The Impact of Contagion on Non-Performing Loans: Evidence from Australia and Canada

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Journal of Business and Policy Research
Vol. 7. No. 2. July Issue. Pp. 13 – 24

The Impact of Contagion on Non-Performing Loans: Evidence from Australia and Canada

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Despite Canadian and Australian banks being widely perceived as having weathered the storm of the Global Financial Crisis (GFC) very successfully, the impaired assets (also known as non-performing loans) of both these two countries increased several fold during this crisis. Previous studies in other countries have tended to focus on the impact of bank specific factors, such as size and return on equity, in explaining bank risk. Our approach involves including those traditional variables, plus Distance to Default (DD), and a novel contagion variable, which is the effect of major global bank DD on Australian and Canadian non-performing loans. The study incorporates all twenty two listed Australian and Canadian Banks and uses a fixed effects panel data regression over the period 1999-2008. Robustness checks include correlation and VIF analysis as well a two stage least squares model as an alternative. We find that bank specific balance sheet and income statement factors are not good explanatory variables for bank risk. In contrast, the contagion variable is significant in explaining Canadian and Australian bank risk, which suggests that prudential regulators should look to specifically allocate a portion of regulatory capital to deal with contagion effects.

JEL Codes: G01, G21

1. Introduction

The relative success of Australian and Canadian banks in weathering the Global Financial Crisis (GFC) has been noted by a number of commentators. Their earnings, capital levels and credit ratings have all been a source of envy for regulators of banks in Europe, America and the United Kingdom. The G-20 and the European Union have tried to identify the features of the Canadian and Australian financial systems which have underpinned this success in order to use them in shaping a revised international regulatory framework.

The popular press contains many references to how the two countries are similar (e.g. Sales, 2003). Academic research has also identified similarities as well as differences in a number of different contexts (e.g. Brooks, 2009; Allen & Powell, 2010; Allen, Boffey, & Powell, 2011). MacMillan & McKenzie (2002) provide a detailed analysis of how the various relations between Canada and Australia have changed during the twentieth century. They conclude that similarities between the two countries have underpinned the cooperation and cordiality that is a feature of the relationship.

Canada and Australia share many similarities but also some differences. Their geography involves small populations living mainly in large cities, with large parts of each continent being uninhabited and possessing substantial mineral wealth. The

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Queen of Australia and the Queen of Canada is the same person, which reflects their shared British heritage. Differences are found in their locations: one in the northern hemisphere close to the USA and the other far away in the southern hemisphere close to Asia.

With the occurrence of the Global Financial Crisis (GFC), a new area of similarity between the two countries has emerged: "the relative resilience of our banking sectors" (Stevens, 2009). In this speech, RBA Governor Stevens highlights how Canadian and Australian banks lent more conservatively and held only modest amounts of the complex securities which have plagued banks in other countries, allowing them to emerge from the GFC "… largely free of serious problems" (Stevens, 2009). Other authors have reached similar conclusions. Dickinson (2010a, 2010b) identifies a number of factors, including the past conservatism of Canadian and Australian regulatory requirements regarding capital adequacy; the lack of compromised lending standards; and a focus on domestic lending. Ratnovski and Huang (2009) undertake similar analysis, but only focus on Canadian banks and their balance sheets. The benefit of strong bank regulation in Canada and Australia is a sentiment also echoed by Smith (2010). Dickinson notes that both the European Union and the G-20 are looking to modify their banking regulations in the light of the Canadian and Australian experience.

Despite this promotion of Canada and Australia as exemplars of bank regulation in the time of a GFC, however, both countries experienced a sharp increase in impaired assets (as shown in section 2), fivefold for Australia and more than double for Canada. The current research question to investigate what factors determined this increase in impaired assets, and more specifically whether bank risk in these countries is most influenced by bank specific variables or contagion arising from key global markets. Potentially, this is important research because it may identify peculiarities of Australian and Canadian banks as well as determine the role of contagion in influencing bank risk. This study adds to previous studies through incorporation of two novel aspects. Firstly, it includes of Distance to Default (DD as measured by the Merton, 1974 structural model) of Australian and Canadian Banks an explanatory variable of bank risk. Secondly, it investigates the impact of global default risk on Australian and Canadian banks by using DD of US and European Banks as a measure of contagion. The study finds that contagion is a far more significant determinant of Australian and Canadian bank risk than bank specific variables.

The next section of the paper provides background information on the banking industry in Australia and Canada, together with a literature survey on determinants of bank risk. Section 3 deals with data and methodology. Section 4 covers the findings and discussion, with conclusions and implications provided in Section 5.

2. Literature Review

2.1 The Banking Industry in Australia and Canada

The Australian Prudential Regulation Authority (APRA) regulates all Authorised Deposit-taking Institutions (ADI's) in Australia. As per statistics from APRA (2009) and the RBA (2009a), ADI's comprise 58 banks, 11 building societies, and 129 credit unions. Of the 58 banks, 13 are Australian-owned comprising 88 % of total bank assets. The remainder are subsidiaries or branches of foreign banks, comprising 12 % of total bank assets. The four major banks (Westpac, ANZ, National Australia Bank, and Commonwealth Bank) comprise approximately 75 % of all ADI assets.

The Canadian Bank regulator is the Office of the Canadian Superintendent of Financial Institutions (OSFI). Figures provided by the OSFI (2009) show Canada has a total of 78 banks with assets totalling USD $3 trillion. Twenty two of these are domestic banks, with the others being primarily branches of foreign banks. Of the 22 domestic banks, 9 are public companies listed on the Toronto Stock Exchange. The ‘Big 5’ banks (Royal Bank of Canada, Toronto-Dominion Bank, Bank of Nova Scotia, Bank of Montreal, and Canadian Imperial Bank) have total assets of USD $2.4 trillion, which is approximately 80% of the total Canadian domestic banking market.

It is important to examine impaired assets, given this is our dependent variable. Table 1 shows growth in total and impaired assets. Australian and Canadian banks continue to grow total assets over the GFC period. Total assets in Australian banks doubled over the 5 years to 2009, a slightly higher growth rate than for Canada. Impaired assets for Australia showed a fivefold increase from 2007 - 2009. However, because this is off a low base of 0.19%, the peak of 0.95% is very low in comparison to international standards. Canadian banks more than doubled their increase in impaired assets from 0.4% to 0.9%, but off a higher base. In comparison to Australia and Canada, the US (Federal Reserve Bank, 2009) and UK (Bank of England, 2009) showed delinquency rates more than trebling from 2007 to 2009 from 2.4% to 8.8% and from 2.1% to 6.6% respectively.

Table 1: Key Growth and Risk Indicators for Australian Banks

	Australia		Canada	
	Total assets ($bn)	Impaired assets (%)	Total assets ($bn)	Impaired assets (%)
Mar-2000	989	0.6	1,431	1.1
Mar-2001	1,176	0.6	1,577	1.4
Mar-2002	1,153	0.7	1,651	1.6
Mar-2003	1,216	0.6	1,703	1.6
Mar-2004	1,396	0.4	1,754	1.1
Mar-2005	1,536	0.3	1,877	0.6
Mar-2006	1,764	0.2	2,083	0.5
Mar-2007	2,016	0.2	2,375	0.4
Mar-2008	2,463	0.3	2,727	0.5
Mar-2009	2,694	1.0	3,021	0.9

Figures are calculated from RBA Statistics (2009b) for Australian banks and OSFI (2009) for Canadian banks. For comparison purposes, all amounts are in USD.

DD is a key explanatory variable in our study. As Equity (capital) ratios are a key component to measuring this DD, as discussed in our methodology section, we present a summary of the capital ratios for Australia and Canada at 2008, the height of the GFC. Tier 1 and total capital ratios for both countries in Table 2 are well above the regulatory requirements of 4% and 8% respectively. Total equity ratio (shareholders funds to total assets) is substantially lower than the total capital ratio for both countries, in line with their high housing loan component which attracts a lower risk weighting than commercial borrowers. The equity ratios for Australian and Canadian banks is substantially higher than the ratio of 3.5% we have calculated for European banks, but somewhat lower than the 7.1% for the US.

Table 2: Capital and Equity Ratios 2008

	Tier 1 Capital (%)	Total Capital (%)	Equity Ratio (%)
Australia	8.4	11.4	6.2
Canada	11.8	14.5	5.2

Figures for both countries are taken at quarterly reporting date March 2009, or closest reporting date to it. Tier 1 and Total Capital figures are as reported by the banks in accordance with Basel requirements.

Overall, this section shows substantial increases in Australian and Canadian bank impaired assets, albeit at modest levels compared to other major global areas.

2.2 Determinants of Bank Risk

Prior studies, in various countries, are mixed in their findings as to determinants of bank risk (such as share price volatility and default), with independent variables including a variety of balance sheet and profitability items such as size, profitability and equity. Several studies have considered diversification of bank income sources (such as interest versus non-interest income and loans versus non-loan assets) as a determinant of bank risk (for example, Acharya, Hasan, & Saunders, 2006; Allen & Powell, 2010; Cornett, Ors, & Tehranian, 2002; De Young & Roland, 2001; Saunders & Walter, 1994; Stiroh, 2004; Stiroh, 2006; Stiroh & Rumble, 2006). Other studies find that balance sheet and income statement items or ratios provide little explanation of bank risk, and that changes in volatility and default are often caused by external shocks or contagion. Several studies have considered the contagion aspect using contagion measures such as correlation of corporate defaults, credit default swaps, macroeconomic factors and Value at Risk (for example, Allen, Powell, Kramadibrata & Singh, 2011; Das, Duffie, Kapadia, & Saiata, 2007; Davis & Lo, 2001; Giesecke & Weber, 2004, 2006; Jorion & Zhang, 2007; Liao & Chang, 2010; Lonstaff & Rajan, 2008; Rosch & Winterfeldt, 2008). There are also some notable studies which look at determinants of bank capital (Gropp & Heider, 2009; Kuo, 2003; Ngo, 2008; Rime, 2001) which have some common independent variables to those used by the abovementioned studies of determinants of bank volatility and default.

3. Methodology

3.1 Data

We include all 13 Australian listed banks and 9 listed Canadian banks. For Australia this includes the 4 major banks and 9 smaller / regional banks (88% of total bank assets in Australia). In Canada this includes the ‘Big 5’ and 4 smaller banks (over 80% of total bank assets in Canada). All data is obtained from Datastream, including 10 years of daily equity prices for each bank, together with required balance sheet data for calculating DD as described below.

3.2 DD Methodology

We measure distance to default (DD) using Merton (1974) structural methodology. The firm defaults when asset values fall below debt levels. Moody's KMV model (Crosbie & Bohn, 2003) is based on the Merton model, and is widely used by banks to measure DD. Based on the thousands of defaulted firms in their worldwide database, KMV find that DD is most accurately measured when debt is taken as short-term liabilities (one year and under) plus half the book value of all long term debt outstanding. This is the approach used in this study. Using equity returns and the relationship between equity and assets, we estimate an initial asset return. Daily log return is calculated and new asset values estimated for every day. Following KMV, this is repeated until asset returns converge. The standard deviation of these asst returns (σv) is used in the calculation of DD as follows:

$$DD = \frac{\ln(V/F) + (\mu - 0.5\sigma_v^2)T}{\sigma_v \sqrt{T}} \tag{1}$$

Where V is the market value of the firm, F = face value of firm's debt, and μ = an estimate of the annual return (drift) of the firm's assets. T is usually set as 1 year.

3.3 Multiple Regression

Impaired assets (also known as non-performing loans) is the dependent variable (*NPL*), with separate fixed effects regressions for Australia and Canada. This is confirmed via the Hausman test to be the most appropriate option with panel data for each bank for each of the 10 years in our dataset (1999 -2008). Drawing on key prior studies identified in section 2, as well as including *DD* and *Contagion* (explained after the equation), we use the following variables:

$$\begin{aligned} NPL_{it} = {} & \beta_1 Size_{it} + \beta_2 Equity_{it} + \beta_3 ROE_{it} + \beta_4 LA_{it} + \beta_5 CLL_{it} + \beta_6 INTI_{it} \\ & + \beta_7 DD_{it} + \beta_8 Contagion_{it} + \alpha_i + \varepsilon_{it} \end{aligned} \tag{2}$$

NPL is the percentage of non-performing loans (or impaired assets as described in Table 1). *Size* is the natural logarithm of total balance sheet assets. *Equity* is total balance sheet equity / total balance sheet assets. *ROE* is net profit before tax / total balance sheet equity. *LA, CLL and INTI* are measures of diversification. *LA* is total balance sheet loans / total balance sheet assets. *CLL* is commercial loans (as opposed to residential) / total loans. *INTI* is gross interest income / total income. *DD* is the distance to default for each Canadian or Australian bank. *Contagion* is global DD which is the combined DD of Europe and US which we calculate for listed banks in these regions in the same way as we calculate it for Australia and Canada per section 3.2. Note that we also examined *ROA* as an alternative to *ROE*, and *Tier 1 Capital* ratio as an alternative to *Equity* ratio. We selected *ROE* and *Equity* as they provided a slightly better fit in term of R^2 than the alternate measures, and to avoid multicollinearity we excluded the alternate measures. A variety of lags were applied to each of the variables, but no lagging of variables significantly improved any of the outcomes and so lags are not reported here.

As high pair-wise correlations and Variance Inflation Factors (VIF) are indicators of a multicollinearity threat, we calculate and report on these factors prior to undertaking our regression analysis. In the event of collinear variables being identified, these would need to be dropped from the model.

We also undertake a number of variations on the variables in the fixed effects model. These serve as a robustness check and can assist in improving the estimation of the model. Firstly, given that *Contagion* is central to our research questions, we estimate the fixed effects model both with and without *Contagion*, to clearly see the impact of this variable. Secondly, as fixed effects models can suffer from problems such as endogeneity or reverse causality, we also incorporate an instrumental method, two stage least squares (2SLS), which can be useful in overcoming such problems and serve as an alternative method in helping to test the robustness of the fixed effects model. Thirdly, as current year *NPL* may be affected by previous year *NPL*, we estimate a panel regression model which incorporates a lagged dependent variable (*NPL-1*) as an explanatory variable.

We have 9 Canadian banks and 13 Australian banks over a period of 10 years, which does not provide a very high number of observations. Therefore, in addition to estimating the model for the individual countries, we pool the data for both countries and estimate the combined model. We also report on both R^2 and *adjusted* R^2, given that R^2 does not take into account the number of observations and will always increase when variables are added. *Adjusted* R^2 does factor in the number of observations, only increasing if the new variables improve the model more than mere chance would do, and could therefore be a more appropriate indicator in our case, where we are adding variables and the number of observations is not that high.

4. Findings and Discussion

We commence by showing our VIF and correlation results in table 3.

Table 3: VIF and Correlation

Australia

VIF		*DD*	*Size*	*Equity*	*ROE*	*LA*	*CLL*	*INTI*	*Contagion*
1.446	DD	1.000							
3.061	Size	-0.047	1.000						
1.637	Equity	0.010	-0.514	1.000					
2.437	ROE	-0.115	-0.388	0.229	1.000				
4.511	LA	-0.133	-0.541	0.444	0.198	1.000			
4.085	CLL	-0.051	0.432	-0.345	-0.138	-0.432	1.000		
3.018	INTI	-0.150	0.294	-0.419	-0.056	0.121	-0.135	1.000	
1.106	Contagion	0.282	-0.007	-0.010	0.049	0.008	-0.049	-0.113	1.000

Canada

VIF		*DD*	*Size*	*Equity*	*ROE*	*LA*	*CLL*	*INTI*	*Contagion*
2.717	DD	1.000							
4.953	Size	0.126	1.000						
2.071	Equity	0.050	-0.477	1.000					
1.227	ROE	0.228	-0.137	0.207	1.000				
4.882	LA	-0.128	-0.542	0.469	0.089	1.000			
1.452	CLL	-0.240	-0.187	0.152	-0.237	0.089	1.000		
3.063	INTI	-0.340	-0.512	0.414	-0.181	0.592	0.387	1.000	
2.791	Contagion	0.477	0.014	-0.080	0.204	-0.057	-0.174	-0.347	1.000

Combined

VIF		*DD*	*Size*	*Equity*	*ROE*	*LA*	*CLL*	*INTI*	*Contagion*
1.305	DD	1.000							
3.144	Size	-0.112	1.000						
3.611	Equity	0.075	-0.491	1.000					
1.142	ROE	0.113	0.147	-0.206	1.000				
4.540	LA	0.011	-0.537	0.437	-0.208	1.000			
2.211	CLL	-0.212	0.397	-0.389	0.174	-0.546	1.000		
4.049	INTI	-0.199	0.177	-0.475	0.138	0.159	0.012	1.000	
1.181	Contagion	0.319	0.000	-0.010	0.125	-0.015	-0.070	-0.156	1.000

The far left column shows Variance Inflation Factors (VIF) which measure the extent of muticollineariaty. The remaining figures show pair-wise correlations between all the explanatory variables. The combined figures include both Australia and Canada.

There are no VIF or correlation numbers that would indicate high multicollinearity concerns. Whilst there are no fixed rules as to what level of VIF or correlations should be excluded, generally VIF>10 or correlations >0.8 would definitely be cause for exclusion or investigation. Our numbers are well below this. This is because, as mentioned in Section 3.3, we have already excluded measures showing multicollinearity. We thus move on to the next step of our analysis which is to estimate our fixed effects model both without and with *Contagion*.

Results are shown in Table 4.The model excluding *Contagion* does not provide a good explanation for *NPL* with R^2 of only 0.306 for Australia (*DD* being the only significant item) and 0.493 for Canada (*DD* being the most significant item, with lesser significance shown for *Size* and *Equity*). *Adjusted* R^2 is very low especially for Australia. We note that these bank specific variables have slightly more explanatory power for Canada (and *Contagion* less) as compared to Australia which we attribute to the higher country specific *NPL* experienced by Canada in the earlier years of our data sample. R^2 and *adjusted* R^2 increase substantially and the two measurements come closer together, especially for Australia, when including *Contagion*. Findings are generally consistent with the studies mentioned in section 2.2., which found that balance sheet and income statement factors are not a good indicator of bank risk and that external shocks caused by global contagion (as measured by global *DD* in our study) can have a significant impact.

Table 4: Risk Determinants

Excluding Contagion

	Australia			Canada			Combined		
	Coefficient	t		Coefficient	t		Coefficient	t	
Size	-0.091	-1.282		-0.256	-1.752	*	-0.165	-1.887	*
Equity	-0.083	-0.258		-19.220	-2.351	**	-1.133	-2.040	**
ROE	-0.028	-0.148		-0.199	-1.307		-0.701	-2.070	**
LA	-0.580	-1.373		0.199	0.211		0.761	1.546	
CLL	0.383	1.251		-0.788	-0.621		-0.361	-0.848	
INTI	0.008	0.952		0.199	0.239		1.139	2.843	***
DD	-0.025	-6.382	***	-0.066	-3.968	***	-0.021	-3.611	***
Constant	2.015	1.988	**	14.215	4.830	***	2.589	1.637	
R^2	0.306			0.493			0.483		
Adjusted R^2	0.186			0.382			0.407		

Including Contagion

	Australia			Canada			Combined		
	Coefficient	t		Coefficient	t		Coefficient	t	
Size	-0.053	-1.462		-0.128	-1.166	*	-0.029	-0.427	
Equity	-0.054	-0.324		-16.291	-2.628	**	-0.007	-0.015	
ROE	-0.079	-0.782		-1.451	-2.422	**	-0.714	-2.774	***
LA	-0.079	-0.782		0.482	0.681		0.893	2.358	**
CLL	0.108	0.675		-1.682	-1.803	*	-0.635	-1.934	*
INTI	0.007	0.149		0.002	1.005		-0.583	-0.179	
DD	-0.004	-1.542		-0.048	-2.583	**	-0.008	-1.565	
Constant	2.014	1.988	***	10.180	4.639	***	1.462	1.197	
Contagion	-0.120	-17.300	***	-0.268	-8.490	***	-0.152	-11.530	***
R^2	0.815			0.747			0.695		
Adjusted R^2	0.780			0.686			0.649		

The table shows regression results with *NPL* as the dependent variable. The regression includes panel data for the ten years 1999 – 2008 with bank fixed effects. Independent variables are shown in the first column, as defined in Section 3.3. */**/*** denote significance at the 90/95/99 percent levels respectively. The top half of the table includes bank specific variables only, whereas the bottom half includes contagion.

To investigate whether the fixed effects model suffers from endogeneity or reverse causality, and as a robustness check to our fixed effects model, we included as an alternative a two stage least squares instrumental (2SLM) method in our analysis. Several studies on banks have treated various risk measures and capital as endogenous (Aggarwal & Jacques, 1998; Ngo, 2008; Rime, 2001; Shrieves & Dahl, 1991) with interdependent relationships existing between these variables as well as external shocks impacting on them. In our case, there is a complex relationship between *DD*, global *DD* (*Contagion*), *NPL* and Capital (*Equity*). External shocks could lead to increased risk, causing *DD* and global *DD* to reduce and *NPL* to increase. Banks will need to increase regulatory capital to deal with increased risk. Losses as a result of these shocks could erode *Equity*. *Equity*, in turn, is a component of *DD* (the distance between assets and liabilities per equation 1). One year lags have commonly been used in studies as instrumental variables for capital and risk factors. Relationships have also been found between stock market returns and capital (Baker & Wurgler, 2002; Ngo, 2008) with stock market returns having been deemed a suitable instrumental variable for capital. This is because banks potentially time the market and issue capital when returns are highest and costs are lowest. Our instrumental variables thus incorporate stock market returns for *Equity* and one year lags for *Equity*, *DD* and *Contagion* (we model various combinations, including one instrumental variable at a time as well as different combinations of two and three variables). Stock market returns are based on the S&P/ASX200 (Australia) and the S&P/TSX index (Canada). Hausman tests finds in favour of the fixed effects model and in the interest of avoiding unnecessary over-reporting of rejected results, we have restricted our tables to fixed effects.

Because current year *NPL* may be affected by previous year *NPL*, we include a re-estimation of the fixed effects model by incorporating a one year lagged dependent variable (*NPL-1*) as an explanatory variable. These results are shown in Table 5.

Table 5: Lagged *NPL* as an explanatory variable

	Australia			Canada			Combined		
	Coefficient	t		Coefficient	t		Coefficient	t	
Size	-0.058	-2.020	**	-0.228	-2.426	**	-0.060	-0.861	
Equity	-0.141	-1.145		-15.456	-2.022	**	-0.369	-0.821	
ROE	-0.126	-1.553		-1.897	-3.679	***	-1.088	-3.857	***
LA	-0.187	-1.239		-1.071	-1.588		0.260	0.683	
CLL	-0.045	0.404		-0.196	-0.459		0.180	0.503	
INTI	-0.007	1.240		-1.589	-2.090	**	-0.527	-1.390	
DD	-0.002	-0.819		-0.044	-2.603	**	-0.015	-2.728	***
Contagion	-0.141	-19.380	***	-0.137	-3.141	***	-0.826	-4.513	***
NPL-1	0.309	6.760	***	0.618	4.465	***	0.467	5.818	***
Constant	0.022	4.619	***	6.561	2.749	***	1.894	1.526	
R^2	0.882			0.819			0.782		
Adjusted R^2	0.856			0.774			0.742		

NPL is the dependent variable. The regression includes panel data for the ten years 1999 – 2008 with bank and time fixed effects. Independent variables are shown in the first column, as defined in Section 3.3. */**/*** denote significance at the 90/95/99 percent levels respectively. The model is the same fixed effects model shown in the bottom half of Table 4, with the addition of a one year lagged NPL as an explanatory variable.

We see that our lag factor *NPL-1* is a significant variable for Australia, Canada, and the combined model. It has also raised the goodness of fit quite markedly, with noticeably higher R^2 and *adjusted* R^2 for both countries and the combined model. This is likely because during the pre-GFC period, there were a number of successive years of low NPLs for Australia, whereas Canada had four years of high *NPL*s followed by four successive years of low *NPL*s.

5. Conclusion

The study has added to prior studies by incorporating the two novel aspects of *DD* and *Contagion* (global *DD*) as determinants of bank risk. Although banks in these two countries fared substantially better than their global counterparts during the GFC, both regions nonetheless experienced a significant increase in risk as measured by impaired assets. For both countries, collective balance sheet and income statement characteristics were not found to be a good predictor of bank risk, but global contagion was found to be highly significant. At present, Basel regulation focuses primarily on risk-weighted assets of banks as the main criteria for measuring credit risk for capital adequacy purposes. However, the low balance sheet significance and high contagion aspect makes it important for regulators and banks in smaller countries such as Australia and Canada to factor in potential external shocks as a key component of risk measurement and management.

The study is limited to twenty two banks, given that these are the only listed Australian and Canadian Banks. There is future scope for widening the study to incorporate other smaller areas, such as in Africa, Asia and New Zealand to ascertain the impact of US and UK led events on their banks. Expanding the study to include other areas might also lead to improved fixed effects estimation due to an increased number of observations.

Acknowledgements

The authors would like to thank the Australian Research Council for funding support. We thank participants at the 2011 World Institute Conference in Bangkok and an anonymous reviewer for their helpful comments in improving the paper.

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