

Cost and Profit Efficiency of Australian banks, and the impact of the global financial crisis

Ha Vu and Sean Turnell

Department of Economics, Macquarie University, Australia

Abstract

This paper analyses cost and profit efficiencies of Australian banks over the period 1997-2009 and examines the impact of the recent global financial crisis on bank efficiency. The paper also investigates the factors determining *differences* in the efficiency of Australian banks. Using a stochastic frontier analysis we find that the profit efficiency of Australian banks is higher than their cost efficiency, and that major banks are more profit efficient, but marginally less cost efficient than regional banks. Interestingly, the global financial crisis had an adverse effect on the profit efficiency of Australian banks, but had no significant impact on the cost efficiency.

I. Introduction

The Australian banking industry was broadly resilient throughout the recent global financial crisis (GFC), which originated in the sub-prime mortgage market in the US and then spread out to major economies in Europe, Japan, and elsewhere throughout the world. In particular, no Australian bank had to be ‘bailed out’ by the government, and nor were any concerns seriously entertained with respect to the solvency of any of the major banks. Indeed, all four major Australian banks were ranked among the world’s top 20 safest banks for 2009.¹ According to the Reserve Bank of Australia (RBA), the positive performance of the Australian banking sector during the crisis was the result of ‘their proactive stance on prudential regulation and tougher lending standards than those seen in the US’ (Pais and Stork, 2010, p. 16).

From an efficiency point of view, the fact that Australian banks robustly survived the crisis might be explained by their high degree of performance (i.e., their high efficiency scores) for the pre-crisis period. As pointed out by Blejer (2006), countries with efficient financial systems are less prone to banking and currency crises, and these countries also suffer much less when a crisis does occur. In view of that, it is of interest to assess the efficiency of Australian banks in recent years to see if Australian banks were indeed efficient at the onset of the recent crisis, from which we might deduce one of the reasons for their durability during the crisis. Prima facie on the observable facts, it is reasonable to expect that the efficiency levels of Australian banks were high at the onset of the GFC, declined during the crisis, but then recovered quickly.

¹ Information is published by *Global Finance*, see <http://www.gfmag.com/tools/best-banks/2341-words-50-safest-banks-2009.htm>

There have been a number of studies into the efficiency of Australian banks, including Walker (1998), Avkiran (1999), Sathye (2001), Neal (2004), Sturm and Williams (2004). Amongst them, Walker (1998) examined the cost efficiency of 12 Australian banks from 1978 to 1990, and reported an average efficiency level of around 90%, thus suggesting that Australian banks needed to reduce their actual costs by 10% to become cost efficient. He also found that the smaller banks enjoyed higher cost efficiency levels than the major banks. Neal (2004) found that the average cost efficiency of Australian banks ranged between 71 and 83% during the period 1995 to 1999, and that the cost efficiency scores of the four major national banks were higher than that of the regional banks.

More recent studies on Australian banking efficiency include Kirkwood and Nahm (2006), Paul and Kourouche (2008), Lee *et al.* (2009), and Sturm and Williams (2010). Amongst them, only Kirkwood and Nahm evaluated profit efficiency (the others examined technical efficiency) of a sample of ten Australian banks between 1995 and 2002, and found that the average efficiency scores were not high – ranging between 62 and 73%. Their findings also showed that the major banks experienced improvements in profit efficiency across the period examined, whereas smaller regional banks exhibited declining profit efficiency.

There have as yet been no studies analysing the impact of the recent GFC on Australian banking efficiency. Accordingly, this research aims to fill in this gap in the literature. More specifically, this study investigates the efficiency of Australian banks through two main measures: cost efficiency and profit efficiency. Cost efficiency tells us how close a bank's actual costs approximate what the 'best practice' bank's costs would be for producing the same output under the same conditions, whereas profit efficiency tells us how close a bank's actual profits are to what the 'best practice' bank would make under the same conditions. These two types of efficiency are measured based on two different behavioural assumptions: cost minimization and profit maximization. Technically and practically, banks that achieve

maximum profit do not necessarily achieve minimum costs, thus banks which are identified as being profit efficient are not necessarily also cost efficient. For instance, following an investment in new technology (which is likely associated with a significant increase in costs), banks would expect a corresponding (hopefully greater) increase in revenue to achieve profit gains. Under this scenario, banks might experience high profit efficiency but low cost efficiency. Therefore, a study on both cost and profit efficiencies can help to determine banks' behaviour, and the main source of inefficiency (i.e., whether inefficiency comes mainly from the cost or the revenue sides).

With estimates of cost and profit efficiencies, the study aims to clarify the following research questions: How efficient were Australian banks before the GFC? How large was the efficiency gap between national and regional banks? How has the efficiency level changed in the wake of the GFC? And, finally, what factors have shaped the efficiency levels of Australian banks?

This paper provides a number of contributions. First, it evaluates Australian bank performance via both cost efficiency and profit efficiency in order to identify the main sources of inefficiency. Second, it is the first study to consider the impact of the GFC on Australian banks' efficiency. In understanding this, the paper is structured as follows. Section II provides a brief overview of the impact of the GFC on the Australian banking sector. Section III presents the methodology, while Section IV explains the selection of variables and model specifications. Section V analyses the empirical findings, and Section VI presents some conclusions.

II. The impact of the crisis on the Australian banking sector

Australia's banks emerged from the GFC with their international reputation enhanced, and their domestic competitive position strengthened. Of course, this is not to say that challenges and risks do not remain for Australia's banks, or that a return to 'normality' is yet apparent.

Nevertheless, the steady performance of the Australian banking sector through a period of intense dislocation in international financial markets was an important factor in protecting the country more broadly from the worst aspects of the global crisis. It was also revealing of a sector that, on the whole, is well managed, comfortably capitalised, and well regulated. In contrast to the situation overseas, the Australian government was not required to recapitalize or otherwise ‘bail out’ any of the country’s banks.

Yet, and notwithstanding this apparent health and stability, at the peak of the financial crisis in October 2008 (a month after the collapse of Lehman Brothers), the Australian government was compelled to introduce broad (and relatively generous) guarantee arrangements for both deposits and wholesale funding of Australia’s banks.² These arrangements, provided ‘free’ of charge for smaller deposits and at various fees for larger deposits and wholesale debt instruments, were deemed necessary to reassure depositors and investors, and to assist Australian banks in accessing wholesale funding which, for a time, had become closed off to all but sovereign issuers. Wholesale funding (especially offshore), has assumed a growing importance for Australian banks in recent years, and immediately before the crisis accounted (in both its short and long term forms) for nearly 50% of total bank funding. In the end the government guarantees kept capital markets open to Australian banks during the worst period of turmoil, after which the banks were able to raise funds more or less on their own account. For Australia’s four major banks this process was substantially eased by a number of factors, including the highly pertinent fact that they now number amongst just nine banks internationally that enjoy credit ratings of AA or above.³

² For a comprehensive account of the various funding guarantees put in place by the Australian government, see Schwartz (2010).

³ According to the ratings nomenclature used by Standard and Poors, and Fitch ratings (AA2 according to the labels used by the third internationally significant ratings agency, Moodys). Such a rating confers on the long

Profitability

The earnings of Australian banks took a hit in the wake of the GFC, with profits for banks declining by about 20% on average across 2007 – 2009. This fall in profits (extremely mild given the losses recorded elsewhere) was driven primarily by extra provisioning, and by asset write-downs required by mark-to-market accounting. The comparatively benign impact on bank profitability from the financial crisis was the result of a number of factors, but not least that Australian banks had a relatively small exposure to the sort of risky securities that caused such mayhem in other countries. The outcome was also the product of the comparative quality of the on-balance-sheet loans of Australia's banks, and especially home mortgages. Mortgage lending, enormously destructive in the form of the sub-prime phenomenon in the United States, took a less precarious shape in Australia – the result of a legal structure that keeps defaulting borrowers liable for outstanding debts even after bank foreclosure; a low relative share of mortgage borrowers with extremely high debt to income service ratios; widespread third-party insurance coverage for mortgages with high loan to valuation ratios; and, once the crisis was under way, policy that brought about falling interest rates that made for easier household loan repayments. This latter aspect, aided and abetted by additional government policy (primarily in the form of various 'first home-owners' schemes), was partly responsible for the unusual fact that, throughout the financial crisis, the amount of credit provided to the housing sector by Australia's banks actually grew (Stevens, 2010).

With respect to business lending, a similar more conservative credit culture in Australia (driven partly by the fact that Australia's banks had been through their own dramas in the early 1990s, and the lessons perhaps learned accordingly) meant that loan impairment for this

term debt of Australia's major banks the description that they have a 'very strong capacity to meet financial commitments'. Ratings for Australian banks are available at the websites of the ratings agencies. See, for instance, www.standardandpoors.com.

sector too was well short of the disastrous trends elsewhere. Altogether, loan impairment charges for the major Australian banks rose by just over 300% across calendar year 2008, and a further 94% across 2009. Whilst such increases look worrying at first glance, it is critical to note that by the end of 2009 loan impairments still comprised less than half of 1% of total bank assets (KPMG, 2009a; 2010). Of course, a relatively conservative credit culture and ‘good management’ was not the sole reason for this relatively good outcome – figuring strongly in the result (although only partly serendipitously) was an economy that weathered the global crisis especially well.

Harder hit by the GFC than Australia’s four major banks, in terms of profitability and in other ways, were the country’s smaller and regional banks. Like the majors, the regional banks remained profitable through the worst of the financial crisis, but their profits took a significant hit, more than halving from 2007 to end 2009 (KPMG, 2009b). The regional banks faced a 600% increase in impaired assets across 2009 and they were more exposed to problem borrowers generally (especially small to medium enterprises) and, naturally, to the extra risks that come from geographic concentration (KPMG, 2009b). As shall be examined below, the profitability of Australia’s smaller and regional banks was also hit by the fact that they faced particular disadvantages with respect to the major banks (and even large corporates) in accessing inexpensive funding in the post-crisis environment.

Bank Funding

Perhaps the most significant effect of the financial crisis (and its aftermath) on Australian banks was its impact on the mix of their funding sources. The crisis brought about a (deliberate) shift to ‘stickier’ deposits, from 39% in mid-2007 to 42% at end 2009, an increase in long-term wholesale debt (domestic and foreign) from 18 to 24%, and a significant *fall* in short-term wholesale debt, from 30 to 24%. Securitisation underwent an even larger proportionate decline (halving to just 3%), while funding from equity (most banks sought to

increase their capital during the crisis) rose from 6 to 7%. Dividing the sector into its major bank and regional components, the changing patterns of funding differed most significantly in the securitisation story. As a funding vehicle, securitisation had always been a minor source of funding for the major banks (5% before the crisis, 1% in January 2010), but it was a much more significant item for the smaller and regional banks – for whom, accordingly, the fall in securitisation as a funding source was a precipitous 17 to 9% (Brown *et al.*, 2010).

This changing source of bank funding in Australia will likely increase its cost and, as such, it may become something of a brake on the further *growth* of profits for the sector. Deposits are more dependable in a crisis, but they are also more expensive (Battellino, 2010). Already something of a ‘deposits war’ has opened up amongst Australia’s banks, with the result that deposit rates have risen (*relatively*, to the cash rate and other metrics) and possibly putting future pressure on margins (so far, as per below, protected via rising relative lending rates). Likewise, and reflecting the decreased appetite internationally for risk, wholesale funding markets are more expensive (relative to benchmark rates) than before the crisis, even though they remain open to Australian bank issues. Altogether, by the end of 2009 bank funding costs in Australia had risen around 130 – 140 basis points relative to the cash rate from their immediate pre-crisis levels (Brown *et al.* 2010). Finally, as with most of the issues examined here, there was something of a divergence in the situation with respect to the smaller and regional banks vis-à-vis the majors – with the former (from both the deposits and wholesale funding angles) facing a relatively more expensive funding environment.

Margins

Across the GFC the net interest margins (NIMs) of Australian banks increased, to an extent that not only covered their higher funding costs noted above, but to levels that also partly compensated for increased provisioning against rising bad debts. Overall, the NIMs of Australia’s major banks were, at an average of 2.4% overall, about 20 – 25 basis points higher

at the end of 2009 than they had been immediately before the crisis (Brown *et.al.* 2010). Such increasing NIMs were the product of the higher interest rates the banks charged on outstanding loans. At the end of 2009 the average rate charged by banks on their overall loan portfolio was around 160 basis points higher relative to the cash rate than it had been in mid-2007. The increase in NIMs reversed the trend of falling margins that had been underway since the mid-1990s, and which up to this point had been driven by the competition from both new banks, as well as new non-bank lenders supported by (the) then vibrant securitisation markets (Brown *et. al.* 2010).

As with the other issues outlined here, there were different outcomes on margins with respect to the major banks vis-à-vis their regional counterparts. For the smaller and regional banks, NIMs declined across the crisis period – being, at end 2009, about 20 basis points lower than they had been in mid-2007 (Brown. *et al.* 2010).

Competition

The GFC increased concentration in the Australian banking system, as a consequence of some significant mergers that took place amidst the dislocation, and the scaling back of the operations of a number of foreign banks (a few withdrew from the Australian market completely). With respect to the mergers, noteworthy were the effective takeovers of St George Bank (SGB) by Westpac Bank (WBC)⁴, and BankWest by the Commonwealth Bank (CBA). SGB had been Australia's fifth-largest bank and a keen competitor to the majors in home mortgage lending especially. BankWest, a Western Australian bank that was owned by the UK's HBOS, had in recent years expanded aggressively in the eastern states and had

⁴ As noted in its annual report 2009, St.George currently operates as a wholly owned subsidiary of Westpac, however, it is anticipated that Westpac and St.George will become a single ADI in the first half of the 2010 calendar year.

become in many ways an innovative price leader across a number of product lines. Of course, whether this increased industry concentration leads to a reduction in the competitive pressures in the Australian banking system, or to less market ‘contestability’ more broadly, remains to be seen. At present, the fierce competition for deposits, and in other areas, does not as yet foreshadow Australian banks being in a position to increase efficiencies through the exploitation of anti-competitive rents.

III. Methodology

Evaluating the efficiency of a bank involves a comparison between actual and optimal values. In particular, it is concerned with the comparison between observed outputs and maximum potential outputs obtained from given inputs; or observed inputs and minimum potential inputs to produce a given amount of outputs. It is also possible to define efficiency in terms of behavioural goals, where efficiency is measured by comparing observed and optimal costs and profits, leading to cost and profit efficiencies respectively.

In performance studies, the measurement of efficiency links to a relevant frontier. Since the true frontier is unobservable, an approximation is frequently constructed known as a ‘best-practice’ frontier. One of the main approaches commonly used in the construction of the ‘best-practice’ frontier, and the estimation of efficiency relative to this constructed frontier, is Stochastic Frontier Analysis (SFA). This approach assumes that a deviation from the estimated frontier can be due to either random fluctuations or inefficiency. To separate these two components, an asymmetrical probability distribution is presumed for the inefficiency term, whereas the noise error term is assumed to be normally distributed. The estimated inefficiency can then be further analyzed to determine the main drivers of inefficiency, and to provide information for bank managers and authorities on how to improve bank performance.

In this paper, to measure the cost and profit efficiency of Australian banks, we employ the Battese and Coelli (1995) model using the SFA approach. This model incorporates the

estimation of cost and profit inefficiencies and the determinants of efficiency at the same time, by parameterizing the mean of the efficiency term as a function of exogenous variables.

In a standard cost function, banks take the amount of outputs and input prices as given, and minimize costs by adjusting the amount of inputs and output prices. In a standard profit function, it is assumed that banking markets are perfectly competitive (i.e., banks are price takers), thus banks maximize profits by adjusting the quantities of inputs and outputs. However, clearly perfect competition rarely pertains in reality. In practice, banks do have some degree of market power, and so it is more appropriate to consider the case of imperfect competition, in which banks are only price takers in the input market, but have some market power in the output market. Correspondingly, an alternative profit function is employed, in which banks take as given output quantities and input prices, and optimize profits by changing input quantities and output prices. Therefore, total costs and profits are functions of the same variables and are specified as

$$\ln H_{it} = \ln f(y_{it}, w_{it}; \theta) + u_{it} + \Phi v_{it} \quad (1)$$

where the subscript i indicates a single bank ($i = 1, 2, \dots, N$) and t is for a specific year ($t=1, 2, \dots, T$); H represents total costs (C), using to estimate cost efficiency and profit Π , using to estimate profit efficiency; $\ln f(y_{it}, w_{it}, z_{it}; \theta)$ is a logarithmic functional form; y is a vector of outputs; w is a vector of input prices; Φ is equal to one for the cost function, and negative one for the profit function. θ is a vector of parameters to be estimated.

The random noise term, v , follows a symmetrically normal distribution with zero mean and variance of σ_v^2 , $v_{it} \sim i.i.d N(0, \sigma_v^2)$. The inefficiency term, u , can follow any non-negative distribution and can be specified as a function of factors affecting efficiency levels. In this paper, u is assumed to follow a non-negative truncated distribution which is specified as follows

$$u_{it} = f(g_{it}; \delta) + \xi_{it} \quad (2)$$

where g is a vector of explanatory variables; δ is a set of unknown parameters; and the random variable ξ_{it} follows a truncated normal distribution with zero mean and variance of σ_ξ^2 such that the point of truncation is $-f(g_{it})$ (i.e., $\xi_{it} \geq -f(g_{it})$). Therefore, u_{it} follows a non-negative distribution of $N(f(g_{it}), \sigma_u^2)$.

Equations (1) and (2) are estimated simultaneously using the maximum likelihood estimation.

Then cost and profit efficiencies are calculated as:

$$CE_{it} = \frac{C_{it}^{\min}}{C_{it}} = \frac{f(y_{it}, w_{it}; \beta) \exp\{v_{it}\}}{f(y_{it}, w_{it}; \beta) \exp\{v_{it}\} \exp\{u_{it}\}} = \exp\{-u_{it}\}, \text{ and}$$

$$PE_{it} = \frac{\Pi_{it}}{\Pi_{it}^{\max}} = \frac{f(y_{it}, w_{it}; \beta) \exp\{v_{it}\} \exp\{-u_{it}\}}{f(y_{it}, w_{it}; \beta) \exp\{v_{it}\}} = \exp\{-u_{it}\}$$

In other words, cost efficiency is the ratio of the minimum cost to the actual cost needed to produce a given set of outputs, while profit efficiency is the ratio of the actual profit and the maximum profit. Therefore, cost and profit efficiencies are bounded between zero and one. The closer to one, the more efficient banks are. When cost efficiency/profit efficiency is equal to one, banks operate completely efficiently.

IV. Sample data and model specification

Sample data

The studied sample consists of nine Australian banks, including the “four-pillar” national banks (major banks), namely CBA, WBC, NAB (National Australia Bank) and ANZ (Australian and New Zealand Banking Group), and five regional banks (Bendigo Bank -

BEN, Suncorp - SUN, Bank of Queensland - BOQ, Macquarie Bank - MQB, and SGB).⁵ The study covers the period of 13 years from 1997 to 2009. This time interval witnessed a number of events occurring in Australia and around the world such as the Asian financial crisis 1997 – 1998, the early 2000s global downturn, and the recent global financial crisis. Thus the findings promise to provide some interesting implications and lessons. All data were collected from the individual bank annual reports and deflated with the GDP deflator, with 1997 as the base year.

Unlike other industries, the banking industry is a service one, and so the definition of bank inputs and outputs is more complex. In the banking literature, there are a number of ways to define inputs and outputs of banks. The *intermediation approach* assumes that banks collect deposits to transform them, using labor and capital, into loans and other assets. Hence, banks are considered financial intermediaries connecting savers and investors. The *production approach* views banks as producers, using labor and capital to produce deposits and loans in terms of the number of accounts. The *value added approach* asserts that all liabilities and assets of banks have some output characteristics, rather than categorizing them as either inputs or outputs only. In empirical research, the intermediation approach seems to be preferred since it better represents the role of banking in providing financial services (Berger and Mester, 1997; Altunbas *et al.*, 2001; Maudos *et al.*, 2002; Koetter, 2006). Thus, we opt the intermediation approach to define inputs and outputs for Australian banks.

⁵ Westpac and St.George Bank Limited completed their merger on 1 December 2008. However, St. George continued to operate as a wholly owned Westpac subsidiary until the first half of 2010. After this date the assets, liabilities, and business of St.George would be transferred to Westpac, and St.George Bank Limited would be deregistered as a separate company. Therefore, in this paper St.George and Westpac are treated as two individual banks.

The three outputs then are loans and advances (y_1), other earning assets (y_2) (including investment and trading securities), and off-balance assets proxied by non-interest income.⁶ Regarding input prices, the unit price of customer deposits (w_1) is the ratio of interest expenses over total borrowings; the unit price of capital (w_2) is defined as total expenses on premises and buildings divided by physical capital; and the unit price of labour (w_3) is defined as total personnel expenses divided by the number of full-time equivalent employees. Profit (II) is the operating profit before tax and is defined as the difference between total income (interest and non-interest) and total cost (C) which is the sum of interest expenses and non-interest expenses. Furthermore, to capture the effect of risk propensity on efficiency, given the detail level of the data set (and as commonly used in the literature), equity capital (denoted as z) is incorporated into the model as a fixed input.⁷

Table 1 displays the mean values and standard deviations of variables mentioned above for the sample of all nine banks, and the two groups of major and regional banks. Readily apparent is that the output portfolios of the major banks are much larger than those of regional banks. More ambiguous, however, is the data suggesting that the unit prices of the three inputs noted are higher for the regional banks than for the majors. Normally, it could be anticipated that the cost of labour, for instance, would be cheaper for regional banks than the

⁶ There are alternative measures of a bank's aggregate off-balance sheet (OBS) activities, including the credit equivalent approach, the asset equivalent approach, and the non-interest income approach which is based on the assumption that non-interest income includes all income from OBS activities. Each approach contains different features and there is no consensus as to which approach should be preferred. In this paper, given the data availability, we choose non-interest income as a proxy for OBS activities.

⁷ Maudos et al. (2002) pointed out some advantages of the inclusion of financial capital in the frontier model. First, capital affects costs (then profits), because it is a source for funding in addition to the main source of deposits (that does not generate financial costs). Second, this inclusion enables differences in banks' risk-aversion to be taken into account, because banks with higher risk-aversion will seek a higher level of financial capital than the optimum (i.e. that which minimizes costs or maximizes profits). If capital is not included, banks that are most prudent or most risk-averse will be penalized even if they behave optimally in terms of their preferences regarding risk.

majors, since the former provide less sophisticated products and services – and hence employ fewer highly remunerated staff. Similarly, the cost of fixed assets for regional banks should normally be lower than that of major banks, since regional banks run a limited branch network with fewer offices in high real estate-price major cities. The solution to the seeming conundrum here is provided by the inclusion of Macquarie Bank in the regional bank category. Predominantly an investment bank with an especially complex product mix, Macquarie has both expensive trading platforms and other sophisticated infrastructure, as well as a large cohort of very-well remunerated staff (both in terms of salaries and bonuses).

Table 1 Means and standard deviations of variables

	Major banks		Regional banks		All banks	
	Mean	Std	Mean	Std	Mean	Std
y_1	165,077.3	56,369.6	21,102.9	17,771.4	85,091.5	82,058.3
y_2	16,495.5	6,530.6	5,254.9	5,504.6	10,250.7	8,181.4
y_3	4,328.7	2,527.2	1,085.1	1,389.5	2,526.7	2,548.2
w_1	0.062	0.013	0.090	0.075	0.078	0.058
w_2	1.867	1.092	6.036	6.698	4.183	5.441
w_3	0.063	0.008	0.075	0.047	0.070	0.036
z	15,094.0	5,507.4	2,434.6	2,174.9	8,061.0	7,473.7
C	12,880.7	4,405.4	2,449.6	2,089.9	7,085.7	6,167.6
Π	3,240.7	1,009.2	393.2	358.4	1,658.7	1,593.1

Model specification

To specify the frontier functions, and following the general preference in the literature regarding appropriate flexible functional forms, we employ a translog function. The translog stochastic cost and profit frontiers for the case of three outputs and three inputs is given as⁸

$$\ln H = \alpha_o + \sum_{m=1}^3 \alpha_m \ln y_m + \frac{1}{2} \sum_{m=1}^3 \sum_{k=1}^3 \alpha_{mk} \ln y_m \ln y_k + \sum_{n=1}^3 \beta_n \ln w_n + \frac{1}{2} \sum_{n=1}^3 \sum_{l=1}^3 \beta_{nl} \ln w_n \ln w_l$$

$$+ \sum_{m=1}^3 \sum_{n=1}^3 \chi_{mn} \ln y_m \ln w_n + \phi_1 \ln z + \frac{1}{2} \phi_2 (\ln z)^2 + \sum_{m=1}^3 \phi_{2+m} \ln z \ln y_m + \sum_{n=1}^3 \phi_{5+n} \ln z \ln w_n$$

⁸ For simplicity, index variables t ($t = 1:13$) and i ($i = 1:9$) are suppressed from equation (3)

$$+\varphi_1 t + \frac{1}{2}\varphi_2 t^2 + \varphi_3 d_{major} + v + \Phi u \quad (3)$$

where t is a time trend variable designed to capture the effect of technological change;⁹ d_{major} is a dummy variable which is equal to 1 for major banks and 0 otherwise. This variable is added to the frontiers to control for differences between major and regional banks.¹⁰

By symmetry: $\alpha_{mk} = \alpha_{km}$, $\beta_{nl} = \beta_{ln}$ for all m, n, l, k .

The conditions for ensuring that the cost function is linearly homogeneous in input prices are:

$$\sum_{n=1}^3 \beta_n = 1; \quad \sum_{n=1}^3 \beta_{nl} = 0; \quad \sum_{m=1}^3 \chi_{mm} = 0; \quad \sum_{n=1}^3 \phi_{5+n} = 0; \quad (4)$$

To meet these homogeneity conditions, equation (3) is transformed into a normalized function. Specifically, costs, profit and input prices are normalized by the price of the last input, w_3 . Thus the normalized cost/ profit frontier to be estimated is

$$\begin{aligned} \ln(H / w_3) = & \alpha_o + \sum_{m=1}^3 \alpha_m \ln y_m + \frac{1}{2} \sum_{m=1}^3 \sum_{k=1}^3 \alpha_{mk} \ln y_m \ln y_k + \sum_{n=1}^2 \beta_n \ln(w_n / w_3) \\ & + \frac{1}{2} \sum_{n=1}^2 \sum_{l=1}^2 \beta_{nl} \ln(w_n / w_3) \ln(w_l / w_3) + \sum_{m=1}^3 \sum_{n=1}^2 \chi_{mn} \ln y_m \ln(w_n / w_3) + \phi_1 \ln z + \frac{1}{2} \phi_2 (\ln z)^2 \\ & + \sum_{m=1}^3 \phi_{2+m} \ln z \ln y_m + \sum_{n=1}^2 \phi_{5+n} \ln z \ln(w_n / w_3) + \varphi_1 t + \frac{1}{2} \varphi_2 t^2 + \varphi_3 d_{major} + v + \Phi u \end{aligned} \quad (5)$$

To examine factors affecting cost and profit efficiencies, the study considers an array of bank-specific features, including bank size, bank capitalization, liquidity risk, management risk, and bank profitability. More specifically, the inefficiency model is defined by

$$u = \delta_0 + \delta_1 \ln TA + \delta_2 LTD + \delta_3 NIETA + \delta_4 ETA + \delta_5 ROE + \delta_6 NIM + \delta_7 GFC + \xi \quad (6)$$

where:¹¹

⁹ Because of the small sample size, we do not include the interaction of the time variable on inputs and outputs.

¹⁰ Technically, to control for differences between major and regional banks, one can either add a dummy variable (which is equal to 1 for major banks and 0 otherwise) or estimate different frontiers for these two types of banks. Given the small number of banks in the sample, the former approach is preferred.

- *lnTA* is the natural logarithm of a bank's total assets, and is used as a proxy for bank size.
- *ETA* is the ratio of equity capital over total assets and is a measure of bank capitalization. The expected sign for this variable is mixed as it is a practical matter of having either too much or too little capital. Capital is generally considered as a cushion to cover losses, thus, having too little capital may imply a risk of default for banks. However, having too much capital may impose higher costs for banks and result in a poor return on equity.
- *LTD* is the ratio of loans to deposits. It assesses a bank's ability to transform deposits into loans. The higher this ratio, the more efficient the process of financial intermediation provided by the bank.
- *NIETA*, the ratio of non-interest expense over total assets, measures the size of administrative expenses. Banks that have a good management system should be able to incur less administrative costs. Thus it is expected that the higher the *NIETA*, the higher the bank management risk, then the less efficient the bank is.
- *ROE* is return on equity, with an anticipation that the higher the *ROE*, the more efficient banks are.
- *NIM* - Net interest margin - is defined as the difference between interest income and interest expense divided by total assets.
- *GFC* is a dummy variable which takes the value of 1 for years 2007 – 2009, and 0 otherwise. Although the Australian banking sector was resilient during the crisis, we expect some contagion effects which may bring down the efficiency levels.

¹¹ We check the correlation between endogenous independent variables and find no strong correlation between them, thus equation (6) would have no problems of multicollinearity

V. Empirical findings and discussion

Profit and cost efficiency scores

The yearly-mean cost and profit efficiencies of nine Australian banks, and of the two groups of banks, are reported in Table 2. Overall, the cost and profit efficiency scores of the average banks over 13 years are 0.705 and 0.804 respectively, suggesting that Australian banks, on average, need to reduce their actual costs by 29.3% and increase their actual profit by 19.6% to become fully efficient. The fact that profit efficiency is higher than cost efficiency indicates that the main source of inefficiency comes from the cost side rather than the revenue side. This finding is understandable as nowadays the ultimate objective of most banks is to maximize profit, rather than to minimize costs. Thus banks may incur higher costs (implying lower cost efficiency) in order to raise earnings, and then profits.

Table 2 Efficiency scores

	Profit efficiency		Cost efficiency	
	Mean	SD	Mean	SD
Whole period, 1997-2009	0.804	0.141	0.705	0.108
Major	0.840	0.098	0.694	0.070
Regional	0.774	0.161	0.715	0.131
Before GFC, 1997-2006	0.835	0.121	0.709	0.111
Major	0.865	0.084	0.691	0.073
Regional	0.811	0.140	0.723	0.134
During GFC, 2007-2009	0.699	0.153	0.693	0.097
Major	0.758	0.100	0.701	0.064
Regional	0.653	0.174	0.686	0.118

At the bank category level, the major banks are more profit efficient (by 6.6%) but less cost efficient (by 2.1%) than the regional banks. To test whether these differentials are statistically significant, the study employs the *t* test and Mann-Whitney test for the hypothesis that the differences in the mean cost and profit efficiencies between the two categories are equal to zero. P-values for profit efficiency presented in Panel A Table 3 are equal or smaller than 5%, suggesting that the difference in the mean profit efficiencies between major and regional

banks is statistically significant, and major banks are more profit efficient than regional banks. However, there is no significant differentiation in cost efficiency between these two types of banks as p-values are not small enough (i.e., less than 10%).

Concerning the impact of the GFC on the performance of Australian banks, the results presented in Table 2 show that the average cost and profit efficiency scores during the crisis period are lower than those before the crisis occurred, implying that the crisis imposed an adverse effect on Australian banks' performance. Nevertheless, while the impact on profit efficiency seems to be significant, with a reduction of around 14%, the negative change in cost efficiency is modest, at just 1.5%. These findings are reaffirmed by the t-test and Mann-Whitney test in Panel B Table 3, where at both the whole sample level and bank category level, all test statistic values for profit efficiency are statistically significant at 1%, while all test statistic values for cost efficiency are insignificant. The reduction in profit efficiency is mainly because of a decrease in non-interest income, extra provisioning, and write-downs required by mark-to-market accounting. The slight change in cost efficiency likely results from the cutting of labour costs, and the closing down of some branches.

Table 3 Tests of equal mean

<i>Test statistics</i>	<i>t test</i>		<i>Mann-Whitney test</i>	
	Profit efficiency	Cost efficiency	Profit efficiency	Cost efficiency
	<i>t (prob(T > t))</i>		<i>z (prob(Z > z))</i>	
Panel A:				
Major v.s Regional	2.576***(0.011)	-1.042 (0.300)	1.958**(0.050)	-0.417 (0.677)
Panel B: Before v.s During GFC				
All banks	4.782***(0.000)	0.684 (0.495)	3.933***(0.000)	0.563 (0.574)
Major banks	3.706***(0.000)	-0.412 (0.678)	2.845***(0.004)	-0.413 (0.678)
Regional banks	3.609***(0.000)	0.963 (0.339)	3.036***(0.002)	1.090 (0.276)

*** 1% significance level; ** 5% significance level; p-values are in parentheses

Regarding the evolution of efficiency over time, Figure 1 shows that at the beginning of the study period the major banks were highly profit efficient with a score of above 0.90, while regional banks were 13% lower. In 1998, due to the impact of the Asian financial crisis, the profit efficiency score of the major banks fell by 6%. However, they recovered quickly and reached the profit efficiency level of around 0.90 during 1999 – 2000, before declining again

in 2001, a year of global recession. Profit efficiency of the regional banks did not change much during 1998 – 2000, but it fell by 5% in 2001.

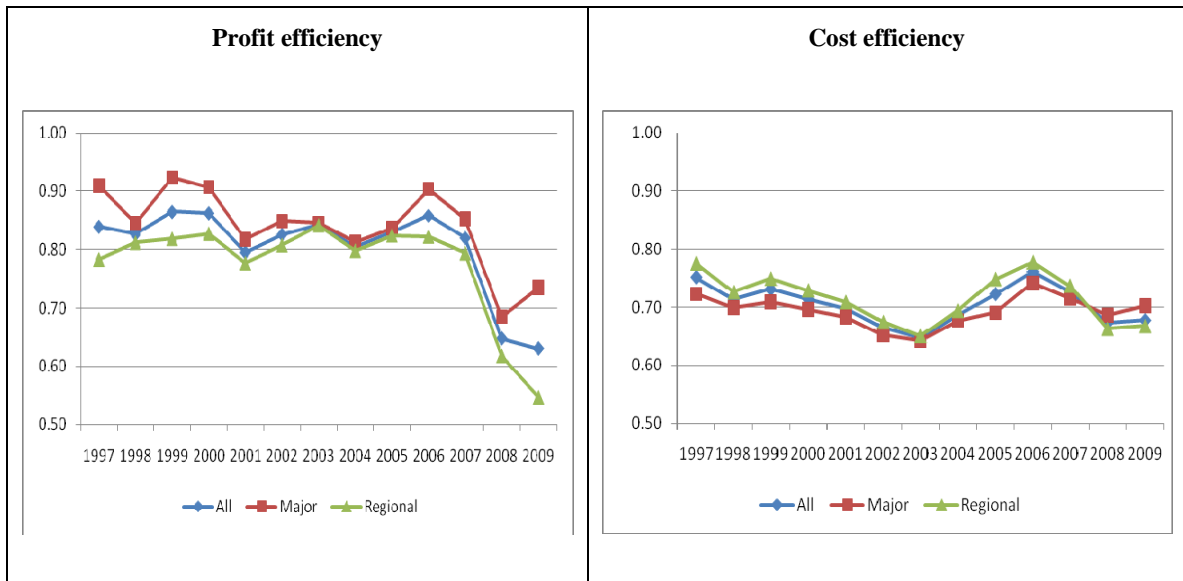


Figure 1 Profit and cost efficiency over time

After the 2001 downturn, both major and regional banks regained their moderate profit growth and narrowed their efficiency gap significantly. There appeared no differential in profit efficiency between major and regional banks during 2003 – 2005, indicating the growth and development of the regional banks in the Australian banking system in this period. In 2006, Australian banks on average made further improvements in profit efficiency on the back of a well-performing economy with accompanying solid business, housing, and personal credit growth.

During the GFC, both the major and regional banks were less profit efficient, with most of them suffering an especially sharp profit decline during 2007 – 2008. Major banks then showed some signs of recovery in 2009, while it took longer for the regional banks to recover. The deterioration in profit efficiency of Australian banks in 2007 and 2008 could be explained by a number of factors. First, because of the fraught market of 2007 and 2008, foreign lenders refused to roll over their funding of Australian banks (Edwards, 2010). This funding problem prompted a retrenchment in new loans in general and, with this, interest income fell. Second,

the GFC induced Australian banks themselves to tighten their lending standards to reduce exposures to risk. As a result, the total domestic credit of the Australian banking sector grew at an annualised rate of 4.5% from September 2008, compared with an average of 14% over the previous five years. Finally, as noted earlier, there was a shift in the composition of banks' loan portfolios towards housing lending, and the amount of banks' off-balance sheet credit commitments fell (Gorajek and Turner, 2010).

Towards the end of 2008, and with the deposit guarantee from the Australian government (as well as the RBA's re-assertion of liquidity support as required), the four major banks achieved improvements in their profit efficiency levels in 2009, while the five regional banks suffered a minor decrease in profit efficiency. This finding supports the information reported in Section II that the regional banks were more seriously affected by the downturn than the major banks. The recovery trend in the major banks could also be explained by the growth in fee income. Total domestic fee income grew by 9% in 2009, with fee income from businesses growing much faster than that from households (RBA, 2010).

Regarding cost efficiency, both national and regional banks seemed to experience a downward trend from 1997 to 2003, before gradually recovering and reaching an efficiency peak in 2006 at 0.69 and 0.75 for major and regional banks respectively. As with profit efficiency, both categories of banks experienced sliding cost efficiency between 2007 and 2008. This deterioration was driven by increased provisioning for bad loans, higher impairment expenses, and higher funding costs due to the dire conditions in global credit markets. Although regional banks were more cost efficient than major banks for most of the years until 2007, their cost efficiency scores deteriorated during the GFC, suggesting that the big banks were able to cope with the external disturbances better than their smaller competitors.

Finally, as two indicators of performance have been measured in this paper, it is of further interest to test if there exists any correlation between them. For this purpose, the study employs the Spearman's rank-order and Kendall rank correlation coefficients to test the hypothesis that cost and profit efficiencies are independent. As reported in Table 4, when considering all banks together, both correlation coefficients are small and statistically insignificant, implying that there is no relation between cost and profit efficiencies (i.e., banks which are ranked the most profit efficient are not necessarily the most cost efficient). Berger and Mester (1997) similarly found that measured cost efficiency is essentially uncorrelated with the profit efficiency of the US banking industry. This could occur because of competitive pressures if, for example, banks with highly valued product mixes or high revenue efficiencies felt less market discipline to control their costs. However, amongst the regional banks, it seems that cost and profit efficiencies *are* negatively correlated. Thus regional banks which are ranked high in terms of profit efficiency tend to be ranked low in cost efficiency.

Table 4 Tests of correlation between profit and cost efficiency

	Spearman's rank-order correlation coefficient	Kendall rank correlation coefficient
All banks	-0.130 (0.162)	-0.088 (0.162)
Major banks	0.233* (0.097)	0.125 (0.193)
Regional banks	-0.289** (0.019)	-0.191** (0.025)

** 5% significance level; * 10% significance level; p-values are in parentheses

Determinants of cost and profit efficiencies

The impact of bank-specific factors and the crisis on Australian banks' cost and profit efficiencies are reported in Table 5. Regarding the effect of bank size, the coefficients on *lnTA* are negative in both cost and profit efficiency terms, but only statistically significant in the case of cost efficiency. This result suggests that larger banks seem to be more cost efficient, but have profit efficiency levels that are little different from the smaller ones. This may suggest that Australian banks might experience decreasing returns to scale, and that increasing bank size may not be a good choice to improve bank (profit) performance.

Table 5 Determinants of Efficiency

	Profit efficiency		Cost efficiency	
	coefficient	t-ratio	coefficient	t-ratio
<i>constant</i>	0.774**	2.497	-1.686***	-4.713
<i>lnTA</i>	-0.099	-0.381	-0.100***	-5.607
<i>LTD</i>	0.397***	5.828	0.368***	11.140
<i>NIETA</i>	-3.022***	-2.911	-5.826***	-7.241
<i>ETA</i>	-1.426*	-1.729	-4.885***	-5.958
<i>ROE</i>	3.619***	6.928	0.235	0.568
<i>NIM</i>	0.944**	2.971	9.627***	28.715
<i>GFC</i>	-306***	-3.034	0.072	1.400

Notes: *** 1% significance level; ** 5% significance level; * 10% significance level

Positive and statistically significant coefficients for *LTD* in both cost and profit models suggest that banks with a higher ability to transform deposits into loans (i.e., that maintain a high ratio of loans to total deposits) would be more cost and profit efficient than their counterparts. This finding is reasonable in the sense that a higher ratio of loans to deposits means that inputs are utilized more productively and, given prices, net interest income (i.e., the difference between interest income and interest expense) is larger, leading to increased profit and reduced relative cost.

The results also show a negative effect of *NIETA* on cost and profit efficiencies. The economically and statistically significant coefficients in both models indicate that higher administration costs will cause a decrease in efficiency. Furthermore, the magnitude of the coefficient in the cost model is substantial and much greater than that in the profit model, implying that banks that incur more non-interest expense would suffer from a larger decline in cost efficiency than a decline in profit efficiency.

Concerning the effect of bank capitalization (measured by *ETA*) on bank efficiency, we found that capitalization has a negative and statistically significant impact on both cost and profit efficiencies with a more dominant effect on the former. In other words, banks with a higher level of capital are less efficient, whereas banks taking more risk by keeping a low level of capitalization seem to be more efficient. Thus, banks might intend to keep their equity to

assets ratio low to become more efficient *ceteris paribus*. Our findings are in line with some previous studies such as Cavallo and Rossi (2002) (who found a positive and significant relationship between capitalization and cost inefficiency for German and Italian banks), Hermes and Nhung (2007) (for banks in 10 economies in Latin America), and Pasiouras *et al.* (2007) (who found exactly the same results as our ones for a large sample of 677 bank from 88 countries). It is important to note that the equity to assets ratio employed in this paper is not risk-weighted, thus it is not equivalent to the ratio for the capital adequacy requirement (i.e., the ETA ratio being smaller than the Basel Capital Accord's 8% minimum does not necessarily mean that the capital adequacy requirement is violated). The implication could be that, to become more efficient while simultaneously behaving prudently and protecting themselves against risks, banks should maintain their capital levels right around the capital adequacy ratio.

With regards to the effect of bank profitability on efficiency, our findings unsurprisingly show that the higher the profitability (both in terms of *ROE* or *NIM*), the more profit efficient banks are. This finding is consistent with the main literature (see, for example, Casu and Girardone, 2004; Hermes and Nhung, 2007).

Finally, the negative and significant coefficient of the GFC in the profit efficiency model confirms the result discussed earlier □ that this external shock imposed an adverse effect on the profit efficiency of Australian banks. However, it caused no significant impact on cost efficiency.

VI. Conclusions

This paper attempted to analyse the cost and profit efficiencies of Australian banks across 1997-2009 and, accordingly, both before and after the GFC. It also compared the performance of Australia's four major banks with the country's regional banks, and determined factors driving efficiency differences between them.

Our findings showed that Australian banks were more profit efficient than cost efficient, suggesting that the main source of inefficiency came from the cost side rather than the revenue side. Thus, to improve efficiency levels, banks might need to pay more attention in the selection of the combination of inputs utilized. Furthermore, the major banks seem to be more profit efficient but less cost efficient than regional banks, implying the strong business objective of the major banks remains profit maximization rather than cost minimization.

The findings also revealed that Australian banks were relatively profit efficient prior to the GFC before suffering a significant decline in their profit efficiency levels during the crisis. However, the GFC brought almost no changes in cost efficiency levels. Although Australian banks performed solidly during the crisis, with generally sound asset quality, moderate volume growth in key product lines, and tight expense management, these underlying results were offset by increased provisioning for bad debts and loan impairments, and higher funding costs due to the volatility in global credit markets. Nonetheless Australian banks, especially the major ones, recovered quickly. The fact that Australian banks' efficiency was high before the crisis, fell during it, and then recovered toward the end of the crisis supports the point made by Blejer (2006) that countries with efficient financial systems seem to be better insulated from some of the worst effects of the financial crises.

The paper further analysed the factors playing a crucial role in shaping the efficiency of Australian banks. It was found that loans to deposits, bank capitalization, non-interest expenses to total assets, and profitability are the main determinants of profit and cost efficiency of Australian banks. Thus, the implications for bank management (and to some extent banking authorities) in order to enhance bank efficiency are (1) to make sure bank capitalization is kept at a level that satisfies the capital adequacy requirements; (2) ensure better management of non-interest expenses and liquidity funding.

References

- Altunbas, Y. and Chakravarty, S. P. (2001), 'Frontier cost functions and bank efficiency', *Economics Letters*, **72**, 233-240.
- Altunbas, Y., Evans, L. and Molyneux, P. (2001), 'Bank Ownership and Efficiency', *Journal of Money, Credit and Banking*, **33**, 926-954.
- Avkiran, N. K. (1999), 'The evidence on efficiency gains: The role of mergers and the benefits to the public', *Journal of Banking & Finance*, **23**, 991-1013.
- Battellino, R. (2010), 'Some comments on bank funding', RBA Bulletin, March, 71-76.
- Battese, G. E. and Corra, G. S. (1977), 'Estimation of a Production Frontier Model: With Application to the Pastoral Zone of Eastern Australia', *Australian Journal of Agricultural Economics*, **21**, 169-179.
- Battese, G. E. and Coelli, T. J. (1995), 'A model for technical inefficiency effects in a stochastic frontier production function for panel data', *Empirical Economics*, **20**, 325-332.
- Berger, A. N. and Udell, L. J. (1997), 'Inside the black box: What explains differences in the efficiencies of financial institutions?', *Journal of Banking and Finance*, **21**, 895-947.
- Blejer, M. I. (2006), 'Economic growth and the stability and efficiency of the financial sector', *Journal of Banking & Finance*, **30**, 3429-3432.
- Brown, A., Davies, M., Fabbro, D. and Hanrick, T. (2010), 'Recent Developments in Banks' Funding Costs and Lending Rates', RBA Bulletin, March, 35-43.
- Casu, B. and Girardone, C. (2004), 'Financial conglomeration: efficiency, productivity and strategic drive', *Applied Financial Economics*, **14**, 687-696.
- Cavallo, L. and Rossi, S. P. S. (2002), 'Do environmental variables affect the performance and technical efficiency of European banking systems? A parametric analysis using the stochastic frontier approach', *European Journal of Finance*, **8**, 123-146.
- Gorajek, A. and Turner, G. (2010), 'Australasian Bank Capital and the Regulation Framework', RBA Bulletin, September, 43-50.
- Hermes, N. and Nhung, V. T. (2007), 'The Impact of Financial Liberalization on Bank Efficiency: Evidence from Latin America and Asia', *SSRN eLibrary*, available at <http://ssrn.com/paper=983865>
- Kirkwood, J. and Nahm, D. (2006), 'Australian Banking Efficiency and Its Relation to Stock Returns', *Economic Record*, **82**, 253-267.
- Koetter, M. (2006), 'Measurement Matters - Alternative Input Price Proxies for Bank Efficiency Analyses', *Journal of Financial Services Research*, **30**, 199-227.
- KPMG (2009a), 'Major Australian Banks: Year End 2009, Financial Institutions Performance Summary', KPMG: Sydney.
- KPMG (2009b), 'Regional Banks: 2009, Financial Institutions Performance Survey', KPMG: Sydney.
- KPMG (2010), 'Major Australian Banks: Half Year 2010, Financial Institutions Performance Summary', KPMG: Sydney.
- Lee, J.-D., Heshmati, A. and Wu, S. (2009), 'The Impact of the Wallis Inquiry on Australian Banking Efficiency Performance', in W. A. Müller and M. Bihn (eds.), *Productivity, Efficiency, and Economic Growth in the Asia-Pacific Region*, Physica-Verlag HD.
- Maudos, J., Pastor, J. M., Perez, F. and Quesada, J. (2002), 'Cost and profit efficiency in European banks', *Journal of International Financial Markets, Institutions and Money*, **12**, 33-58.
- Neal, P. (2004), 'X-Efficiency and Productivity Change in Australian Banking', *Australian Economic Papers*, **43**, 174-191.
- Pais, A. and Stork, P. A. (2010), 'Contagion risk in the Australian banking and property sectors', *Journal of Banking and Finance*, **35**, 681-697.
- Pasiouras, F., Tanna, S. and Zopounidis, C. (2007), 'Regulations, Supervision and Banks' Cost and Profit Efficiency Around the World: A Stochastic Frontier Approach', *SSRN eLibrary*, available at <http://ssrn.com/paper=970373>

- Paul, S. and Kourouche, K. (2008), 'Regulatory Policy and the Efficiency of the Banking Sector in Australia', *Australian Economic Review*, **41**, 260-271.
- RBA (2010), 'Banking Fees in Australia', RBA Bulletin, June, 31-36.
- Sathye, M. (2001), 'X-efficiency in Australian banking: An empirical investigation', *Journal of Banking and Finance*, **25**, 613-630.
- Schwartz, C. (2010), 'The Australian Government Guarantee Scheme', RBA Bulletin, March, 19-26.
- Stevens, G. (2010), 'Recent Financial Developments', RBA Bulletin, June, 69-74.
- Sturm, J.-E. and Williams, B. (2004), 'Foreign bank entry, deregulation and bank efficiency: Lessons from the Australian experience', *Journal of Banking and Finance*, **28**, 1775-1799.
- Sturm, J.-E. and Williams, B. (2010), 'What determines differences in foreign bank efficiency? Australian evidence', *Journal of International Financial Markets, Institutions and Money*, **20**, 284-309.
- Walker, G. (1998), 'Economies of Scale in Australian Banks 1978-1990', *Australian Economic Papers*, **37**, 71-87.