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THE IMPACT OF THE GLOBAL FINANCIAL CRISIS ON AUSTRALIAN BANKING EFFICIENCY

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Abstract

The theory of financial stability postulates that financial institutions in a country experiencing financial crisis would witness productivity losses. This study examined whether they experience productivity losses when there is no crisis, and whether the financial sector is not immune from global economic events. The Australian financial institution efficiency and productivity during 1999-2009 were examined, that is, after the financial system reforms but the test period includes the financial crisis years. Efficiency scores were computed using Stochastic Frontier Analysis and total factor productivity using Malmquist indices. Australian institutions were found to have experienced productivity decline during the global financial crisis. The evidence is just the opposite of the common belief that Australian institutions remained *insulated* from the crisis. Global economic slowdown can also lead to productivity losses in a country not experiencing severe financial crisis because of the reforms taken long before the crisis to improve prudential oversight of the financial institutions in Australia.

Keywords: Total factor productivity, Cost efficiency, Profit efficiency, Global Financial Crisis, Financial firms size

JEL Classification: G2, O3, G11

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1. Introduction

Theory of financial stability suggests that inefficiencies or instability in the system are associated with welfare costs (the deviation from the nexus between

savings-investments). However, 'there have been few (if any) studies evaluating precisely the *direct* welfare costs associated with financial instability and financial inefficiency (Haldane, Hoggarth, & Saporta 2001). The welfare costs often take the form of output losses. Hoggarth, Reis, and Saporta (2001) in their study of 43 banking crises found that average output losses were 15-20 % of annual GDP.

What happens, however, when a country is not experiencing a severe banking crisis itself but is still not immune from the financial crisis that pervaded the global economies? Do financial institutions in such an economy experience output losses or productivity decline? Going by the theory, as there would be no financial crisis in Australia from the Global Financial Crisis, the financial institutions should not experience any output losses or productivity decline, or if at all they do, then these would be only marginal. Financial stability theory does not provide guidance, whether there are output losses when a country is not going through financial crisis but cannot avoid the impact of a financial crisis from around the world. Furthermore, theory does not provide a clue what is the magnitude of impact of various macro-economic variables on productivity loss.

This study addressed this gap in the literature for which Australia provides an excellent example. The country did not experience a noticeable banking crisis (of the type witnessed in the US, UK, Japan, and other European countries) though it was affected by the global financial crisis. The productivity and efficiency of Australian financial institutions were examined in the pre and post crisis years. The study however, went a step further and extended the analysis to include financial firms other than banks as well.

Against the above background, our study of national and international importance had the following objectives: (a) to measure the efficiency and productivity of Australian financial firms in a 10-year period including the years of financial crisis, (b) to measure the impact of macro-economic variables on productivity, and (c) also to examine how financial crisis affects productivity of the financial firms, including banks, insurance companies, investment, and fund management firms.

The rest of the paper is organised as follows. Section 2 provides a brief review of the relevant literature, that is, financial stability theory and the theory of efficiency and productivity on which the current research draws upon. Section 3 contains a description of the data and methodology. In section 4, the findings of the study are provided, while Section 5 concludes the paper.

2. What Does the Literature Suggest?

As already stated, the current work drew from two related theories, that is, the theory of financial stability, and the literature on economic efficiency and productivity.

In his seminal work on the theory of financial stability, Crockett (1997) stated that "monetary and financial stability are of central importance to the effective functioning of a market economy. They provide the basis for rational

decision making about the allocation of real resources through time and therefore improve the climate for saving and investment". Schinasi (2005), however, stated that "no framework exists now either for measuring the efficiency losses associated with market imperfections in finance or for assessing the risks to financial stability associated with market imperfections". Goodhart, Sunirand, and Tsomocos (2006) preseneted a model that highlights "the trade-off between financial stability and economic efficiency". The model does take into account the individual behaviour of banks, but analyses the trade-off from regulatory and monetary policy perspectives.

Empirical evidence that highlights the trade-off between bank behaviour as reflected in the institutional economic efficiency and financial stability was not found in the literature, save a recent study on Japanese banks. The Japanese banking sector study by Jones and Tsutsumi (2009) examined the financial stability and banking efficiency in Japan. These authors found that Japanese banking sector could withstand the global crisis but did result in sharp contraction in output. These authors recommended improving the efficiency of banking sector for greater stability. It is important to note that the Japanese government did inject capital into banks, which helped avoid the potential crisis in the banking sector in that country.

On the background of this, Australia presents a unique example. There was no fiscal aid provided to banks except for a government deposit guarantee and wholesale funding guarantee to ensure smooth flow of credit when the Global crisis hit Australian financial institutions in September 2008. The Australian banking sector did not experience difficulties as in the US, UK, or rest of Europe during the global financial crisis. Consequently, a study of banking sector efficiency in Australia pre and post crisis period could add a unique perspective to extend the literature on financial stability. It is to be noted that central bankers "recognise that efficiency in the banking sector is a key contributor to macroeconomic stability. It is also a precondition for economic growth and is important for the effectiveness of monetary policy" (ADBG, 2009, p.1)

Efficiency and productivity of banks have been a subject matter of study in many countries. "Productivity relates the quantity of output produced to one or more inputs used in its production, irrespective of the efficiency of their use" (OECD, 2004). To compute efficiency, two popular frontier analysis methods used are the parametric stochastic frontier analysis (SFA) and the non-parametric data envelopment analysis (DEA). Malmquist index is the method commonly used in the literature to compute productivity. Caves, Chistensen and Diewest (1982) applied the Malmquist index decomposition for the first time in productivity analysis. This method defines an index as a ratio of two frontier distance functions, which represent multiple inputs and multiple outputs technology without a need to specify a firm's behavioural objective, such as profit maximisation or cost minimisation. Over the years, many studies examined the efficiency of banks, but these were mainly confined to the US and Europe. Berger and Humprey (1997) surveyed 130 studies covering 21 countries and

found that non-parametric measures of efficiency yield a mean efficiency statistic slightly "lower with a large dispersion: parametric measures provide a slightly higher efficiency with lower dispersion statistics". For financial firms, the averages reported were 0.72 and 0.84 respectively.

Australian studies on financial institution efficiency have been few. Avkiran (1999) found evidence of efficiency gains post merger in Australian banking sector. Sathye (2001) studied the x-efficiency of Australian banks in 1996 using data envelopment analysis and found it to be low. Strum and Williams (2004) studied the impact of foreign bank entry and deregulation on bank efficiency, and found that foreign banks were more efficient than their domestic counterparts. Neal (2004) found that productivity in Australian banks "total factor productivity in the banking sector was found to have increased by an average annual 7.6% between 1995 and 1999". This author found that efficiency does impact stock returns.

The authors of this present study did not come across a study that examined the impact of the financial crisis on Australian financial sector efficiency and productivity. Similarly the impact of contextual and environmental variables on banking efficiency is yet to be explored in the Australian context, though a few studies overseas explored the issue in other countries. Some recent studies included Liadaki and Gaganis (2009), that examined the relationship which exists between profit efficiency and stock prices of banks in 15 countries over a five year period. Ariss (2010) reported significant negative association betwen market power and cost efficency of 81 banks from 60 developing countries across Africa, East and South Asia, the Pacific, and Eastern Europe. Ariff and Luc (2009) studied the the pre and postmerger efficiency of IMF's restructuring of banks in four East Asian countries. Thangavelu and Findlay (2010) studied the determinants of bank efficiency in South Asian economies. Feng and Serletis (2010) found a decrease in productivity of America's large banks over 2000-2005. Berger and De Young (1997), Beard Caudill, and Gropper (1997), and Hunter and Timme (1995) analysed cost efficiency in order for the management and policy maker to identify over or under use of inputs to produce given output(s). Humphrey and Pulley (1997) found that changes in banking environment lead to extra changes in profit efficiency.

Recently studies incorporated the likely impact of environmental variables on bank's efficiency performance. These may be divided into two types of research: internal using bank- specific and external using macroeconomic factors to identify their relationship to efficiency. Common macro-economic factors that may have impact on efficiency performance are gross domestic product (GDP), inflation rate, and inter-bank rate or cash rate. Thoraneenitiyan and Avkiran (2009) examined the impact of restructuring and country-specific factors on East-Asian bank efficiency. They found that macro-economic conditions have more effect on bank's efficiency compared to restructuring policy. In addition, the second study of this kind to-date by Ramlall (2009) found that bank-specific variables such as capital and credit risk affect bank profitability significantly in

Taiwan. Drake, Maximilian, and Simper, (2006) found in the context of Hong Kong, that bank technical efficiency is significantly affected by bank size.

Following from the above, the current study was motivated to seek answer the following questions. (a) What is the impact of the Global financial crisis on the productivity and efficiency (using both cost and profit efficiency measures) of Australian financial institutions? (b) What is the magnitude and impact of bank specific and macro-economic factors on Australian banking efficiency? (c) How do Australian banks compare with other financial firms in terms of efficiency and productivity?

3. Data and Method

This study combined a time series and cross-sectional data of 44 publicly-listed financial firms. Of the 44 firms in the final sample, there were nine banks (all banks), nine insurance firms, and 26 other financial firms. The complete data on all the variables in the model were not available for all firms for all years. Accordingly, the researchers could obtain and used 10 years of data for banks (2000-2009), five years for insurance (2005-2009), and four years for other firms (2005-2008). The data after 2009 were left out since the crisis was officially over in November 2008, and the test period was stopped at 2009. The data were collected from various sources: databases such as DatAnalysis, FinAnalysis, Dunn and Bradstreet, DataStream and financial information available at firm's website.[1]

The study used the following procedure to answer the question whether there was a significant difference in the mean efficiency and mean productivity of financial institutions during the study period, that is, during crisis and non-crisis periods. To compute efficiency and productivity scores, following the steps used in prior studies and the commonly adopted intermediation approach (Sealey & Lindley, 1977), this study used the value of net loans (y_1), and other earning assets (y_2) as output variables while input variables were purchased funds (x_1), labour cost (x_2), and capital input (x_3). To estimate the cost and profit efficiencies, this study used additional use of the price data of inputs and outputs.

Malmquist indices were computed to measure total factor productivity (TFP), economic change (EC), technical efficiency (TE), overall efficiency (OE), and allocative efficiency (AE). Parametric SFA method was used to compute the cost efficiency (CE) and profit efficiency (PE) measures. To check the statistical significance, this study applied the *Mann-Whitney* and *Kruskal Wallis* statistical test. The panel regression was performed using suitable econometric software (E-views) with accounting for corrections for serial correlation and heteroscedasticity.

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[1] This project arose from one of the authors being granted the Australian Prime Minister's Fellowship to study this issue through an international study award. The project was completed in 2009, so the data collection ended in 2009 with the funding for that project. Hence, the study could not be extended beyond the test period stated in this paper.

3.1 Malmquist Productivity and Scale Economies

Following Fare and Grosskopf (1994), the Malmquist productivity change index can be written as:

$$m_0(y_t, x_t, y_{t+1}, x_{t+1}) = \frac{d_0^{t+1}(y_{t+1}, x_{t+1})}{d_0^t(y_t, x_t)} \left[\frac{d_0^t(y_{t+1}, x_{t+1})}{d_0^{t+1}(y_{t+1}, x_{t+1})} \times \frac{d_0^t(y_t, x_t)}{d_0^t(y_t, x_t)} \right]^{1/2} \quad (2)$$

where *y* and *x* are outputs and inputs across time *t* to *t+1* to indicate Malmquist indices which are computed relative to the previous period. The technical efficiency change measures the change in efficiency between period *t* and *t+1*, while technical change captures the shift in the technology applied over time as banks adopt newer methods of production. A value greater than one in both cases indicates growth in productivity, that is, positive factor values suggest that banks are functioning with gains in productivity.

3.2 Cost Efficiency

Cost efficiency describes how the cost of a firm compares with the best practice in the fitted frontier, to produce the same output under the same environmental conditions (Berger & Mester, (1997). In this, cost efficiency is measured using SFA, which allows for incorporation of both allocative and technical efficiencies from inputs. It measures the change in a firm's variable cost adjusted for random error relative to the estimated cost needed to produce ouput(s) as efficiently as the best practice firm in the sample.

This study used the translog stochastic function by Battese and Coelli (1995) to estimate firms' relative efficiency. The general form of cost efficiency can be written as:

$$C_{it} = (q_{it}, p_{it}, \beta) + (U_{it} + V_{it}) \quad \text{i = 1,2,...,N; t=1,2,...,T} \quad (3)$$

Where C_{it} represents the costs (expenses) of the i-th firm in the t-th period, q_{it} is vector prices of variable inputs, p_{it} is vector of quantity of variable outputs, V_{it} is random error, while U_{it} is inefficiency, and β is unknown vector parameter.

The specific form of cost function used in this study can be written as follows:

$$LnTC = \alpha_0 + \sum_i \alpha_1 \ln W_{it} + \sum_i \beta_i \ln Q_{it} + \frac{1}{2}\sum_i \sum_j \alpha_{ij} \ln W_{it} W_{jt} + \frac{1}{2}\sum_i \sum_j \beta_{ij} \ln Q_{it} Q_{jt} + \sum_i \sum_j \gamma_{ij} \ln W_{it} \ln Q_{jt} +$$
$$\sum_i \delta_i \ln Z_{it} + \sum_i \sum_j \phi_{ij} \ln Z_{it} Q_{ij} + \sum_i \phi_{ij} \ln Z_{it} \ln W_{jt} + (V_{it} + U_{it}) \quad (4)$$

where, TC is defined as the total costs, W_i is the vector of input prices, Q_i is a vector of variable outputs, and Z_i is a vector of fixed netputs. This model is estimated using maximum likelihood estimation.

3.3 Profit Efficiency Model

According to Humphrey and Pulley (1997), profit efficiency refers to the closeness of the firm to generate maximum possible outputs given a particular level of input and output prices. It is the ratio of predicted maximum profit, which could be earned if a firm was as efficient as the best practice firms after adjusting for random error. The value is bounded between 0 and 1. The higher the measured value, the more profit efficient the banks are. A score of 1 means the firm has achieved optimal profit efficiency. The general form of profit function can be written as:

$$P_{it} = f(q_{it}, p_{it}; \beta) + (V_{it} - U_{it}) \qquad (5)$$
$$i = 1,2,...,N; t = 1,2,...,T$$

Where *Pit* is the profit before tax of the i-th bank in the t-th period, q_{it} represents the vector of output quantities of the i-th bank in the t-th period, p_{it} is vector of quantities output variable of the i-th firm in the t-th period, and β is unknown vector parameter.

To estimate profit efficiency, this study used the translog frontier profit function developed by Altunbas and Chakravarty (2001), as in the following:

$$Ln\pi_{it} = \alpha_0 + \sum_i \alpha_1 \ln W_{it} + \sum_i \beta_i \ln Q_{it} + \frac{1}{2}\sum_i \sum_j \alpha_{ij} \ln W_{it} W_{jt} + \frac{1}{2}\sum_i \sum_j \beta_{ij} \ln Q_{it} Q_{jt} + \sum_i \sum_j \gamma_{ij} \ln W_{it} \ln Q_{jt} +$$
$$\sum_i \delta_i \ln Z_{it} + \sum_i \sum_j \phi_{ij} \ln Z_{it} Q_{ij} + \sum_i \phi_{ij} \ln Z_{it} \ln W_{jt} + (V_{it} - U_{it}) \qquad (6)$$

where π_i is defined as pre-tax profit; to avoid negative value for profit, the minimum absolute value of profit plus one to the profit values was added; W_i is the vector of input prices; Q_i is a vector of variable outputs; and Z_i is a vector of fixed netputs. This model is estimated using maximum likelihood estimation.

3.4 Panel Regression

The efficiency measures (TFP, AE, CE, and PE) were modelled as being determined/associated with two sets of variables. To identify the likely relations, Panel Data Regression method was used, which corrects the impact of changing variances in the time-series and cross-section data, thus yielding *robust* results. Hence, two sets of regressions (one for macroeconomic and another for bank-specific factors) were run using the panel data available for N number of banks over t to T periods of annual observations.

The dependent variables are the four measures of efficiency from frontier methods as in the equations above. Following from prior studies, the independent variables were three macroeconomic factors (GDP growth, inflation, and interest

rates) in the first four regressions. Six bank-specific variables were regressed with efficiency as the dependent variables. The general model is:

$$DV_{jt} = \delta_0 + \sum_{i=1}^{N} \delta_{ij} (IV_i)_{jt} + \varepsilon_{jt} \quad (7)^2$$

where,

DV_j: either TFP_j: AE_j : CE_j : PE_j, as defined earlier. Thus, panel data regressions were run respectively including (a) three for macroeconomic, and (b) six for bank-specific variables.

$\delta_0 : \delta_i$: measured intercept and coefficients of respective independent variables in each regressions;

IV_j: the independent variables, macroeconomic and bank-specific variables in respective regressions; and

εj: the error term in each regressions.

As is the procedure in panel data regression, random effect or fixed effect model was teasted for. Test statistics suggested that the fixed effect model was appropriate for the data set in this study. The test results were then obtained from eight regressions.

The independent variable are measured as below: CAR=Capital Adequacy Ratio, NPL=ratio of non-performing loans to total loans, cost ratio=cost to income ratio, NIM=net interest margin percentage, Core earning assets=ratio of core earning assets to total assets, and size=total assets.

4. Findings and Discussion

Descriptive statistics and variables

Tables 1 and 2 present a summary of descriptive statistics and the theory-predicted relationship of measures with factors.

Table 2 is a summary of expected signs of theoretical relationship between factors and productivity measures. Economic growth is favourable to banks, and so productivity is gained during economic growth. Productivity declines as growth declines. Hence a positive sign for this factor was predicted. Increases

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[2] The symbols are defined as: j indicates the banks; I indicates variables, and t indicates time from t=2000 to 2009.

in inflation and interest rates retard real sector growth, so their effects are negative on bank efficiency. There are six bank-specific variables in the panel regression (we could also include them as factors in the SFA, but we did not do so because we wanted to use the panel regression because of its known robustness). Increases in factors such as NPL (non-performing loans ratios) reduce banking efficiency, so the signs were expected to be negative. The other factors were likely to increase efficiency except in the case of capital adequacy ratio (CAR) where it takes a positive or negative value.

Table 1: Summary Statistics of the Input and Output Variables Adjusted for Inflation ($ million)

Variables	Description	Mean	Standard Deviation
Outputs:			
LOAN	Total loans-loan loss reserve	9688.82	1579.70
OEA	Placement with other banks, securities,		
	and investments	1060.63	1401.195
Inputs:			
Purchased funds	Deposits, money market funding, and others	58574.68	83125.95
Labcost	Salary and wages	1128.05	1457.27
Capital	Net value of fixed assets	245.26	320.88
Dependent variables			
Y1	Total Costs	1124.22	2453.80
Y1	Pre-tax Profit	741.67	428.52
Input Prices			
w1	Price of Purchased Funds	0.13	0.63
w2	Price of Labour	6.16	3.47
w3	Price of Physical Capital	0.04	0.01

Note: All values are in $ millions, except for input prices. Input prices were derived using the procedure in Altunbas and Chakravarty (2001).

Table 2: Predicted Relationship between Efficiency and Factors

Determinant Variables	Dependent Variables			
	Productivity Growth	Allocative Efficiency	Cost Efficiency	Profit Efficiency
Macro-economic variables				
GDP	+	+	+	+
Inflation rate	-	-	-	-
Cash rate	-	-	-	-
Bank - specific variables				
CAR	±	±	±	±
NPL	-	-	-	-
Cost ratio	-	-	-	-
NIM	+	+	+	+
Core Earning Assets	+	+	+	+
SIZE	-	-	-	-

CAR (cumulative abnormal returns) can affect efficiency in either way. Hence this study indicated the effect as not predetermined. For example, reducing CAR may act as a sign of risk, so efficiency may decline (-). It can also be argued that banks may minimise CAR in order to decrease capital input, so the profits are raised (+). This study determined the actual effect by noting the signs obtained.

4.1 Total factor productivity of banks and other financial firms

Table 3 provides some new evidence on the performance of the financial firms studied in this case. The mean values of the TFP, EC, and TE are summarised in Table 3 for the 10-year period. Results showed that the mean TFP was 1.072, that is, the average productivity gain over the study period was 7.2 index points (1.072-1.00) suggesting a gain equal to about 7.2% per year. This suggests that the banks are highly productive, experiencing increasing returns to scale in each year of the test period with very good increase of efficiency: exceptions are during 9/11 and global crises years.

As can be seen from above table, for the banks, the total factor productivity increase of 7.2% is mainly driven by a 6.8% shift in the fitted frontier, that is, from adoption of newer ways of doing business, such as technological change. There was a slight increase in catching-up to the frontier due to managerial efficiency. This suggests that the frontier itself had shifted (given efficient use inputs) by an annual average of 6.8%, while annual catching-up to the frontier contributed just 0.4%. Thus, management increased output efficiency while technology/newer methods contributed a bulk of the increases. Panel B shows the estimates for insurance companies. These numbers indicated a decrease of

Table 3: Malmquist Productivity Indices

Year	Malmquist idex of total factor productivity change	Efficiency change (catch-up)	Technological change (frontier shift)
Panel A: Banks: Annual means of total factor productivity change and its components			
2000-2001	0.973	1.017	0.957
2001-2002	1.156	1.012	1.142
2002-2003	1.069	1.028	1.040
2003-2004	1.006	0.990	1.016
2004-2005	1.106	0.971	1.139
2005-2006	1.110	1.015	1.093
2006-2007	1.169	0.965	1.211
2007-2008	0.964	1.042	0.925
2008-2009	1.117	0.998	1.119
mean	1.072	1.004	1.068
Panel B: Insurers: Annual means of total factor productivity change and its components			
2005-2006	1.056	0.441	2.391
2006-2007	0.72	2.123	0.339
2007-2008	1.036	1.133	0.915
2008-2009	0.987	0.726	1.360
mean	0.939	0.937	1.002
Panel C: Other financial firms: Annual means of total factor productivity change and its components			
2005-2006	1.206	1.092	1.104
2006-2007	1.324	0.707	1.873
2007-2008	0.782	0.983	0.795
mean	1.077	0.912	1.180

average productivity of 6.1%. In contrast to the case of banks, the TFP decrease was primarily due to negative efficiency change (6.3%). However, the average technological change of these firms increased by 0.2%. This indicates that the TFP decline as being entirely due to negative technical change, although there are small improvements in catching-up to the average frontier.

The efficiency estimation for other financial firms indicated an increase of total factor productivity by 7.7% as in Panel C. Similar to the cases of insurance firms, the TFP growth was due most likely to shifts in the frontier (18%) rather

than improvement efficiency relative to the sample firms' frontier. These results were similar to prior studies. Importantly, despite the challenges of the 9/11 in 2001 and the Global Financial Crisis in 2007-8, there were overall gains in productivity of Australian banks.

4.2 Global Financial Crisis and Efficiency performance

On testing the mean differences across the three groups (banks, insurance companies, and other firms), interesting results were revealed. The efficiency declined substantially by 3.6% (banks) and 21.8% (others). Although the financial sector did not collapse as was the case in Europe and the US, the results identified a large drop in production efficiency in the Australian financial sector.

Tabel 4.1 and 4.2 respectively present a summary of test results of mean efficiency and productivity differences of financial firms during the crisis and the pre-crisis years. An examination of the results showed that there were no significant differences of mean productivity growth of banks and insurance firms between the pre-crisis and crisis period, although there was a substantial decline in productivity in the case of other firms. The difference was statistically significant for other financial firms at a 0.05 probability level. In addition, the results showed that there were no significant differences of mean efficiency of banks and other financial firms between the pre-crisis and crisis period, while there was also a substantial decline in efficiency of insurance firms at 0.05 probability level. The decline in bank efficiency was 1.7% during the crisis period (in 2007-09), for insurance 35.4% for others (investment and fund management firms) 7.4%.

These findings have significant implications for the theory of financial stability. In the context of Australia where there was no banking crisis, the macro-economic situation faced difficulties due to the impact of global financial crisis engulfing the rest of the world. The banks and insurance firms did not experience statistically significant productivity loss but other financial firms did. The lesson for theory of financial stability is healthy banking and insurance sectors can withstand influence of macro-economic crisis, however, the weakest institutions are affected first which in the Australian context were found to be other financial firms (other than banks and insurance companies). It is often said that in a herd under attack from predators it is the weakest in the herd that falls prey first.

Table 4: Test of Mean Efficiency Difference: Crisis versus Pre-Crisis Periods

Description	Mean	Standard Deviation	Test for Sign Mann-Whitney U Test
Panel A: Banks			
Crisis Period (2007-2009)	0.982	0.048	

(continued)

Description	Mean	Standard Deviation	Test for Sign Mann-Whitney U Test
Pre-Crisis Periods (2000-2006)	0.999	0.002	37 (0.398)
Panel B: Insurers			
Crisis Period (2007-2009)	0.484	0.218	
Pre-Crisis Periods (2005-2006)	0.838	0.265	21 (0.047)*
Panel C:Other Financial Firms			
Crisis Period (2007-2009)	0.563	0.415	
Pre-Crisis Periods (2006)	0.637	0.351	327 (0.419)

*Statistically significant at 0.05 significance level. Insurance firms had significant difference.

Table 5: Test of Mean Productivity Difference: Crisis versus Pre-Crisis Periods

Description	Mean	Standard Deviation	Test for Sign Mann-Whitney U Test
Panel A: Banks			
Crisis period (2007-2009)	1.028	0.436	780 (0.388)
Pre-crisis period (2000-2006)	1.165	0.282	
Panel B: Insurers			
Crisis period (2007-2009)	1.178	0.705	78 (0.450)
Pre-crisis period (2005-2006)	0.898	0.352	
Panel C: Other Financial Firms			
Crisis period (2007-2009)	1.056	0.474	494 (0.027)*
Pre-crisis period (2006)	3.951	12.905	

*Statistically significant at 0.05 significance level. Other firms had significant difference.

Evidence reported in Table 5 suggests that both banks and insurance firms were not as significantly affected by the crisis as the other financial firms (investment and fund management firms). This makes sense as well. The other firms were capital market firms, which experienced the worst impact from financial crisis occurring across the world. The other firms in our study were investment and fund management firms, which generate revenues from investing in securities that were severely affected by the crisis with stock and bond market price declines. The other financial firms such as pension funds, stockbrokers, and investment firms all had experianced significant impact losing by a factor of two-thirds of the average efficiency during non-crisis period.

4.3 Firms's Size and Efficiency Performance

This study examined the impact of firm size on efficiency. The null hypothesis was: the mean efficiency growth of large firms was greater than that of non-large (small firms). The test used was the Mann-Whitney U-test. Test statistics and significance values are included in Table 6. The table shows that there was no significant difference in the efficiency of small and large banks.

This finding is different from the findings by Kwan (2006) for Hong Kong where small banks were found to be more efficient than large banks. Walker (1998), using Australian data, found that smaller banks were more efficient than the larger ones. Both studies did not provide statistical tests, so it is difficult to say if the differences were significant. Our test result suggested that, small banks tend to be more cautious in playing their role as intermediary institutions compared to large banks. Perhaps this is symptomatic of the moral hazard problem that has been highlighted in the debate across the world on the Global Financial Crisis about the *too-big-to-fail* argument. The banks in our tests account for about 97% of the total assets of the banking sector. These results pointed to the need to continue with the four pillar policy that bans merger in big four banks.

Table 6: Summary Test of Mean Difference: Big versus Non-big Firms

Firms	Mean	Standard Deviation	Test for Sign Mann-Whitney U Test
Panel A: Banks			
Big	1.101	0.366	464
Non-big	1.143	0.500	(0.387)
Panel B: Insurers			
Big	1.035	0.269	154
Non-big	0.941	0.195	(0.431)

(continued)

Firms	Mean	Standard Deviation	Test for Sign Mann-Whitney U Test
Panel C: Other Financial Firms			
Big	1.170	6.364	734
Non-big	1.038	0.503	(0.395)

Note: These test statistics show that the differences are not significant.

4.4 Macroeconomic and Bank-specific Determinants

Do *non*-parametric efficiency measures have identifiable relationships with macroeconomic and firm-specific factors? The macroeconomic factor effects are summarised in Panel A while the bank-specific factor effects are presented in Panel B (Table 7). The dependent variables were the values of total factor productivity, and allocative efficiency, which are regressed against three macroeconomic factors, GDP growth, inflation, and interest rates. The coefficients were obtained after corrections for serial correlation and heteroscedasticity run as panel regressions, so the coefficients are robust.

The results are presented in Table 7.

Table 7: Bank Efficiency Measures and their Macro- and Micro-Determinants

Explanatory Variables	Total Factor Productivity (TFP)	Allocative Efficiency (AE)
Panel A: Macro Factors		
GDP	0.0127	1.767
	(2.162)*	(0.339)
INFL	-1.322	0.546
	(-8.879)***	(0.619)
INTR	-0.407	1.952
	(-1.028)	(2.040)**
Durbin-Watson stat	1.172	0.795
R-squared	0.340	0.227
F-statistic (Probaility)	14.726 ***	3.381***

(continued)

Explanatory Variables	Total Factor Productivity (TFP)	Allocative Efficiency (AE)
Panel B: Bank-Specific Factors		
CAR	-0.001	6.501
	(-0.110)	(2.439)**
NPL	0.109	0.019
	(0.970)	(0.054)
CR	3.644	-0.043
	(2.616)***	(-0.055)
NIM	-0.096	-0.104
	(-4.794)***	(-1.790)*
CEA	-3.662	-4.459
	(-7.894)***	(-8.777)***
SIZE	-0.052	0.0004
	(-1.099)	(1.967)*
Durbin-Watson stat	1.034	0.817
R-squared	0.502	0.541
F-statistic (Probaility)	12.381***	8.424***

Note: *** indicates significance at .01; ** at 0.05; and * 0.10.

Regression results summarised in Panel A of Table 7 show F-statistics of 14.726 (significant at lower than 0.001 probability) and adjusted R-square of 33.98%. This indicated that macroeconomic factors have a significant impact on efficiency. The GDP growth has positive effect on efficiency with a coefficient of 0.0127 (significant at 0.05 levels). The other two were also significant with a negative impact on efficiency since higher inflation and higher interest rates reduce efficiency given their negative impact on firm's operations. The input variables purchased funds and labour costs would be directly affected by inflation and interest rates.

Meanwhile in Panel B, the F-value and R-squares are respectively 12.381 and 50.20% for TFP: the corresponding numbers for AE are 8.424 and 54.10%. Of the bank-specific variables, significant association was observed for the independent variables: CR (cost ratio), NIM (net interest margin), and CEA (core earning assets). Given that the banks did not have non-performing loans during the test period, the variable NPL did not have any effect. However, the capital adequacy ratio and size were not found to have a significant association, although these had negative signs consistent with predictions. Higher levels of CAR and size were found to have negative association to TFP.

In the case of allocative efficiency, the findings were similar except for the findings relating to NPL, Size, and CR. Larger banks have easy access to

capital, and so its impact is significantly positive, although judged by the size of the coefficient, this impact is but marginal. Strangely NPL had a positive impact, cost ratio was found to have a significant impact.

Overall, as in previous studies, efficiency gains were reported for banks although there were declining treads in bank efficiency during the 2007-08 crisis period. Compared to banks and insurance firms, the other financial firms had significant loss of efficiency the loss in efficiency was two-thirds during the crisis years. Unlike previous reports, size appears not to provide a disadvantage for efficiency in this test period compared to previous reports for other countries, for example, Hong Kong banks. Finally, banks dominated gains in efficiency over insurance and other financial firms.

In the literature, how macro-economic factors affected Australian banking efficiency is an unanswered question. This study found that macro-economic variables significantly impact banking efficiency, as well as strong correlations of four bank-specific factors with these non-parametric efficiency measures. Together, these results add important insights about the efficiency of financial firms in the last decade, the impact of financial crisis on efficiency and the impact of macro-economic and firm specific variables on efficiency.

4.5 Parametric Efficiency and its Determinants

In this sub-section, the results are presented on cost and profit efficiency as these relate to determinants specified in the test model where this study compared this with a prior study by Worthington (2000).

Cost and profit efficiency

Mean values of cost and profit efficiency estimates are presented in Table 8. It shows that mean bank efficiency was 0.701 (70.1%), while profit efficiency was 0.309 (31%). Banking efficiency was high as compared to mean efficiency reported for Australian credit unions scores range between 63 and 67% (Worthington, 2000).

Table 8: Cost and Profit Efficiency of Banks

	Minimum	Maximum	Mean	S.D
Banks				
Cost Efficiency	0.147	0.543	0.701	0.141
Profit Efficiency	0.002	0.742	0.309	0.032

4.6 Macroeconomic and Bank-specific Determinants

Table 9 provides a summary of test results. As described in the previous sub-section, these statistics were obtained from two panel regressions with corrections

for serial correlations and heteroscedasticity, as was deemed appropriate. The dependent variables are two parametric efficiency measures namely CE or cost efficiency, and PE or profit efficiency. The macro and the bank-specific variables are listed in the table. The overall fit of models are good as can be judged by the explained variation and the significant R-squares. For CE, these numbers were: 39.3% and 6.247, significant at 0.001 levels. For PE, the numbers were 54.40% and 36.436, again significant.

The three macroeconomic factors affect these efficiency measures as predicted by theories. GDP growth affects efficiency positively: the coefficient on cost efficiency has 0.59 and significant while the 7.538 for PE indicated a strong significant effect.

Table 9: Banking Efficiency Measures and their Macro-and Micro- Determinants

Explanatory Variables	Cost Efficiency	Profit Efficiency
Panel A: Macro Factors		
GDP	0.590	7.538
	(6.816)***	(6.894)***
INFL	-0.024	-0.012
	(-0.043)	(-0.058)
INTR	-1.737	-1.378
	(-2.491)**	(5.300)***
Durbin-Watson stat	0.738	1.028
R-squared	0.393	0.544
F-statistic (Probaility)	6.247***	36.436***
Panel A: Firm-Specific Factors		
CAR	0.228	5.632
	(1.981)*	(5.764)***
NPL	0.168	0.246
	(1.150)	(2.216)**
CR	4.111	3.159
	(3.187)***	(2.101)**
NIM	-0.100	-0.090
	(--5.0373)***	(-4.791)***
CEA	-4.4197	-3.098
	(-7.4964)***	(-6.929)***
SIZE	-0.00009	-0.001

(continued)

Explanatory Variables	Cost Efficiency	Profit Efficiency
	(-0.5221)	(-0.703)
Durbin-Watson stat	1.059	1.3171
R-squared	0.5897	0.6203
F-statistic (Probaility)	18.250***	21.535***

Note: *** indicates significance at .01; ** at 0.05; and * 0.10.

While inflation does not have a significant impact (although the signs are as predicted), interest rate increases have negative and significant effect on efficiency. The coefficients were -0.014 and -1.374 for CE, and -0.012 and -1.378 for PE. As for bank-specific factors, all factors except size were significantly correlated as predicted by theory. In the case of CE, the NPL effect was not significant. All other coefficients were strongly correlated with cost and profit efficiency measures.

5. Conclusion

The objective of this study was to measure the efficiency and productivity of Australian banks and non-bank financial firms over a 11 year period, 1999-2009. In so doing, this study also examined the impact of financial crisis on efficiency and productivity to extend the theory of financial stability to a unique economy that did not experience banking crisis and yet was not immune from global financial crisis effects on some parts of the financial institutions. It is a special case for which theory did not provide an answer. It was found that while banks and insurance firms did not record a significant decline in productivity and efficiency as contemplated by the theory, other financial firms witnessed a sharp and significant decline in efficiency. The study also demonstrated that several firm-specific and macro-economic variables do impact cost and profit efficiency an issue that escaped the attention of researchers so far.

As a summary of findings of this study, it is noted that Australian financial firms' efficiency is on trend, and did not suffer a decline over the recent tested years, but, the global crisis had a knock-on effect on the trend gains for banks, insurance firms and other financial firms in the last two years of the data series. So, the common belief that Australian financial intermediaries are insulated from the global financial crisis is not borne out by empirical evidence in this study. Though banks were found to have higher efficiency than other financial firms, size did not provide any incremental efficiency gains to large Australian banks. Finally, this study identified three important macro-economic and four key firm-specific factors as the key sources determining production efficiency. Further cross country research on similar lines may help refine the theory of financial stability for other countries affected by the global financial crisis.

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