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David E. Allen  
*Edith Cowan University*

Ray R. Boffey  
*Edith Cowan University*

Robert J. Powell  
*Edith Cowan University*

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# **Survival of the fittest: contagion as a determinant of Canadian and Australian bank risk**

By

**D. E. Allen, R. R. Boffey and R. Powell**

School of Accounting, Finance and Economics, Edith Cowan University

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Correspondence author:

Ray Boffey  
School of Accounting, Finance and Economics  
Faculty of Business and Law  
Edith Cowan University  
Joondalup, WA 6027  
Australia  
Phone: +618 6304 5264  
Fax: +618 6304 5271  
Email: r.boffey@ecu.edu.au

## ABSTRACT

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. Despite this perceived success, the impaired assets (also known as non-performing loans) of banks in both countries increased several fold over the GFC, and we investigate the determinants of this, using impaired assets as our measure of bank risk. 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 banks. Using panel data regression over the period 1999-2008, we find that various 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.

**Keywords:** Bank risk; Distance to default; Impaired assets; Panel regression

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## 1. Introduction

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 relatively uninhabited and possessing substantial mineral wealth. The 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.

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.

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 aims 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 has two novel aspects. Firstly, it includes 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 Australian and Canadian banks in 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 the 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 asset returns ( $\sigma$ ) is used in the calculation of DD as follows:

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

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.  $T$  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:

$$NPL_{it} = \beta_1 Size_{it} + \beta_2 Equity_{it} + \beta_3 ROE_{it} + \beta_4 LA_{it} + \beta_5 CLL_{it} + \beta_6 INTI_{it} + \beta_7 DD_{it} + \beta_8 Contagion_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

$NPL$  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.

## 4. Findings and Discussion

Results are shown in Table 3.  $R^2$  is shown at 2 levels; excluding and including  $Contagion$ . 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  $Equity$ ).  $R^2$  increases substantially, 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. We note that bank specific variables have slightly more explanatory power for Canada as compared to Australia (and  $Contagion$  slightly less) which we



attribute to the higher country specific *NPL* experienced by Canada in the earlier years of our data sample.

**Table 3. Risk Determinants**

	Australia		Canada	
	Coefficient	t	Coefficient	t
<i>Size</i>	-0.091	-1.282	-0.256	-1.752 *
<i>Equity</i>	-0.083	-0.258	-19.220	-2.351 **
<i>ROE</i>	-0.028	-0.148	-0.199	-1.307
<i>LA</i>	-0.580	-1.373	0.199	0.211
<i>CLL</i>	0.383	1.251	-0.788	-0.621
<i>INTI</i>	0.008	0.952	0.199	0.239
<i>DD</i>	-0.025	-6.382 ***	-0.066	-3.968 ***
<i>Constant</i>	2.015	1.988 **	14.215	4.830 ***
$R^2$ - excluding contagion	0.306		0.493	
$R^2$ - including contagion	0.815		0.720	

The table shows regression results with *NPL* as 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.

## 5. Conclusions and Implications

Although both Australian and Canadian banks 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. 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.

## References

- Acharya, V. V., Hasan, I., & Saunders, A. 2006. "Should banks be diversified? Evidence from individual bank loan portfolios". *Journal of Business*, vol. 79, no. 3, pp. 1355-1412.
- Allen, D. E., Boffey, R. R., & Powell, R. J. 2011. "Peas in a pod: Canadian and Australian banks before and during a global financial crisis". Working paper Edith Cowan University. Retrieved 26 August, 2011. Available at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1884084](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1884084)
- Allen, D. E., Kramadibrata, A. R., Powell, R. J., & Singh, A. K. 2011. Bank risk: Does size matter? Paper presented at the Econometrics Society Australasian Meeting Adelaide.
- Allen, D. E., & Powell, R. J. 2010. "The fluctuating default risk of Australian banks". Working Paper, Edith Cowan University. Retrieved 26 August, 2011. Available at <http://www.ecu.edu.au/schools/accounting-finance-economics/research-activity/working-papers>
- APRA. 2009. List of authorised deposit-taking institutions. Retrieved 27 August 2009. Available at <http://www.apra.gov.au/ADI/ADIList.cfm>
- Bank of England. 2009. Bankstats. Retrieved 12 January 2010. Available at <http://www.bankofengland.co.uk/statistics/>
- Brooks, K. 2009. "Tax treaty treatment of royalty payments from low-income countries. A comparison of Canada and Australia's policies". *eJournal of Tax Research*, vol. 5, no. 2, pp. 168-197.
- Cornett, M. M., Ors, E., & Tehranian, H. 2002. "Bank performance around the introduction of a Section 20 subsidiary". *Journal of Finance*, vol. 52, no. 1, pp. 501-521.
- Crosbie, P., & Bohn, J. 2003. Modelling default risk. Retrieved 20 July 2011. Available at <http://www.moodyskmv.com/research/files/wp/ModelingDefaultRisk.pdf>
- Das, S., Duffie, D., Kapadia, N., & Saiata, L. 2007. "Common failings: How corporate defaults are correlated". *Journal of Finance*, vol. 62, pp. 93-117.
- Davis, M., & Lo, V. 2001. "Infectious defaults". *Quantitative Finance*, vol. 1, pp. 382-387.
- De Young, R., & Roland, K. P. 2001. "Product mix and earnings volatility at commercial banks: Evidence from a degree of total leverage model". *Journal of Financial Intermediation*, vol. 10, pp. 54-84.
- Dickinson, A. 2010a. Canadian economy and major banks: A Comparison with Australia (KPMG Study). Retrieved July 4, 2011. Available at <http://www.kpmg.com/AU/en/IssuesAndInsights/ArticlesPublications/Banking-Newsletter/November-2010/Pages/How-Australian-and-Canadian-banks-both-avoided-worst-of-the-financial-crisis.aspx>
- Dickinson, A. 2010b. How Australian and Canadian Banks both avoided the worst of the financial crisis. Retrieved July 4, 2011. Available at <http://www.kpmg.com/AU/en/IssuesAndInsights/ArticlesPublications/Banking->

[Newsletter/November-2010/Pages/How-Australian-and-Canadian-banks-both-avoided-worst-of-the-financial-crisis.aspx](http://www.federalreserve.gov/Newsletters/November-2010/Pages/How-Australian-and-Canadian-banks-both-avoided-worst-of-the-financial-crisis.aspx)

- Federal Reserve Bank. 2009. Federal Reserve statistical release. Charge-off and delinquency rates. Retrieved 27 December 2009. Available at [www.federalreserve.gov](http://www.federalreserve.gov)
- Giesecke, K., & Weber, S. 2004. "Cyclical correlations, credit contagion, and portfolio losses". *Journal of Banking and Finance*, vol. 28, pp. 3009-3096.
- Giesecke, K., & Weber, S. 2006. "Credit contagion and aggregate losses". *Journal of Economic Dynamics and Control*, vol. 30, pp. 741-767.
- Gregoriou, G. N. 2009a. *The VaR Implementation Handbook*. New York: McGraw Hill.
- Gregoriou, G. N. 2009b. *The VaR Modeling Handbook*. New York: McGraw Hill.
- Gropp, R., & Heider, F. 2009. "The determinants of bank capital structure". *Review of Finance*, vol. 14, no. 4, pp. 1-36.
- J.P. Morgan, & Reuters. 1994, 1996. *RiskMetrics Technical Document*.
- Jorion, P. 1996. *Value at Risk: The New Benchmark for Controlling Derivative Risk*. Irwin Professional Publishing.
- Jorion, P., & Zhang, G. 2007. "Good and bad credit contagion: Evidence from credit default swaps". *Journal of Financial Economics*, vol. 84, pp. 860-883.
- Kuo, H.-C., & Lee, C.-H. . 2003. "The determinants of the capital structure of commercial banks in Taiwan". *International Journal of Management*, vol. 20, no. 4, pp. 515 - 522.
- Liao, S., & Chang, J. 2010. "Economic determinants of default risks and their impacts on credit derivative pricing". *The Journal of Futures Markets*, vol. 30, no. 11, pp. 1058-1081.
- Lonstaff, F., & Rajan, A. 2008. "An empirical analysis of the pricing of collateralized debt obligations". *Journal of Finance*, vol. 63, pp. 529-563.
- MacMillan, M., & McKenzie, F. 2002. *Parties Long Estranged: Canada and Australia in the Twentieth Century*. Vancouver: UBC Press.
- Merton, R. 1974. "On the pricing of corporate debt: The risk structure of interest rates". *Journal of Finance*, vol. 29, pp. 449-470.
- Ngo, P. T. H. 2008. *Capital-risk decisions and profitability in banking: Regulatory versus economic capital*, 21st Australasian Finance and Banking Conference.
- Office of the Superintendent of Financial Institutions Canada. 2009. Financial data - banks. Retrieved 12 January 2010. Available at <http://www.osfi-bsif.gc.ca>
- Ratnovski, L., & Huang, R. 2009. Why are Canadian banks more resilient? IMF Working Paper WP 09/152.
- Reserve Bank of Australia. 2009a. The main types of financial institutions in Australia. Retrieved 26 August 2009. Available at <http://www.rba.gov.au/fin-stability/index.html>

- Reserve Bank of Australia. 2009b. Statistics. Retrieved 28 August 2009. Available at <http://www.rba.gov.au/statistics/>
- Rime, B. 2001. "Capital requirements and bank behaviour: Empirical evidence from Switzerland". *Journal of Banking and Finance*, vol. 25, pp. 789-805.
- Rosch, D., & Winterfeldt, B. 2008. "Estimating credit contagion in a standard factor model". *Risk*, vol. 21, pp. 78-82.
- Sales, L. 2003. Australia - Canada comparisons. Retrieved July 4, 2011. Available at <http://www.abc.net.au/worldtoday/stories/s801557.htm>
- Saunders, A., & Walter, I. 1994. *Universal Banking in the United States: What Could We Gain? What Could We Lose?* New York: University Oxford Press.
- Smith, P. 2010. Australian regulator hits out at global tax plans. *Financial Times*.
- Stevens, G. 2009. Australia and Canada - Comparing notes on recent experiences, Canadian Australian Chamber of Commerce Canada-Australia Breakfast, 19 May 2009. Sydney.
- Stiroh, K. J. 2004. "Diversification in banking: Is non-interest income the answer?". *Journal of Money, Credit and Banking*, vol. 36, no. 5, pp. 853-882.
- Stiroh, K. J. 2006. "New evidence on the determinants of bank risk". *Journal of Financial Services Research*, vol. 30, no. 3, pp. 267-263.
- Stiroh, K. J., & Rumble, A. 2006. "The darkside of diversification: The case of U.S. financial holding companies". *Journal of Banking and Finance*, vol. 30, no. 8, pp. 2131-2161.