Impact of the Financial Crisis on Australian Bank Default Risk

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Financial Crises: Causes, Characteristics & Effects

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FORWARD

Welcome to Joondalup for the International Conference on Financial Crises: Causes, Characteristics and Effects.

This international conference brings researchers together in the fields of finance, financial econometrics and economics and has attracted participants from England, France, Netherlands, Taiwan, Tokyo, and Australia.

All submitted papers were subjected to an anonymous review process by at least two reviewers. The review process was managed by the conference committee. 47 papers were submitted to the conference and after the review process 31 were accepted for publication and presentation at the conference.

I would like to thank the keynote and invited speakers plus all paper presenters and attendees and I sincerely hope that you enjoy the conference.

Professor David Allen

ACKNOWLEDGEMENT

I wish to acknowledge the generous support of the following sponsors of this conference.

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IMPACT OF THE FINANCIAL CRISIS ON AUSTRALIAN BANK
DEFAULT RISK

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and

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Abstract

Australian Banks are widely considered to have remained in far better shape during the financial crisis than their global counterparts. The Australian banking sector has retained solid earnings and good capitalisation. Indeed, the 4 major Australian banks are part of a select group of only 8 global banks who hold AA credit ratings. Nonetheless, Australian banks have experienced significant deterioration in market values of assets in line with global financial market fluctuations. The KMV / Merton structural model is widely used by Australian and global banks to measure default probabilities of their customers based on market asset values and debt levels. We use this model to examine default probabilities of the Australian Banks themselves during the financial crisis. In addition, we measure default probabilities under extreme conditions by modifying structural credit methodology to incorporate conditional value at risk (CVaR). We find that prior to the global financial crisis, Australian banks show negligible default probabilities. During the financial crisis, based on extreme movements in market asset values, Australian banks default probabilities fare only slightly better than their global counterparts.

Keywords: real capital, financial crisis; conditional value at risk; credit risk; banks; probability of default; capital adequacy.

JEL Codes: G01, G21, G28

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² School of Accounting, Finance and Economics, Edith Cowan University, Joondalup Campus, Joondalup Drive, Joondalup, Western Australia 6027. Tel 61863045471, email d.allen@ecu.edu.au.
1. Introduction

There is strong evidence to demonstrate the resilience of Australian Banks during the extreme conditions of the Global Financial Crisis (GFC). The 5 largest banks in Australia showed net profit of approximately $8 billion over the second half year in 2008. In contrast the 5 largest US Banks showed losses of nearly $50 billion over the 2008 year, and the 5 largest banks in the UK reported losses of approximately £20 billion before extraordinary items (Reserve Bank of Australia, 2009a). The ratings of the 4 major Australian Banks were raised from AA- to AA in 2007 on the back of “progressive structural strengthening of financial profiles, as well as continued development of their risk-management capabilities”. These ratings were confirmed in July 2009 with Standard & Poor’s (2009) citing a key underpinning reason for this being adoption of a more traditional retail and commercial model, with little reliance on volatile market related trading income. This was supported by the rater’s expectations of continued satisfactory earnings, well controlled credit losses, adequate capitalisation, well-managed funding and liquidity, and conservative risk appetite.

The Australian economy has not been immune to the GFC, with a reduction in business confidence and sharp falls and volatility in financial markets. However the economic downturn has been less severe than in most other countries. As happened internationally, stimulus packages were introduced to boost the Australian economy. These included payments to consumers as well as projects to increase infrastructure spending on schools, transport and public housing. Globally, governments have introduced measures to support troubled banks. Examples include the 2008 US $700bn Troubled Asset Relief (TARP) programme and the 2008 UK £500bn financial support package. Many countries introduced (or increased) deposit guarantees. In line with international measures, and to shore up confidence in the banking industry, in 2008 the Australian Government introduced guarantees on deposits and wholesale funding. This applies to deposits below AUD$1m, with optional fee-based guarantees for wholesale funding and deposits above $1m. The guarantee on deposits remains in place for 3 years and on wholesale funds ‘until market conditions normalise’.

In July 2009, the RBA (Stevens, 2009b) reports that Australian business and consumer confidence has recovered some ground as seen by the following indicators. Businesses are raising equity to strengthen their balance sheet, and the fact that they are able to do so, is an indicator of the resilience of the financial system. Households have gained benefits from fiscal packages, lower petrol prices and reduced interest rates. Whilst there have been rises in unemployment, these have been lower than feared, and positive factors appear to have outweighed the negative. Australia is benefitting from strong commodity prices and China’s continued expansion and demand for resources.

Banks have been tightening lending conditions and increasing lending margins but evidence shows only some moderation in growth.

Parallels have been drawn between the Australian and Canadian financial sectors, (Stevens, 2009a). The major Banks in both countries reported similar returns on equity (Canada 14.5% and Australia 17%), which in both cases was down on the preceding two years. Banks in both countries had low holdings of complex securities in comparison to international standards, and.
both had conservative lending standards. Whilst both countries show increases in mortgage arrears, households in these countries seem to having less trouble servicing debt than those in the US and UK.

The comments from Standard and Poor’s earlier in this section provide some of the reasons why Australian banks have performed better than Global counterparts. The RBA Financial Stability Review (Reserve Bank of Australia, 2009a) provides further insight. Firstly, the Banks retained high lending standards and did not become involved in sub-prime lending. Equivalent non-standard loans were about 1% of total loans, compared to around 13% in the US. The second factor is interest rates, which have been comparatively stable. Rates did not reach the low levels of US Banks and other Global countries and did not see the same level of rapid increases thereafter. A third, and very important factor, is that there is full legal recourse to the borrower, who cannot just hand in the keys to the house and walk away from the debt. Fourthly, Banks in Australia subscribe to the Uniform Consumer Credit Code (and many also subscribe tp the Banking Code of Practice), which places a strong obligation on banks to make responsible lending decisions. Courts can set aside mortgage agreements where lenders would reasonably have known that loan repayments would have caused substantial hardship. Further factors noted by the report are the strong regulatory framework, with home loan stress tests by APRA, and the introduction of higher risk weights on non-standard loans. Also, Australian banks only receive about 5% of their income from trading related activity as compared to many global banks who receive up to one third of their income from this source. VaR associated with trading activity equates to only approximately 0.05% of shareholder funds. Capital is sound, with Australian Banks holding well above regulatory requirements. Aggregate Tier 1 capital is 8.2% (double the requirement) and total capital 11.4%. Banks have been able to raise capital from private shareholders at only modest discounts to prevailing market prices.

All of the above provides an extremely rosy picture of the Australian Banking industry, which should surely be reflected in Bank equity prices and reduced Probability of Default (PD) measures as compared to international experience, and these factors are examined in this paper. The authors (Powell & Allen, 2009a) have previously used a range of metrics such as VaR, CVaR, and structural modelling as used by Merton and KMV, to examine fluctuations in market asset values of US, UK, and other global banks through the GFC. In addition, the authors have applied their own conditional probability of default (CPD) model to global banks, which examines extreme fluctuations in asset values. These techniques have shown how the capital of these banks has been eroded, bringing many banks precariously close to default levels. The increasing default probabilities shown through this modelling are supported by the difficulties experienced in practice by these global banking industries, as demonstrated by increased bank failures and the need for Government rescue packages. This paper applies similar metrics to the Australian banking industry, and finds that on the basis of fluctuating asset values, the Australian banks perform only moderately better than global counterparts, showing substantially heightened default probabilities during the GFC period. As this seems at odds with the above commentary on the resilience of Australian Banks, reasons for this phenomenon are explored, and recommendations provided on the use of these modelling techniques.

The remaining paper is organised as follows. Section 2 outlines the benefits and contributions of the study. Section 3 provides background on the Australian banking industry. Section 4 covers
VaR and CVaR, followed by a discussion on PD and structural methodology in Section 5. Data and methodology are discussed in Section 6. Results are presented in Section 7. Finally, Section 8 provides conclusions and recommendations.

The study does not make representations about PD of individual banks. Default probabilities calculated using structural methodology are based on available balance sheet and equity price information, and do not take into account external options available to banks for reducing PD, such as additional capital raising or government intervention.

2. Contribution and Benefits of the Study

The study can benefit regulators and banks by providing insight into the accuracy of PD estimates using models based on asset value fluctuations. A key finding of this study is that the structural models have not performed equally well across all portfolios examined. Whilst the default probabilities shown by the model are supported by evidence such as losses, bad debts and bank failures in the US and European markets, this is not the case in the Australian market. This means that asset fluctuations alone are not necessarily a good predictor of credit risk and that other factors need to be taken into account in determining default probabilities. The underlying quality of loan assets, in particular serviceability of loans, is highlighted as an important factor.

In addition, key insights are provided into the Australian banking industry as compared to global counterparts during times of extreme risk. The study incorporates CVaR techniques into structural models, which is a unique metric developed by the authors (see also Allen & Powell, 2009). Not only is credit risk measured in the extreme circumstances of the GFC, it is also measured at the extreme tail of asset fluctuations, precisely when default is most likely to occur.

3. The Australian Banking Industry

The Australian Prudential Regulation Authority (APRA) regulates all Authorised Deposit Taking Institutions (ADI’s). As per statistics from APRA (2009) and the RBA (2009b), ADI’s comprise 58 Banks, 11 Building Societies, and 129 Credit Unions. The industry is dominated by the four major Banks, who comprise approximately 75% of the sector’s total assets. These Banks include Westpac, Australia and New Zealand Banking Corporation (ANZ), National Australia Bank (NAB), and Commonwealth Bank of Australia (CBA). These figures include the assets of St George Bank and the Bank of Western Australia (Bankwest) who have recently merged with Westpac and CBA respectively. The Central Bank is the Reserve Bank of Australia whose primary responsibilities are monetary policy, financial system stability, and the payments system.

The figures in Table 1 show that banks continue to grow total assets, although the growth to March 2009 slowed to 9% as compared to 22% the previous year. APRA (2008) reports that growth is driven predominantly by housing loans which account for 52.1% of total bank assets.

Total assets have doubled over the past 5 years, and have continued to increase over the past year. A significant increase is shown in impaired assets. However, this is off a very low base of 0.19%, and the peak of 0.95% is very low in comparison to international standards. Provisions for doubtful debts have not quite doubled over the past year, and are at slightly lower levels than
in the early 2000's. In comparison, the US Federal Reserve (2009) show delinquency and charge-off rates approximately quadrupling from 1.52% to 6.49% in the 3 years to the second quarter of 2009, and doubling over the past year. In their 2009 2nd Quarterly Banking Profile Report, FDIC (Federal Deposit Insurance Corporation, 2009) shows continued aggregate bank losses for the industry, reducing total bank assets, increasing charge off rates and continued rises in loan loss reserves to 2.77%. The Bank of England Credit Conditions Survey (2008a) reports rising default rates, widening spreads, and reduced credit availability to households and businesses due to economic outlook concerns as well as the cost and availability of funds. The survey shows an expectation that these circumstances will continue going forward. The Financial Stability Report (Bank of England, 2009) shows mortgage arrears nearly trebling from the first quarter 2008 to first quarter 2009.

Table 1. Key Growth and Risk Indicators for Australian Banks

<table>
<thead>
<tr>
<th></th>
<th>Total assets ($bn)</th>
<th>Impaired assets (%)</th>
<th>Provisions for bad &amp; doubtful debts (%)</th>
<th>Tier 1 capital ratio (%)</th>
<th>Total capital ratio (%)</th>
<th>Total Risk Weighted assets ($bn)</th>
<th>Equity Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar-2000</td>
<td>958</td>
<td>0.61</td>
<td>0.73</td>
<td>7.38</td>
<td>9.88</td>
<td>671</td>
<td>7.09%</td>
</tr>
<tr>
<td>Mar-2001</td>
<td>1,139</td>
<td>0.59</td>
<td>0.65</td>
<td>6.88</td>
<td>9.77</td>
<td>790</td>
<td>6.77%</td>
</tr>
<tr>
<td>Mar-2002</td>
<td>1,118</td>
<td>0.69</td>
<td>0.71</td>
<td>7.85</td>
<td>10.50</td>
<td>763</td>
<td>7.16%</td>
</tr>
<tr>
<td>Mar-2003</td>
<td>1,178</td>
<td>0.58</td>
<td>0.61</td>
<td>7.69</td>
<td>10.00</td>
<td>819</td>
<td>6.95%</td>
</tr>
<tr>
<td>Mar-2004</td>
<td>1,352</td>
<td>0.41</td>
<td>0.54</td>
<td>7.55</td>
<td>10.06</td>
<td>928</td>
<td>6.90%</td>
</tr>
<tr>
<td>Mar-2005</td>
<td>1,489</td>
<td>0.27</td>
<td>0.48</td>
<td>7.87</td>
<td>10.88</td>
<td>1,013</td>
<td>7.41%</td>
</tr>
<tr>
<td>Mar-2006</td>
<td>1,709</td>
<td>0.21</td>
<td>0.43</td>
<td>7.68</td>
<td>10.52</td>
<td>1,133</td>
<td>6.97%</td>
</tr>
<tr>
<td>Mar-2007</td>
<td>1,953</td>
<td>0.19</td>
<td>0.38</td>
<td>7.56</td>
<td>10.38</td>
<td>1,277</td>
<td>6.78%</td>
</tr>
<tr>
<td>Mar-2008</td>
<td>2,387</td>
<td>0.34</td>
<td>0.39</td>
<td>7.31</td>
<td>10.49</td>
<td>1,337</td>
<td>5.88%</td>
</tr>
<tr>
<td>Mar-2009</td>
<td>2,610</td>
<td>0.95</td>
<td>0.69</td>
<td>8.42</td>
<td>11.44</td>
<td>1,406</td>
<td>6.16%</td>
</tr>
</tbody>
</table>

Figures are calculated from RBA Statistics (2009c). Impaired assets refer to non-accrual (income may no longer be accrued ahead of its receipt because there is doubt about the ultimate collectability of principal and/or interest) and restructured assets (modified to provide for concessions of interest or principal exposures), both on- and off-balance sheet, plus any assets acquired through the enforcement of security conditions. Provisions include specific and collective provisions. Tier 1 and Total capital ratios are as per Basel requirements. A minimum of 8% is required for total capital of which at least half must be Tier 1. Risk weighted assets are also as per Basel requirements, where different assets have different risk weightings for the purpose of calculating capital. The equity ratio is total capital to total assets (no risk-weighting applied). Amounts are all in Australian dollars.
Tier 1 and total capital in Table 1 are showing an increasing trend, both well above the regulatory requirements of 4% and 8% respectively. The total equity ratio is just over half of the total capital ratio, showing that assets, on average, are being discounted at nearly 50% to obtain risk weighted assets. This is in line with the high housing loan component of the Australian Banks, which attract a lower risk weighting than commercial borrowers.

Interest rates in Australia have not experienced the same volatility levels as some of their global counterparts. The cash rate moved from a low of 4.25% in Dec 2001, peaking at 7.25% in March 2008 (an increase of 1.7%), and falling to 3% in April 2009. In contrast, the US Fed funds rate rose from 1% in June 2003 to 5.25% (an increase of 5.25x) in June 2006, and down to 0% in Dec 2008. There is broad consensus that the RBA has reached the bottom of the interest rate cycle, and that rates may soon be on the way up due to strong economic data.

Australia had a housing boom in the early 2000’s. For some regions, such as Western Australia which experienced a commodities led boom, this continued through to 2007. House prices in most Australian areas softened over the past few years, but have fared better than many countries. House prices reduced by about 4% in Australia over 12 months to March 2009, compared to reductions of between 10-25% in areas of US and Europe. Nonetheless, housing loan arrears increased from 0.32% in 2007 to 0.48% in 2008, associated with the general downturn in the economy, and associated unemployment.

The equity ratio of just over 6% shown in Table 1 is higher than most European Banks, but somewhat lower than in the US. Prior studies by the same authors show 20 of the world’s largest Banks to have an aggregate equity ratio of 4.2%, with US Banks ratios being 7.1%, Asian banks 3.6%, UK banks 4.4%, and other European banks 3.2%. The differential between risk weighted and absolute capital ratios is not as marked for Australia as elsewhere. For example, the major Swiss Banks show 15.6% risk weighted ratio versus 2.8% absolute, US 11.3% risk weighted versus 7.1% absolute, and in the UK 11.7% risk weighted versus 4.4% absolute. Discrepancies among Banks between the Basel risk weighted approach and absolute ratios have led to many parties, for example the Swiss National Bank (Blum, 2007; Hildebrand, 2008) and Bank of England (2008b), calling for the introduction of minimum leverage ratios to run in parallel with the existing regulatory approach. Indeed The Swiss Financial Market Supervisory Authority (FINMA) has already introduced such a measure for the two major Swiss Banks. In Australia, APRA has generally taken a conservative approach to the risk weighting of assets, introducing a higher risk weighting to apply to higher risk non-standard home loans, and in 2003 undertook stress testing on home loans. Subject to the limitations of the stress testing methodology, the aggregate results reported by APRA (Esho, Coleman, Sellahura, & Thavabalun, 2005) indicated that Australian ADIs were well capitalised, with good Loan to Value (LVR) ratios and well placed to withstand a housing market shock that is far more severe than any nationwide experience in Australian history. Over 90 per cent of ADIs were deemed able to survive the stress event, without breaching minimum regulatory capital requirements. Indeed, confidence in the robustness of Australian home loan portfolios had previously led APRA (2001) to make recommendations to the Basel Committee on Banking Supervision for a reduced risk weighting (from 50% to 20%) to apply to home loans. The stress test findings have since been vindicated by the performance of Australian banks through the GFC.
Overall, this section has shown that whilst there has been some increase in Australian bank risk indicators such as impaired assets and provisions, these have been very modest by international standards. Comparatively, Australian banks have low credit risk and are profitable, growing, and well capitalised.

4. \textbf{VaR and CVaR}

VaR is widely used in the Banking industry since being adopted by Basel as the primary measure for calculating market risk capital requirements. The metric measures potential losses over a specific time period at a given level of confidence for a specific time period. Internationally, there is extensive literature coverage on VaR. Examples include RiskMetricsTM (1996) who introduced and popularised VaR, Jorion (1996), and comprehensive discussion of VaR by more than seventy recognised authors in the VaR Modeling Handbook and the VaR Implementation Handbook (2009a, 2009b).

In Australia there is very little study on VaR. An examination of the websites of both APRA and RBA shows only 5 working papers dealing with the topic over the past 12 years. This includes Cassidy & Gizecki (1997) who look at market risk backtesting techniques, Engel and Gizecki (1999a, 1999b) who compare VaR models and consider the stability and forecasting of the variance-covariance matrix, Gizecki and Hereford (1999) who undertake a survey on VaR among Australian Banks, and Sy (2006) who examines the coherence of VaR risk measures for levy stable distributions. Allen and Powell (2007) compare VaR across a range of Australian Sectors.

A key criticism of VaR is that it says nothing of risk beyond VaR. Critics have included Standard and Poor's analysts (Samanta, Azarchs, & Hill, 2005) due to inconsistency of VaR application across institutions and lack of tail risk assessment. Artzner, Delbaen, Eber, & Heath (1999; 1997) found VaR to have undesirable mathematical properties; such as lack of sub-additivity, convexity and monotonicity. Criticism of VaR has mounted since the onset of the GFC with VaR being perceived as having a focus on historical risk and not measuring extreme tail risk.

In addition to VaR, this paper examines CVaR which considers losses beyond VaR. If VaR is calculated at 95%, then CVaR is the average of the 5% extreme returns. Pflug (2000), showed CVaR to be a coherent measure, which does not contain the undesirable properties of VaR. CVaR has been used to measure tail risk in an Australian setting by Allen and Powell (2007), who find significant correlation between VaR and CVaR in ranking risk among Australian sectors and Powell and Allen (Powell & Allen, 2009b) who use CVaR to show how relative risk has changed among industries since the onset of the GFC, with the financials sector (real estate, banking and diversified financials) being among the worst affected.

5. \textbf{Structural Models and PD}

The Merton model is based on the option pricing methodology of Black & Scholes (1973). The model uses fluctuations in market asset values combined with asset and debt levels of a firm to
measure distance to default DD (measured by number of standard deviations). The firm defaults when asset values fall below debt levels. DD is calculated as:

\[ DD = \frac{\ln(V/F) + (\mu - 0.5\sigma^2_v)T}{\sigma_v \sqrt{T}} \]  

(1)

Where \( V \) is the market value of the firm, \( F \) = face value of firm’s debt, and \( \mu \) = an estimate of the annual return (drift) of the firm’s assets.

PD can be determined using the normal distribution. For example, if \( DD = 2 \) standard deviations, we know there is a 95% probability that assets will vary between 1 and 2 standard deviations. There is a 2.5% probability that they will fall by more than 2 standard deviations. Using \( N \) as the cumulative standard normal distribution function, PD is measured as:

\[ PD = N(-DD) \]  

(2)

Moody’s KMV (Crosbie & Bohn, 2003) is a popular model used by banks to measure PD. KMV calculates DD based on the Merton approach, but instead of using a normal distribution to calculate PD, KMV use their own worldwide database to determine PD associated with each default level. In KMV, debt is taken as the value of all short-term liabilities (one year and under) plus half the book value of all long term debt outstanding. \( T \) is usually set as 1 year.

Allen and Powell (2009) have modified the Merton model to incorporate a CVaR approach due to the fact that firm’s are most likely to default under extreme circumstances. Instead of using the standard deviation of all asset returns, they use the standard deviation of the worst 5% of returns (which they label CSTdev) to calculate Conditional Distance to default (CDD) and conditional Probability of default (conditional upon asset values fluctuating at the extreme 5% level):

\[ CDD = \frac{\ln(V/F) + (\mu - 0.5\sigma^2_{CSTdev})T}{CSTdev \sqrt{T}} \]  

(3)

and

\[ CPD = N(-CDD) \]  

(4)

Sy (2007, 2008) discusses shortcomings of existing credit models and proposes a revised causal framework for estimating default. In providing his views as to why he believes credit models have failed during the financial crisis, Sy critiques reduced form and structural models. He argues that the main shortcoming of the econometric approach in the reduced form models, such as that of Jarrow & Protter (2004), is that there is reliance on having large amounts of statistical data coming from a quasi equilibrium state which is not seen in rapidly changing environments such as in a credit crisis. In his critique of structural models he argues that insolvency is not a sufficient condition for default of secured loans, and that many technically insolvent entities continue to make debt repayments. Thus the Merton approach is seen to suffer from incomplete causality. He assumes the primary cause of credit default is loan delinquency due to insufficient
liquidity or cash flow to service debt obligations, and that credit default prediction needs to be based on more complete causal frameworks. For example, falling interest rates improve the ability of borrowers to service the loan. Using data from an Australian environment, Sy shows how house prices have increased in the years leading up to the financial crisis, causing average debt servicing ability to decrease and probability of default to increase. A Merton approach (using the difference between asset values and debt) would have shown falling default probabilities as a result of increasing house prices. Sy proposes a variation to the Merton model whereby \( z_x \) is ‘distance to delinquency’, \( V/F \) is replaced by \( x_z \) (cash flow to service loan / loan payment) and \( \mu_z \) and \( \sigma_z \) describe future conditions and risk:

\[
z_x = \frac{\ln(x_z) + (\mu_z - 0.5\sigma_z^2)t}{\sigma_z \sqrt{t}}
\]

(5)

6. Data and Methodology

6.1. Data

Australian banks are compared to US and European banks using 10 years of daily equity data, together with current balance sheet data on equity and debt, all obtained from Datastream. Australian and US banks include listed banks for which equity prices and Worldscope balance sheet data are available in Datastream. This involves 13 Australian banks with total assets of AUD 2.3 trillion and 52 US Banks with assets of USD 7.8 trillion. European Banks comprise the 15 largest European Banks by total assets (aggregate equivalent to USD 30 trillion), with representation from the UK, France, Switzerland, Belgium, Spain, Italy and the Netherlands. These European banks are all among listings (BankersAlmanac, 2009; The Banker, 2009) of the world’s largest 25 banks.

6.2. VaR and CVaR Methodology

We use the RiskMetricsTM (1996) parametric methodology. This involves calculating the returns using the logarithm of price relatives every day for each bank for the past 10 years. Based on a normal distribution, the standard deviation is multiplied by 1.645 to obtain VaR at 95% confidence level. We use an undiversified approach, whereby total VaR is the weighted average of the individual bank VaRs. Correlation among assets in the portfolio is not calculated as we are not calculating VaR for investment purposes, and do not need to show the effect of portfolio diversification. As per section 4, CVaR is calculated as the average of the worst 5% of returns, i.e., returns beyond VaR.

6.3. Structural Methodology

We apply the Merton methodology discussed in Section 5. Using the equity returns obtained in Section 4, and the proportion of equity to assets, we estimate an initial asset return. The daily log return is calculated and new asset values estimated. This is applied every day. Following KMV, this process is repeated until asset returns converge.
CVaR methodology is incorporated into the structural model to obtain CDD and CPD as per Section 5.

7. Results

Table 4. VaR and CVaR - Results Summary

<table>
<thead>
<tr>
<th></th>
<th>Australia</th>
<th></th>
<th>Europe</th>
<th></th>
<th>US</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VaR</td>
<td>CVaR</td>
<td>VaR</td>
<td>CVaR</td>
<td>VaR</td>
<td>CVaR</td>
</tr>
<tr>
<td>1999</td>
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The table shows Daily VaR and CVaR. VaR is calculated on a parametric basis, whereby the standard deviation of daily returns is multiplied by 1.645 (being 95% confidence level based on a normal distribution). Annual VaR can be obtained by multiplying Daily VaR by the square root of 250. Figures are undiversified and represent the weighted average of the individual Bank VaRs. CVaR is calculated as the average of the worst 5% of actual returns (those beyond the 95% VaR).

Australia shows both VaR and CVaR reducing during the mid 2000’s and increasing sharply over the GFC period. CVaR shows a similar trend at a higher level. Trends are illustrated in figure 1 using 3 point polynomial trend lines.

Figure 1. VaR and CVaR Trend: Australian Banks
Despite the rosy picture painted at the start of this paper, whereby Australian Banks show good profitability and improved credit rating in 2007 which have been maintained during the GFC, the share price has been very volatile. In fact, the ASX200 Bank Index, which includes the six largest Australian banks, plunged by 58% from peak in October to trough in January 2009. The annualised VaR in 2008 is approximately 80%.

As shown by the comparative trends in Figure 2, both the US and European portfolios show higher volatility than the Australian Banks.

**Figure 2. VaR and CVaR Comparison between Bank Portfolios.**

European and US banks show very similar VaR and CVaR levels and trends. European Banks have much higher volatility than US banks in 2007, causing the latter part of trend line to exceed the US banks, but in 2008 Europe and the US are at similar levels. Bank Stock Indices in the US and Europe plunged by up to 85% over the GFC period.

So far, we have only discussed results relating to volatility. We now explore default probabilities based on the Merton model, which are a function of asset volatility and leverage. Based on balance sheet shareholder equity to total assets, the Australian banks in our study have equity of 6.5%, US banks 7.7%, and European Banks 3.4%. Figure 3 shows DD based on the Merton model.

**Figure 3. DD and CDD Comparison.**
The lower volatility levels of the Australian banks result in lower DD levels as compared to the other two regions. The combination of high volatility and low equity means European banks fare the worst. All regions show a dramatic shift towards the default line in 2007 and 2008, brought about the huge drop in equities in all 3 regions. Australia still stays above the other regions due to the lower drop in equities, but nonetheless shows a huge leap towards the default line, with all 3 regions dropping well below DD of 1σ, with associated PDs ranging from 15% to 30%. On a CPD basis, PDs of all regions exceed 40%.

8. Discussion and Conclusions

Despite the lower volatility of Australian Banks in comparison with their international peers, Australia still performs extremely badly on the Merton model during the GFC. Banks typically have much lower equity levels than other industries, and any industry with equity of only 6.5% and a drop in equity values of 58% is going to dive headfirst towards default at an alarming speed, based on a model which uses these two factors (volatility and equity) as the primary inputs.

Taking into account what has happened in the US and Europe, including bank failures, government bailouts, severe losses and capital shortages experienced by many banks, the results shown by the Merton model for these two regions intuitively appear to be a realistic and accurate portrayal of the increased default probabilities over the GFC period. More so than probabilities provided by ratings based approaches. Almost all the Banks in our US and UK sample have BBB ratings and above. This gives PDs of below 0.5% according to Standard and Poor’s (2008) transition matrix.

However, in the case of Australian banks, the default probabilities arising from the structural model appear way overstated, taking into account the continued high levels of profitability and low risk profiles of these banks. The AA ratings given to these banks yield default probabilities of 0.38% on the Standard and Poor’s default matrix, which is about 40x lower than the structural model outcomes. Which is the most realistic? The one approach seems way overstated in light of the apparent low risk of the Australian Banks. The other approach maintained a static rating over the GFC period, which doesn’t intuitively seem right either, considering the massive fall in equity and market asset values.

To understand these discrepancies, we need to consider the reasons why bank stocks plunged. In the US and UK, this was rooted in the poor quality and serviceability of the assets, with a resulting impact on bad debts and bank profitability. These factors were nowhere near as prevalent in Australia. In comparison to global Banks, Australian Bank assets and profitability remained relatively sound, and falls in Bank shares in Australia primarily related to contagion, fear, uncertainty and loss of confidence, due to the global scenario that was unfolding. Thus there was a correlation between asset quality and asset fluctuations in the US and Europe, but not in Australia.
In short, Australian Bank assets remained fairly sound, whereby those in the US and UK did not. Taking the US situation as a case study, one of the key reasons for high default levels on the housing loans was that borrowers could simply not afford them. This was caused by combination of the initial sub-prime quality of the loans, together with rising and adjustable rates. A key assumption of these loans was that the security values (the houses) would retain their value.

Australian banks on the other hand have tended to place much more emphasis on serviceability. Australian Banks generally subscribe to a ‘two-way out’ approach, whereby loans can be repaid from two sources. The ‘first way out’ is from the cashflow of the borrower (ability to meet repayments), and the ‘second way out’ from the sale of the assets securing the loan. Primary importance is given to assessment of the first way out whereby the borrower must be able to repay the loan. The second way out (security) is taken as a form of insurance, and should never be a substitute for the first way out. If a borrower can comfortably service the loan, they are far less likely to walk away from the loan, even if asset values are falling. This tends to lend weight to Sy’s argument that serviceability is of perhaps greater importance than asset values in assessing default probabilities.

Clearly the Merton model has not performed well in predicting bank default in Australia. However, one cannot discount the Merton approach based on this performance. Over the period of the GFC, asset values have fluctuated wildly around the globe and probabilities of default have increased dramatically. The Merton method factors this into the modelling approach, and in the case of our Europe and US portfolios, the model has performed extremely well in highlighting the increased probabilities associated with the GFC period.

The issues identified with the static nature of the ratings based approach and the apparent overstatement of default probabilities associated with the Merton model in an Australian context, highlight the need for a combination of factors to be taken into account in assessing default probability. The reality is that no one model incorporates all the complex factors associated with credit risk. Most Australian Banks, as do many other Global banks, use the Merton based KMV model as only one of several tools in rating customers and determining default probabilities. Bank credit models take many other factors into account, such as past history of loan portfolios and individuals, management quality, industry trends, economic indicators, and several balance sheet and income statement indicators surrounding equity, liquidity, and profitability of the borrower. Many of these factors are assessed on a point-in-time basis, such as annually on receipt of the annual financial accounts of the borrower. A model which takes into account fluctuating asset values through-the-cycle is an essential addition to this assessment, irrespective of whether or not default probabilities associated with such a model are accurate in the Australian context. Because asset values are not static from year to year, but can change on a daily basis, a structural model such as the Merton/KMV approach can quickly highlight potential problems relating to individual borrowers or portfolios of loans. This provides an early warning mechanism which alerts the banker to the need for a close inspection of the borrower or portfolio. In summary, credit risk is complex, and a model which only focuses on a narrow range of criteria, be it asset values or serviceability, is unlikely to perform well in predicting default in all scenarios. Banks need a range of metrics to measure fluctuating asset values, serviceability and the other broad range of factors contributing to credit risk.
References


Standard & Poor's. (2009). *Australia's Four Major Banks Should Weather Expected Mild Downturn; Ratings Affirmed With Stable Outlooks*.


