriptive data available in public reports. These characteristics include the geographic distribution of loan exposures and aggregate credit risk characteristics. As we describe in more detail in the next section, we used corporate loan default rates reported in each bank's Basel 3 filings to establish an initial conditions average PD target. Loans were randomly selected and either kept in the pseudo portfolio or discarded and randomly replaced until the average Expected Default Frequency (EDF) as of the date of the simulation approximated the target starting average PD. We assumed equally sized loan exposures.

<sup>6</sup> APRA Monthly Banking Statistics, August 2015.

<sup>7</sup> APRA addresses this question in their "International Capital Comparison Study" Information Paper (2015).

## 2. LOAN-LEVEL EL CALCULATION

We then calculate the cumulative expected loss for each pseudo loan under a given stressed scenario. The stressed scenarios are generated by Moody's Analytics Economics and Consumer Credit Analytics (ECCA) division, and consist of an adverse scenario and a severely adverse scenario. Moody's Analytics Stressed Expected Default Frequency (EDF) model provides the PD input to this calculation. We do not project stressed loss given default (LGD) rates; rather, we use each bank's (flat) estimated downturn LGD rates sourced from historical bank filings. If a bank does not report an LGD rate we assume 50%.

## 3. PORTFOLIO EL CALCULATION

Finally, in each iteration we sum over all the loans in the pseudo portfolio for each bank to calculate the cumulative expected loss over the next two-and-a-half years. The time horizon for our projections runs from July 2015 through the fourth quarter of 2017. The stressed expected loss rates we report correspond to the mean of the Monte Carlo simulations. Since there are many ways to construct a pseudo portfolio with a given target starting average PD, using the mean of the simulations ensures a more robust estimation of expected losses than relying on simply one randomly drawn pseudo portfolio.

For each bank we repeated steps one to three 1,000 times. Exhibit 3 provides summary statistics for the Monte Carlo simulations. Although we ran 1,000 simulations for each of the five banks, not all iterations successfully yielded pseudo portfolios with the targeted average PD.

**Exhibit 3: Monte Carlo Simulation Summary Statistics**

	AVG# LOANS PER PSEUDO PORTFOLIO	MIN # LOANS PER PSEUDO PORTFOLIO	MAX # LOANS PER PSEUDO PORTFOLIO	# SUCCESSFUL SIMULATIONS
Combined	451	181	1666	522
CBA	461	334	548	449
NAB	402	181	621	351
ANZ	480	302	621	550
Westpac	334	194	394	456
Macquarie	716	308	1666	480

## 3. Data Sources and Characteristics

The corporate loan stress test simulation we perform in this research paper is based on publicly available data and data from Moody's Analytics' data products and models. We in Moody's Analytics do not have access to information about any particular bank's corporate loan portfolio that would be considered private or confidential, such as that which might be shared with regulators or with rating agencies. The stress test simulation requires three types of data:

1. Data describing each bank's corporate loan portfolio that will allow us to construct pseudo portfolios whose characteristics match those reported in public filings
2. Stressed probabilities of default: A projected future path of each firm's PD that incorporates firm-specific credit risk as well as the effect of the hypothetical macroeconomic scenarios
3. Macroeconomic variables that represent severe but plausible downturn scenarios, which we use to calculate stressed PDs

## CORPORATE LOAN PORTFOLIO DATA

Because we do not have detailed information about the banks' corporate loan portfolios, we pursue a method whereby we generate pseudo portfolios where the average default rates, LGD, and geographic exposure match those of the banks, based on publicly-available information. Bank-level data were drawn from each institution's Basel 3 Pillar 3 disclosures of capital positions and risk-weighted assets<sup>8</sup>. While we would have liked to include more Australian banks in our simulation, only Westpac, CBA, ANZ, NAB, and Macquarie Bank have publicly available data detailed enough to construct pseudo portfolios.

APRA's approach to Pillar 3 implementation is non-prescriptive, meaning that each bank reports similar, though not identical, line items. For example, the breakdown by geography and industry is slightly different for each institution and tends to reflect the makeup of each firm's corporate loan book.

Moreover, the distinction between an SME and a corporate loan varies by bank. In each instance, we have taken each bank's reported results at face value. Exhibit 4 shows the geographical exposure for each of the five banks in our sample.

The corporate loan exposures of Australia's "big four" banks across geographies are relatively similar, with the majority of their exposures to borrowers in Australia and New Zealand. Macquarie Bank's corporate loan exposures stand out as distinctly different. Some 77% of its corporate loans are to borrowers in Europe and the Americas and just 16% to borrowers in Australia and New Zealand.

### Exhibit 4: Australia's Four Largest Banks Exhibit Similar Geographic Corporate Loan Exposures

Geographic Distribution of Corporate Loan Exposures, as of FILL

	CBA	NAB	ANZ	Westpac	Macquarie
Total Exposure (Mil. AUD)	112,246	234,372	271,567	134,554	44,486
Australia	65.80%	64.70%	49.10%	69.50%	16.00%
New Zealand	6.10%	12.50%	16.50%	14.90%	-
Asia	-	-	-	9.80%	6.30%
Europe	-	-	-	2.20%	41.20%
UK	-	14.20%	-	-	-
Americas	-	-	-	3.60%	36.60%
Other	28.00%	8.60%	34.40%	0.00%	-

Source: Taken from each bank's latest Basel 3 Pillar 3 report.

Starting PDs for each bank's corporate loan portfolio were calculated as a weighted average by loan exposure within a rating category. This was preferable to the single corporate loan PD provided by each bank, as the exposure by rating bucket was also used in constructing the pseudo portfolios. Note that our stress-testing model is based on a one-year default probability and so, to the extent that the bank-provided PDs refer to a longer horizon, our results will tend to overstate expected losses. Loss given default is assumed constant and refers to each bank's estimated LGD under a downside economic scenario. Macquarie Bank did not provide a corporate loan LGD, so we assumed 50%. Exhibit 5 summarizes the starting PD and assumed LGD values for each of the five banks.

<sup>8</sup> APRA has laid down minimum standards for disclosure in its APS 330.  
<http://www.apra.gov.au/adi/PrudentialFramework/Documents/130409-APS-330-draft-final.pdf>

**Exhibit 5: Wide Variations in Reported Corporate Loan Default Rates**

Starting PD and Static LGD Assumptions for Simulated Stress Tests

	CBA	NAB	ANZ	Westpac	Macquarie
Average PD	0.70%	1.70%	1.20%	0.50%	2.90%
Average LGD	58%	36%	40%	50%	50%

Source: Taken from each bank's latest Basel 3 Pillar 3 report

**STRESSED PROBABILITY OF DEFAULT**

The forecast of the probability of default is one of the strongest determinants of the expected loss rate for a loan. We measure the probability of default using Moody's Analytics Expected Default Frequency (EDF) model. EDF measures are point-in-time estimates of default risk over a given time horizon. Our EDF model is built on the option theoretic framework of the Black-Scholes-Merton model of default risk, with significant, real-world enhancements over the past two decades.

We use the EDF model in two ways in our simulations. First, the level of the EDF measure is one of the sampling criteria when we randomly draw firms to include in each bank's pseudo portfolio. The average EDF of a pseudo portfolio is targeted to match the geographical exposure and weighted average default rate reported by each bank. The EDF measures we use in this step are unconditional, meaning that the PD is based only on the firm-specific drivers of credit risk: asset value, asset volatility, and default point.

The second way we use the EDF model is in the calculation of the stressed expected loss rates. To calculate forward-looking probabilities of default conditional on a stressed scenario, the basic EDF model is extended to include a set of macroeconomic and macro-financial variables, such as GDP, the unemployment rate and interest rates, etc. The stressed scenario is characterized by ascribing specific values to those macroeconomic and macro-financial variables, and the resulting PD projections are referred to as Stressed EDF measures.

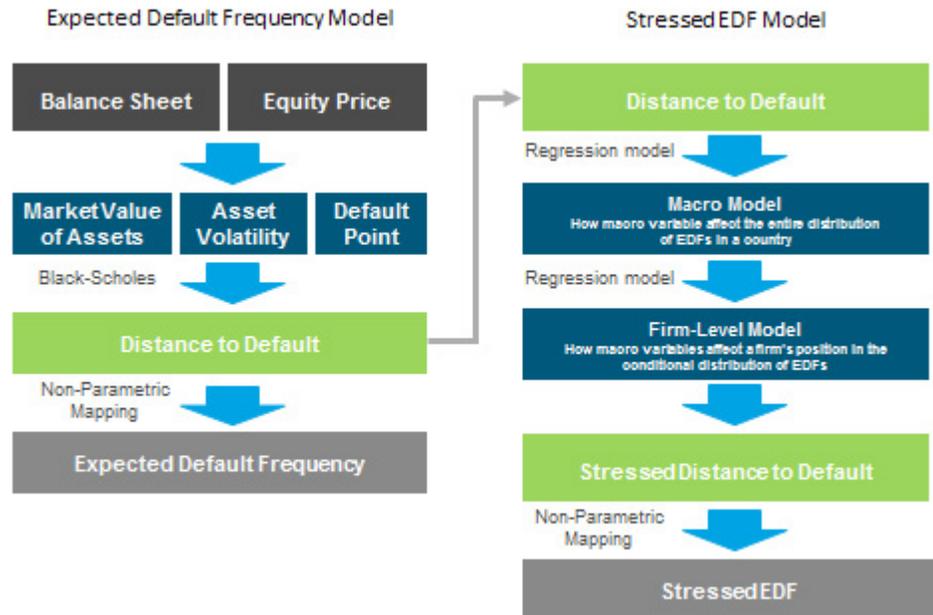
Exhibit 6 illustrates the calculation steps for the Expected Default Frequency model (unconditional) and the Stressed Expected Default Frequency model (conditioned on macroeconomic variables). The two models are closely related. The Stressed EDF model extends the basic EDF model by taking the distance to default from the basic EDF model and using it as the dependent variable in two regression models that introduce the influence of macroeconomic factors.<sup>9</sup> There is an aggregate-level macro model and firm-specific (or micro) model. The macro model recognizes that sharp macroeconomic downturns and stressed scenarios affect the entire distribution of forward-looking PDs. A typical effect during an economic downturn is that the central tendency of the EDF distribution increases and the tail becomes fatter. The micro model measures a firm's sensitivity to the macroeconomic variables and determines where a particular firm sits in the conditional distribution of stressed distance to default. A given firm's default risk may be pro-cyclical, a-cyclical, or anti-cyclical.

These two models are combined to yield a stressed distance to default. In the final step, the stressed distance to default is mapped to a stressed PD using the same non-parametric mapping as the basic EDF model. The mapping is based on historical default data and yields EDF measures that more closely align with realized default rates.

<sup>9</sup> Ferry and Levine (2015) describes the Stressed EDF model methodology in detail.

## Exhibit 6: EDF and Stressed EDF Models

Outline of Calculation Steps for the EDF and Stressed EDF Models



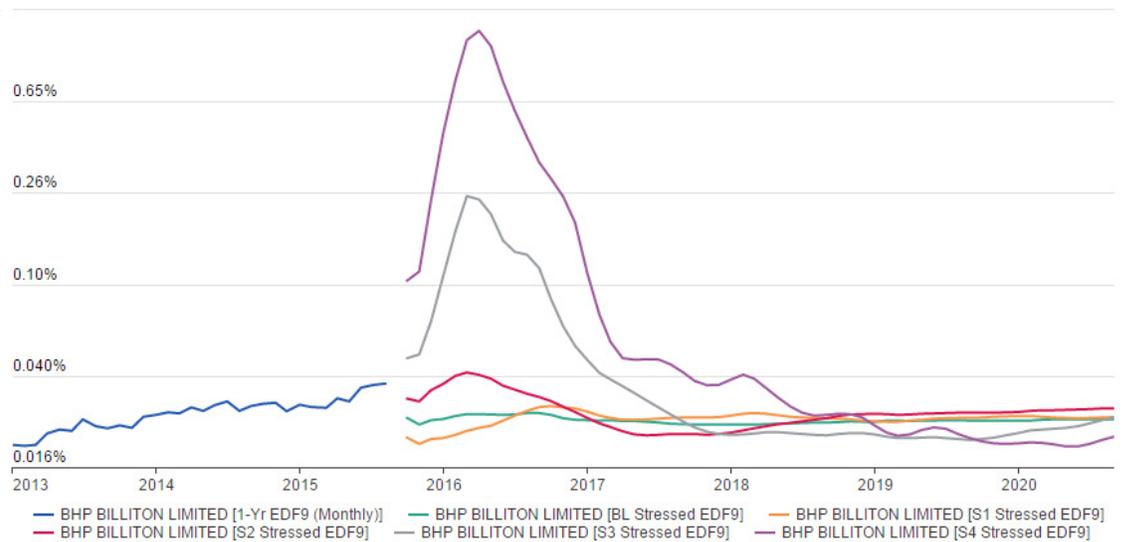
Moody's Analytics currently has Stressed EDF models for North America, Western Europe, Japan, and Australia/NZ<sup>10</sup>. Each regional model includes different sets of macro-financial variables, reflecting data availability as well as the statistical power of the macro-financial variables for that region. The macro-financial variables included in the Australia/NZ Stressed EDF model are real GDP, the unemployment rate, real consumption, real investment, real exports, retail sales, the oil price, the consumer price index, the producer price index, a stock index, stock price volatility, the US Ted spread, and the Baa corporate spread.

Exhibit 7 shows an example of the output of the Stressed EDF model for a particular firm, BHP Billiton Ltd. The blue line through the third quarter of 2015 is the history of the unconditional EDF measure. The other lines starting in the fourth quarter of 2015 are the Stressed EDF measures under different macroeconomic scenarios. The graph shows Stressed EDFs for five different scenarios: a baseline scenario (BL), consisting of the most likely realization of the macroeconomic variables; an upside scenario (S1); and three downside scenarios (S2, S3, and S4). The Stressed EDF measure under the most severe stressed scenario, S4, shows a markedly higher peak in the expected default rate relative to the other scenarios.

<sup>10</sup> Loans in the "Other" category in Exhibit 4 were divided between the Stressed EDF regions for which each bank did not provide any data. For example, CBA provided figures for Australia, New Zealand, and Other, so CBA's "Other" exposure was divided evenly between North America, Western Europe, and Japan.

**Exhibit 7: Stressed EDF Measures are PDs Conditioned on Specific Values of Macroeconomic Variables**

Example: Stressed EDF Measures for BHP Billiton Ltd.



Source: Moody's Analytics

**MACROECONOMIC SCENARIOS**

The macroeconomic data we use in our simulations were drawn from the Moody's Analytics database of Alternative Economic Scenarios, which contains an in-house baseline forecast alongside eight alternative scenarios (known as S1-S8). The database covers 49 countries and more than 90% of global GDP. The first four scenarios (S1-S4) are globally-consistent, demand-driven scenarios, while the remaining scenarios contain more esoteric shocks related to oil prices, interest rates, and productivity.

Ideally, we would have used the macroeconomic scenarios prescribed by APRA in its previous stress tests. The data for the time paths of those macroeconomic variables is, unfortunately, unavailable. Given the strong house price appreciation in recent years, APRA's 2014 stress test used two scenarios centered on a severe downturn in the housing market. One assumed a 40% dive in house prices amid a recession triggered by a slowdown in China. In the second APRA scenario, the plunge in house prices was caused by a sharp hike in interest rates due to strong growth and a spike in inflation.

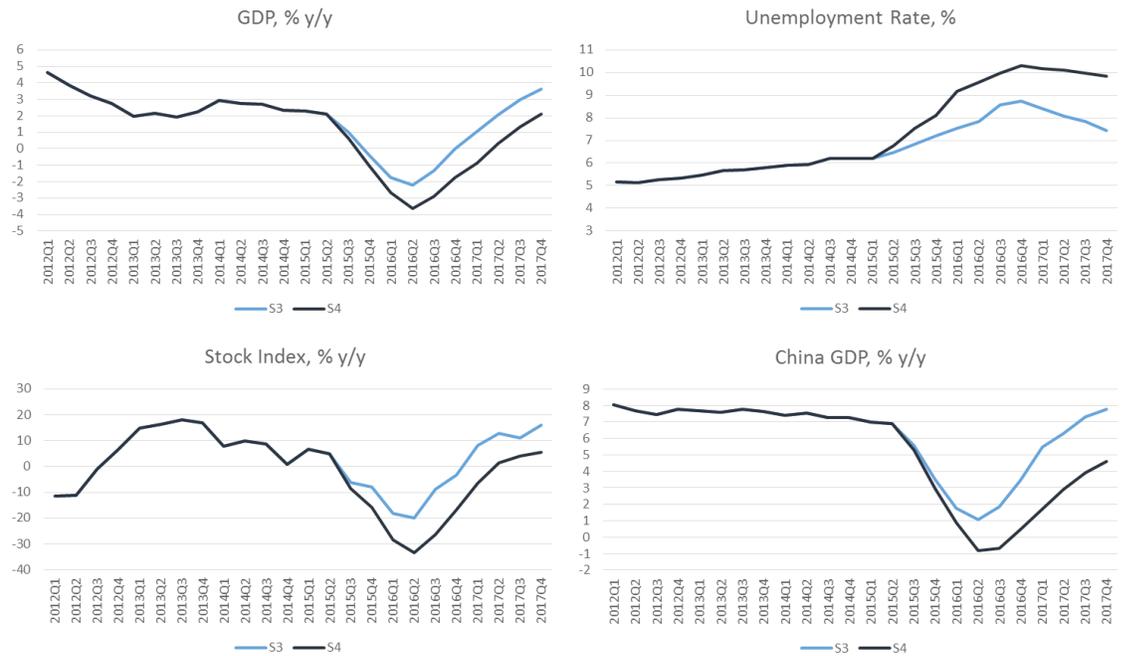
The simulations in our exercise use macro data from the S3 and S4 scenarios, the two most severe downside scenarios. S3 is referred to as a "Moderate Recession" scenario and assumes a sharp fall in Chinese commodity demand, alongside a resumption of the recession in Europe, and a steep decline in Australian house prices. This causes Australian GDP to contract for four straight quarters, pushing the unemployment rate to a peak of 8.7% in late-2016. The S4 "Protracted Slump" scenario is the most severe downside scenario and assumes a disorderly Greek exit from the Eurozone, which drags the global economy into a protracted recession. Australian GDP declines for six straight quarters through 2015 and 2016, with the unemployment rate peaking at 10.3%.

Exhibit 8 shows four of the 11 macroeconomic variables in our data set for the S3 and S4 scenarios. These hypothetical scenarios simulate how the Australian economy might perform under a typical economic downturn and are consistent with APRA's philosophy of applying "severe but plausible" economic scenarios. Notably, these scenarios are milder in some respects than APRA's 2014 stress tests, which contain peak unemployment rates of around 12% and 14% under its two downturn scenarios. The -3.6% yoy GDP growth

nadir in S4 is outside the range of the historical data for Australia. The 10.3% peak in the S4 unemployment rate is similar to that experienced in the early 1980s and early 1990s, placing it in the 93rd percentile. The -33.2% yoy bottoming of the equity index is worse than 99% of the observations evident since 1980, and is similar to the market sell-off experienced in 1982.

#### Exhibit 8: Moody's Analytics' Scenarios Are Somewhat Milder Compared to APRA's 2014 Stress Test

Time Paths of Selected Macroeconomic Variables Under the S3 and S4 Scenarios



Source: Moody's Analytics

#### 4. Simulation Results

The results of our corporate loan stress test simulations are summarized in Exhibit 9. The table shows the mean loss rate from the Monte Carlo simulations we ran for each bank, both in percentage and AUD terms. The average expected loss rate across all five banks in our sample is 2.2% under the S3 scenario and 3.4% under the S4 scenario. The stress test results for the Big Four banks are relatively close to the mean and to each other, which is unsurprising, given the similarities of their corporate loan exposures (refer again to Exhibit 4). The results for Macquarie Bank are almost double those of the top four banks. This result should be interpreted with caution, although there is a good reason to expect this difference.

As we noted in the introduction, our methodology in this study is a very rough approximation of reality, and our results will have very wide implicit confidence bounds. So apparently large differences, such as we observe for Macquarie Bank, may be a statistical artifact<sup>11</sup>. Nevertheless, Macquarie Bank's corporate loan portfolio is indeed distinctive, with a different geographical exposure and a materially higher starting PD – 2.9% compared to an average of 1.0% among the Big Four (see Exhibit 5). The higher initial PD, in particular, is the main reason for Macquarie Bank's higher stressed expected loss rate.

<sup>11</sup> For example, Macquarie Bank has a large exposure to off-balance sheet items and specialized lending, which are recorded as corporate loans in the Basel 3 Pillar 3 reports. If the credit profile of these instruments, particularly under stressed economic conditions, is different to the public firms used to proxy them, then the results of the Stressed EDF model may be misleading.

**Exhibit 9: Stress Tests for Australia's Five Largest Banks (by Assets)**

Nine Quarter Cumulative Corporate Loan Expected Loss Rates Under the S3 and S4 Scenarios

	LOAN EXPOSURE (MIL. AUD)	SCENARIO S3		SCENARIO S4	
		EXPECTED LOAN LOSSES (%)	EXPECTED LOAN LOSSES (MIL. AUD)	EXPECTED LOAN LOSSES (%)	EXPECTED LOAN LOSSES (MIL. AUD)
Combined	827,426	2.2	18,016	3.4	27,725
CBA	112,246	2.3	2,536	3.6	4,073
NAB	234,372	2.2	5,054	3.4	8,081
ANZ	301,768	2	5,966	3	9,166
Westpac	134,554	1.4	1,836	2.6	3,443
Macquarie	44,486	5.9	2,624	6.7	2,962

Source: Moody's Analytics

As we have commented more than once in this report, it is not possible for us to compare the results of our simulation to actual stress test results for Australian banks. However, the figures reported in Exhibit 9 do seem to make intuitive sense, given what we know about the characteristics of the loan portfolios for each bank, their creditworthiness, their business models, and their risk management practices. Although not directly comparable to the results for the Australian banks, it is nonetheless interesting and informative to compare our simulation results to the Fed's CCAR corporate loan stress test results. The stressed scenarios driving the CCAR stress tests are obviously different, but not terribly so. For example, the Fed's 2015 CCAR severely adverse scenario – which is most similar to our S4 scenario – envisages a 4.7% drop in US GDP, while the S4 scenario for Australia considers a 5.4% drop in GDP.

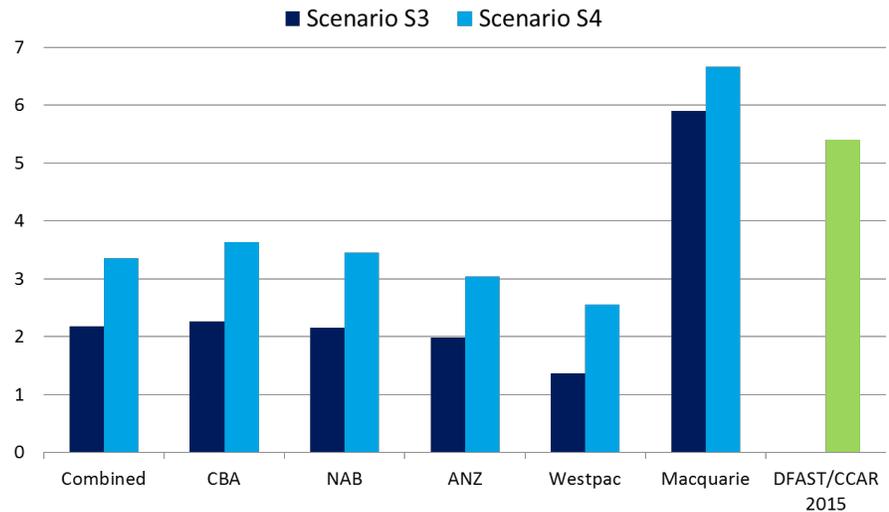
Other macroeconomic variables in our S4 scenario compare similarly to those of the 2015 CCAR severely adverse scenario. Differences in the definitions of C&I loans in the US and corporate loans in Australia could also produce sampling differences that potentially affect the results. The timing of the simulations (CCAR in late 2014 and ours in late 2015) would also affect the outcomes. Lastly, our projections for the Australian banks is over a time horizon of 10 quarters, whereas the CCAR cumulative EL rates are calculated over a time horizon of nine quarters.

The graph shown in Exhibit 10 summarizes the expected loss rate simulations for the Australian banks and compares them to the actual average C&I expected loss rate for the 2015 CCAR banks (as reported by the Federal Reserve). Over a time horizon of 10 quarters, four of the five Australian banks in our study show cumulative expected loss rates on their corporate loan portfolios that are about half as large as the average C&I loss rates for the banks in the 2015 CCAR stress test. The results for Macquarie Bank were similar to those for the CCAR banks.

To rephrase the results, under similarly stressful macroeconomic conditions, four of the five Australian banks' corporate loan books exhibited greater resilience relative to the CCAR banks, and the one bank that did not, Macquarie Bank, was similar to the CCAR banks.

**Exhibit 10: Australian Bank Corporate ELs Compare Favorably to CCAR Bank Average**

Ten Quarter Cumulative Corporate Loan Expected Loss Rates for Australian and CCAR Banks (Avg,9 Quarter)



Source: Moody's Analytics, Federal Reserve Board

**5. Conclusion**

Australian banks and their regulators have made great progress in advancing stress testing as a risk management tool since the global financial crisis. As the economic challenges in Australia – which include slower economic growth and a cooling real estate market – become more immediate, stress testing will take on even greater importance.

In this brief research paper, we extended the simulation exercise we have conducted for the CCAR stress tests in the US to Australia's five largest banks. Our purpose in doing so was twofold.

First, we argue that, given the high stakes involved in stress testing, conducting simulations that might anticipate the outcome of regulatory stress tests are both valuable and necessary. The lessons from the CCAR stress tests in the US clearly demonstrate this – particularly for the banks that failed the stress tests.

Secondly, we showed that a simulation was feasible and that it yielded useful and intuitive results. The corporate loan stress test simulations we undertook in this research paper were done entirely with public information about the banks' corporate loan exposures. By utilizing Moody's Analytics' Stressed Expected Default Frequency model and its macroeconomic scenarios, we were able to simulate corporate loan expected loss rates for the five Australian banks quite straightforwardly.

In the CCAR simulations we have conducted over the past four years, our methodology and results for US banks have proven to be relatively accurate. We have been careful to point out the caveats of our approach when applied to the Australian banks, and the fact that our results cannot be verified by comparing them to actual stress test results.

The expected loss figures that emerge from our simulations for the Australian banks do, however, seem intuitively correct, given the information available about the banks and their loan portfolios. Cumulative corporate loan expected loss rates for the five Australian banks average 3.4% over a time horizon of ten quarters in the most severe economic scenario. This compares favorably to similar results for US banks in the 2015 CCAR stress test.

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