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Does corporate governance affect Australian banks' performance?

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Keywords: Data envelopment analysis, Efficiency, Banking, Corporate governance

1. Introduction

Around the world, good corporate governance is recognised as a fundamental principle that underpins the performance of banks, and is increasingly attracting the interest of academics, economists and politicians. While a successful corporate governance structure can improve public accountability, create value, minimize risk exposure, and boost operational efficiency (Basel Committee on Banking Supervision, 2006; Fu et al., 2014), no study has yet considered its impact on banking efficiency. Shareholders, regulators and banks themselves all share an interest in understanding whether efforts to establish sound corporate governance lead to improvements in organisational performance. Shareholders want value for money in paying board members, regulators seek fewer failures and higher stability and banks intend their corporate governance arrangements to deliver stronger oversight of management.

Good corporate governance requires a board of directors to fulfil its statuary duty to oversee the management of its company, to guard the interests of shareholders and to ensure conformity with regulatory requirements. Over the last decades, investors have become even more concerned about the role of the board, especially in the wake of major corporate collapses including Enron and WorldCom in the United States, and Ansett, OneTel and HIH in Australia. Hence, investors and governments have demanded stronger corporate governance and increased regulation of major corporations, including financial institutions

(Houle, 1990; Park and Shin, 2003). New regulations include the United States' Sarbanes-Oxley (SOX) Act of 2002 and the 2003 Australian Securities Exchange Principles of Good Corporate Governance and Best Practice Recommendations (PGCG) aiming for improved corporate governance.

Corporate governance studies generally exclude banks from their samples because of their special status in providing financial services (Adams and Mehran, 2008). However, as highlighted by several studies, there is a strong need to investigate the role of corporate governance within banks as the highly-regulated banking environment affects the supervisory conduct of boards (Adams and Mehran, 2003; Levine, 2004; Zulkafli and Samad, 2007; de Andres and Vallelado, 2008; Shehzad and De Haan, 2015). Many existing studies on financial institution corporate governance rely on traditional performance measures such as Tobin's Q, return on equity (ROE), and return on assets (ROA). The use of these traditional performance measures, however, has been criticised in the context of corporate governance studies (see *inter alia* Halkos and Salamouris, 2004; Destefanis and Sena, 2007; Bozec et al., 2010). For instance, a scenario is possible in which underinvestment increases Tobin's Q despite a reduction of a firm's net present value. Strong corporate governance can then either decrease Tobin's Q by mitigating underinvestment or increase it by fostering cost reductions. Such arguments provide additional justifications to the surging application of econometric and mathematical programming techniques such as frontier efficiency methods to assess companies' performance (Berger and Humphrey 1997; Fethi and Pasiouras 2010). Blejer (2006) highlights that countries with an efficient financial system are better protected against the occurrence and magnitude of banking and currency crises. To achieve a high efficiency level in banks, boards generally have to carry out their responsibilities to hire and oversee management, to establish policies and objectives, to monitor compliance with those policies and to take part in the weightiest decisions within the financial institution, including the boards' role to prevent excessive risk-taking by management.

Despite the volume of research on Australian banks' efficiency and productivity (Neal, 2004; Kirkwood and Nahm, 2006; Chen and Lin, 2007; Sturm and Williams, 2007, 2008; Wu, 2008; Vu and Turnell, 2011), no study takes corporate governance factors into consideration to explain changes in the efficiency of Australian banks. Therefore, this study is the first to assess the impact of corporate governance—represented by number of directors, proportion of non-executive directors, number of board meetings, number of committee meeting, and the largest share of the individual shareholders—on the efficiency of the Australian banking

industry. Major banks in Australia are ranked among the safest in the world with their proactive attitude towards prudential regulation and higher standards on leveraging compared to the US banks, even during the GFC (Pais and Stork, 2010). However, a comprehensive investigation of major and regional banks' operating performance over the last decade is necessary to better understand the relevance of corporate governance for Australian banks' performance. In order to achieve this aim, this study employs two-stage double-bootstrap data envelopment analysis (DEA) as proposed by Simar and Wilson (2007) under variable returns to scale to estimate the banks' inefficiency scores and regress them against the corporate governance and other control variables.

The rest of the paper proceeds as follows: Section 2 provides a brief discussion of the issues relating to corporate governance and the Australian banking industry, followed by theoretical considerations in Section 3. Section 4 includes a brief review of relevant literature, and the research methodology and description of variables are explained in Sections 5 and 6, respectively. Section 7 includes model estimation and an analysis of empirical results. Section 8 contains concluding remarks and policy implications.

2. Banking regulatory bodies and conditions in Australia

The Australian Securities and Investment Commission (ASIC) and the Australian Prudential Regulation Authority (APRA) are the main regulatory bodies responsible for the Australian financial system. They have the aim of, *inter alia*, improving the long-run efficiency of financial institutions and ensuring fair treatment of their customers. The ASIC is an independent Australian governmental authority with power to enforce legislative control over Australian corporations. It is responsible for market integrity and is in charge of regulating financial institutions including investment banks and finance companies to protect Australian consumers, investors and creditors. ASIC and APRA were founded in 1998 following recommendations of the Wallis Inquiry (1997). ASIC is established under the *Australian Securities and Investments Commission Act 2001* which sets the requirement for ASIC to maintain, facilitate and improve the performance of the financial system and its entities.[1] Since its establishment, ASIC's responsibilities have expanded and it now oversees

[1] ASIC began operating in 1991 as the Australian Securities Commission (ASC) replacing the National Companies and Securities Commission (NCSC) and the Corporate Affairs offices of the states and territories.

Australian Securities Exchange (ASX)-listed companies, including their corporate governance.

The *Australian Prudential Regulation Authority Act 1998* defines APRA's role as the oversight of banks, credit unions, building societies, insurance companies and superannuation funds. It enforces capital-adequacy guidelines in line with the Basel II guidelines of 2008. Financial institutions regulated by APRA are required to report key financial figures describing their credit, market and operational risks to APRA on a periodic basis. This assists APRA fulfil its responsibilities to develop regulatory and supervisory policies related to the performance of its role as prudential regulator. APRA also sets prudential standards under relevant legislation to identify potential weaknesses in regulated institutions as early as possible. APRA follows a risk-based approach under which institutions facing greater risks receive closer supervision.

In terms of governance, the Prudential Standard set by ASIC for locally-incorporated regulated institutions includes: board size and composition requirements; the chairperson of the board must be an independent director; the board must have a policy on board renewal and procedures for assessing board performance; a board remuneration committee must be established and the institution must have a remuneration policy that aligns remuneration and risk management; a board audit committee must be established.

The ASX Corporate Governance Council has developed Corporate Governance Principles and Recommendations (ASX, 2nd edition in 2007 with amendments in 2010) which are designed to assist ASX-listed banks promote investor confidence and meet the expectations of stakeholders. These guidelines put particular emphasis on directors by outlining the role and composition of the board.

3. Theoretical Considerations

The issues of corporate governance for financial and non-financial institutions are usually explained using agency theory (Hermalin and Weisbach, 2003). The separation of control and ownership typical of listed companies causes an 'agency conflict'. Agency theory assumes that managers may engage in actions maximizing their personal utility, minimizing their own work effort, indulging in perquisites, or, generally speaking, employing inputs and outputs which do not maximise the firm value. Hence, the role of the board of directors is to mitigate this conflict and to supervise managers to align their interests with those of shareholders

(Jensen and Meckling, 1976; Fama, 1980; Eisenhardt, 1989). As such, agency theory predicts that board attributes and ownership structure as well as other governance mechanisms (management contracts, management compensation, etc.) are important factors affecting companies' management performance. Previous studies draw on agency theory to explain the impact of the following board attributes and ownership structures on performance or stock price:

Board size

Board size can have either a positive or negative effect on corporation performance. On one hand, a large board makes coordination and communication difficult, allowing the CEO to gain control over the board, triggering the agency issue and reducing company performance (Jensen, 1993; Eisenberg et al., 1998; Chiang and Lin, 2007). On the other hand, resource-dependent theory suggests that a larger board allows for more specialists from different fields and therefore facilitates high-quality decision making. Further, more board members can provide additional networking to allow acquisition of key external resources (Pfeffer and Salancik, 1978; Zahra and Pearce, 1989; Kiel and Nicholson, 2003; Xie et al., 2003).

Ratio of non-executive independent directors to board size

In addition to the size of the board, composition and independence of the board may influence bank performance. This can be measured by the number of non-executive or outside directors, or the ratio of the non-executive independent directors to the board size. The major task of non-executive directors is to reduce the conflicting interests between insiders (managers and executive board members) and shareholders. These non-executive board members can achieve this through monitoring, disciplining and or informing managers (Harris and Raviv, 2008). Some studies found positive relations between this governance variable and operating performance (see *inter alia* Hossain et al., 2001; Bushman et al., 2004; de Andres et al., 2005; Cornett et al., 2007; Doucouliagos et al., 2007; Dahya et al., 2008; Aggarwal et al., 2009). For instance, de Andres and Vallelado (2008) argue that a non-excessive number of outside directors can achieve an improved performance through efficiently exercising its monitoring and advising functions. In contrast, other studies found no significant relationship between the number of non-executive directors and performance (Yermack, 1996; Bhagat and Black, 2002) or no negative relation between the number of insider board members and performance (de Jong et al., 2005). Some found there is no relationship with bank efficiency (Tanna et al. 2008, Lin et al. 2009). For instance, de Andres

et al. (2005), using a sample of 450 non-financial companies from ten countries in Western Europe and North America, found that a higher number of non-executive directors does not necessarily lead to improvements in efficiency.

Stewardship theory takes a contrary point of view: managers are characterised as trustworthy, collectivistic and pro-organizational risk-takers following shareholders' objectives. Managers foster trust-based structures which empower and facilitate the achievement of duties on behalf of shareholders. Under this theory no agency costs occur and variances in performance are caused by the structural situation in which managers are placed or allowed to take effective actions (Donaldson, 1990; Donaldson and Davis, 1991; Donaldson and Preston, 1995). This theory also asserts inside directors make better decisions than outsiders and that they maximize the profit of the company as they have better insights into the business. Ultimately, inside directors best oversee senior managements' actions and should make up majority of the board (Donaldson, 1990; Donaldson and Davis, 1991). Thus, the ratio of the non-executive independent directors to the board size can have either a positive or negative impact on company's performance.

Number of board meetings

Lipton and Lorsch (1992) assert that board members have insufficient time to fulfil their duties and board meetings enhance the board's effectiveness. According to Lipton and Lorsch and Conger et al. (1998), a higher frequency of board meetings could result in directors carrying out their duties in line with shareholders' expectations and interests and to monitor management more efficiently (Brick and Chidambaran, 2010). However, Jensen (1993) takes a contrary view and claims that board meetings might not necessarily be useful because of the shortage in time for outside directors to exchange meaningful ideas among themselves, the board or the management. Besides, Jensen (1993) states that the CEO determines the agenda of board meetings and routine tasks do not leave much time for outside board members to exert sufficient control over management. Thus, Jensen perpetuates the view of the board as being reactive rather than proactive towards enhancement of governance, so increased board activity suggests poor corporate performance with unclear consequences (see also Vafeas, 1999)

Number of committee meetings

A board of directors establishes committees which assist the board fulfil its corporate governance-related duties. Commonly there are four main committees which affect corporate

activities: audit, nominating, remuneration and risk. These are the sources of boards' most important decisions (Vance, 1983; Kesner, 1988; Xie et al., 2003, Jiraporn et al., 2009). Committees' major functions include: holding meetings; deciding on the number of meetings; discussing company-related issues; exchanging ideas on supervising and monitoring managers (Vafeas, 1999; de Andres and Vallelado, 2008).

Concentrated shareholdings

Shareholding concentration is an external governance mechanism which can affect company executives. Management will receive support for actions that maximize investor utility or opposition for decisions that reduce it (Hill and Snell, 1989; Chen et al., 2015). Compared to small shareholders, large shareholders can monitor management more closely and therefore reduce information asymmetry (Shleifer and Vishny, 1986; 1997). Findings in regard to the performance of financial and non-financial corporations are mixed: positive effects of large shareholdings on performance were found by Earle et al. (2005), Destefanis and Sena (2007) and Kapopoulos and Lazaretou (2007), and a negative impact was found by Demsetz and Villalonga (2001). Pedersen and Thomsen (1999) and de Miguel et al. (2004) found no meaningful impact and non-linear associations, respectively. Controlling shareholders may need significant rights to company cash flow in order for sufficient signalling power to affect performance (La Porta et al., 1999).

This study will explore whether corporate governance affects Australian bank performance by regressing their DEA inefficiency scores against a set of above mentioned corporate governance factors which are: board size, ratio of non-executive directors, number of board meetings, number of committee meetings, and the largest share of the individual shareholders. Following Vu and Turnell (2011) and Pathan and Faff (2013), this study also uses the following control variables: bank size, capital strength, ROA as a proxy of profitability, the loans-to-deposits ratio as a proxy of liquidity, and a dummy variable for time trend which all will be explained in section 6.

4. Literature review of Australian related studies

There is an increasing number of Australia-focused bank efficiency studies in the literature (see *inter alia* Walker, 1998; Avkiran, 1999 and 2000; Sathye, 2001; Neal, 2004; Sturm and Williams, 2004; Kirkwood and Nahm, 2006; Paul and Kourouche, 2008; Vu and Turnell, 2011). In a study of 12 Australian banks over the period 1978–1990, Walker (1998) found an

average cost efficiency level of 90 per cent and showed that smaller banks had superior cost efficiency compared with major banks. Avkiran (1999) investigated the operating efficiencies of 17 Australian trading banks during the pre-Wallis period (1986–1995) and found that merged banks did not keep their pre-merger efficiency. Investigating ten Australian banks over the period 1986 to 1995, Avkiran (2004) found regional banks showed increasing and major trading banks decreasing returns to scale. Avkiran also found that medium-sized banks operated at optimal returns to scale in comparison with small and large banks. Similar to Avkiran (2004), Paul and Kourouche's (2008) findings for the technical efficiency of ten Australian banks during the post-Wallis period (1997-2005) indicate medium-sized banks' efficiency improvements are beyond small and large banks. Neal (2004) estimated the efficiency of Australian banks over the period 1995 to 1999, and revealed that the four major banks had efficiency advantages over regional institutions. She also found the banking sector's performance in 1999 was less efficient than that in 1995. Sathye (2002) conducted a similar study and found banks' technical efficiency declined over the period 1995 to 1999. He found no association between bank size and technical efficiency. Using traditional accounting-based measures of profitability and cost efficiency such as interest margin, net profit, ROA, ROE, and the cost-to-income ratio, Thomson and Jain (2006) investigated the impact of corporate governance failure on the performance of the National Australia Bank (NAB) between 2001 and 2005. They found the NAB's efficiency ratios to be of some concern as, over the period 2003 to 2005, the bank had not matched gains in the cost-to-income ratios of other major banks. These authors also determined that NAB investors were willing to pay a premium for, and to shift their shareholdings towards, companies with stronger corporate governance. Kirkwood and Nahm (2006) measured the profit efficiency of ten Australian banks and found that the efficiency of the big four banks improved between 1995 and 2002, while it decreased for regional banks. Wu's (2008) efficiency analysis for the period 1983 to 2001 shows mergers reduced the performance of major banks and the banking sector. Vu and Turnell (2011) analysed the effect of the GFC on the cost and profit efficiencies of eight Australian banks for the period 1997 to 2009, drawing on stochastic frontier analysis. In their comparison of regional and major banks, they revealed that major banks were more profit efficient while regional banks were more cost efficient. Vu and Turnell (2011) also found that Australian banks performed well in terms of both cost efficiency and profit efficiency before the crisis and the effect of the GFC on cost efficiency was not significant. Moradi-Motlagh and Babacan (2015), however, found a negative impact of GFC on the banking efficiency using bootstrapped DEA efficiency measures. Moradi-

Motlagh and Saleh (2014) in their study of 10 Australian banks for period 1997 to 2005 found that smaller banks suffered both pure technical and scale inefficiencies while medium-sized banks operated at the most productive scale size. As for the major banks all except ANZ were found to be operating under decreasing returns to scale. Moradi-Motlagh et al. (2015) examined the efficiency levels of eight major Australian banks over the period 2006 to 2012 and showed how different scenarios of improving technical efficiency scores might lead to cost savings for individual banks. None of the above-mentioned studies, however, has considered the impact of corporate governance characteristics on the performance of Australian banks.

Wang et al. (2012) analysed the impact of corporate governance on the operating performance of 68 bank holding companies (BHCs) during the period 1980 to 2003 in the US. Estimating performance using DEA, they found in the second stage regression that board size, outside directors, the average age of directors and CEO/Chairman duality had a negative effect on operating performance, while the number of committees and Big-4 auditors had a positive impact. Tanna et al. (2011) drew on a sample of 17 banking institutions operating in the UK between 2001 and 2006 to investigate the association between the efficiency of UK banks and their board structure using DEA. The board structure represented by board size and composition had a positive effect on efficiency after taking bank size and capital strength into account.

5. Methodology

There are two methods commonly used to estimate efficiency scores: the parametric stochastic frontier approach (SFA) and non-parametric data envelopment analysis (DEA). The first approach has the advantage of separating the inefficiency component from the purely random component, which represents the effect of variables beyond the control of production units. The second approach has an advantage in the sense that that deviations from the efficient frontier arise only from inefficiency. Both SFA and DEA accomplish three tasks (under different assumptions): (i) approximation of the production frontier (ii) estimation of (unobserved) inefficiency of each firm in the sample in relation to the frontier, and (iii) subsequent analysis of potential causes of firms' inefficiencies. In this study, we use DEA

mainly because it is the most common approach for analysing relatively small sample sizes.[2] We also use the SFA method in order to check the robustness of our results. In addition, we choose the output-oriented measure of technical efficiency under the assumption that bank managers and directors try to maximise revenue for a given level of inputs (expenses).

The DEA-type estimators generally assume that all firms have access to the same technology that allows transformation of a vector of *N* inputs, *x*, into a vector of *M* outputs, *y*:

$$T = \left\{(x,\ y) \in \Re_+^N \times \Re_+^M : x \in \Re_+^N \text{can produce } y \in \Re_+^M \right\}. \tag{1}$$

Although the firms have access to the same technology, they may or may not be on the estimated frontier for this technology. The distance from the frontier is used as a benchmark for measuring the banks' inefficiency caused by firms' specific endogenous or exogenous factors. The aim of this study is to measure such inefficiency and investigate its dependency on hypothesised factors, in particular factors suggested by agency theory as well as other control variables using a two-stage approach suggested by Zelenyuk and Zheka (2006):

The first stage: Estimation of efficiency scores

Following Farrell's (1957) output-oriented technical efficiency measure, efficiency scores of each firm (*j* out of the sample of *n* firms) will be estimated:

$$TE(x^j, y^j) = \max_{\theta} \left\{\theta : (x^j, \theta y^j) \in T\right\} \tag{2}$$

As *T* is practically unobserved, it is replaced with its following DEA estimate under variable returns to scale (VRS):

$$\hat{T} = \{(x, y) \in \Re_+^N \times \Re_+^M : \sum_{k=1}^{n} z_k y_m^k \geq y_m, m = 1, ..., M, \sum_{k=1}^{n} z_k x_i^k \leq x_i, i = 1, ..., N,$$
$$\sum_{k=1}^{n} z_k = 1, z_k \geq 0, k = 1, ..., n\}. \tag{3}$$

where $\sum_{k=1}^{n} z_k = 1$ is the convexity constraint and $\hat{T}$ is a consistent estimator of the unobserved true technology set *T* under VRS. The estimates of efficiency scores, $T\hat{E}_j$, obtained from replacing *T* with $\hat{T}$ in (2), are bounded between unity and infinity. Unity

[2] Chu and Lim (1998), Apergis and Rezitis (2004) and Rezitis (2006) examine six banks, Drake (2001) examines only nine banks, Tanna et al. (2008) examine 10 banks, and Neal (2004) examines 12 banks.

represents full (relative) technical efficiency, and unity divided by $T\hat{E}_j$ represents the level of the (output-oriented relative technical) efficiency of the firms.

After obtaining the efficiency scores, in order to understand which group has better access to the efficient frontier we analyse the distributions of efficiency within each bank group (e.g. Major vs. Regional). First we examine the densities of corresponding distributions using the kernel density estimator. For this, we use the Gaussian kernel, and apply the Silverman (1986) reflection method (around unity)—to take into account the bounded support of the efficiency measure—and the Sheather and Jones (1991) method for bandwidth selection. We then apply a version of the Li (1996) test—adapted for DEA by Simar and Zelenyuk (2006)—to test the equality of the efficiency distributions of the various bank groups. To analyse the performance of each bank group, we test the equality of their aggregate efficiencies (AEs). These aggregate efficiencies are estimated as the weighted average of the individual efficiency scores for each subgroup. The weights are derived from the observed output shares using the economic optimization approach developed by Färe and Zelenyuk (2003) which was extended to the sub-group case by Simar and Zelenyuk (2007). To make statistical inferences based on the group efficiencies, we also utilise the bootstrap-based approach suggested by Simar and Zelenyuk (2007); see this study for further details of this method. Following Simar and Zelenyuk, here we use a relative difference (RD) statistic to test the null hypothesis that the aggregate efficiencies for any two bank groups (e.g. group 1 and group 2) are equal (that is $H_0 : \overline{AE_1} = \overline{AE_2}$): $RD_{1,2} = \overline{AE_1} / \overline{AE_2}$. At a given level of confidence, the null hypothesis can be rejected in favour of $H_1 : \overline{AE_1} > \overline{AE_2}$ only if $RD_{1,2} > 1$ (or $H_1 : \overline{AE_1} < \overline{AE_2}$ only if $RD_{1,2} < 1$) and the estimated confidence interval of $RD_{1,2}$ does not overlap with unity.

The second stage: Analysis of determinants of efficiency

The goal of the second stage of the analysis is to investigate the dependency of the firms' efficiency scores (obtained from the first stage) on corporate governance factors (discussed earlier) and other factors such as firms' profitability, liquidity, size, equity ratio, and time trend. In this study we assume and test the following specification:

$$TE_j = Z_j d + e_j, \qquad j = 1, \ldots, n \tag{4}$$

where Z_j is a (row) vector of firm-specific variables which are expected to affect firm j's efficiency score (that is, TE_j as defined in equation 2) through the vector of parameters δ, which we need to estimate. ε_j is the statistical noise term of the jth observation. A common practice in DEA was to use Tobit regressions to estimate such models, however, Simar and Wilson (2007) proved that the Tobit estimator is not suitable for the context of model (4). They proposed a bootstrap-truncated regression and used Monte Carlo experiments to show its performance was satisfactory. Thus, this study employs Simar and Wilson's 'Algorithm 2' to replace the unobserved regressand of equation (4), TE_j, with the bootstrap bias-corrected estimate, $\hat{TE}_j^{bc}$ in equation (5). Note that both sides of equation (4) are bounded by unity, and the distribution of the noise term is limited by the condition $\varepsilon_j \geq 1 - Z_j\delta$. Hence, we follow Simar and Wilson and assume that this distribution is a truncated normal distribution with a mean of zero and unknown variance. So, the second stage regression is given by:

$$\hat{TE}_j^{bc} = Z_j\delta + \varepsilon_j, \qquad j = 1, \ldots, n, \tag{5}$$

where

$$\varepsilon_j \sim N(0, \sigma_\varepsilon^2), \text{ such that } \varepsilon_j \geq 1 - Z_j\delta, \quad j = 1, \ldots, n, \tag{6}$$

which can be estimated by maximizing the corresponding likelihood function, with respect to $(\delta, \sigma_\varepsilon^2)$, given our data. The parametric regression bootstrap can then be utilised to obtain the bootstrap confidence intervals for the estimated parameters. The bootstrap algorithm is described in detail in Simar and Wilson (2007).

6. Specification of inputs and outputs and regression variables

DEA, originated by Farrell (1957) and popularised by Charnes et al. (1978) as an efficiency evaluation, has become a widely-recognized nonparametric method for evaluating multiple inputs and multiple outputs with the aim of assessing entities' relative efficiency. According to the survey of Fethi and Pasiouras (2010), which reviewed 196 bank performance studies, DEA has become a popular tool in this area around the world. Yet, there is still an ongoing and extensive discussion about the selection of input and output variables for banks. As Berger and Humphrey (1997) stated, there is no perfect approach to specify these variables. Specification mainly depends on the availability of data as well as the particular objective of

a study (see also Soteriou and Zenios, 1999). The intermediation approach introduced by Sealey and Lindley (1977) is a popular way to select DEA variables and assesses the efficiency of banks' ability to transform deposits from savers into loans of varying maturities for borrowers. To achieve this, previous studies have considered the value of loans as a measurable output of bank services and labour, capital and various funding sources as inputs (Berger et al., 1987; Aly et al., 1990; Hancock, 1991; Burgess and Wilson, 1995; Bauer et al., 1998; Wheelock and Wilson, 1999; Sathye, 2001; Neal, 2004; Sufian, 2007; Arjomandi et al., 2012; 2014). In contrast to the intermediation approach, Drake et al.'s (2006) profit-oriented operating approach, considers banks' final objective is to generate maximum revenue from the underlying total operating business cost. This approach consequently defines banks' outputs as total revenue from lending and non-lending activities, and inputs as costs of borrowing and operating expenses (see for example, Leightner and Lovell, 1998; Avkiran, 1999; Sturm and Williams, 2004; Drake et al., 2006; Pasiouras, 2008; Kenjegalieva and Simper, 2011).

This study employs the profit-oriented operating approach for two reasons. First, the main objective of bank management is to maximise profit and shareholder wealth. The board of directors is to secure shareholder interest, entitlement to profits, and to mitigate the principle-agent conflict. Second, Australian financial institutions and especially domestic banks constitute a very small sample. The profit-oriented operating approach requires relatively fewer inputs and outputs and so is technically more appropriate. In our operating approach, we employ two specific inputs: interest expenses, x1, non-interest expenses, x2, and two specific outputs (interest income, y1, and non-interest income, y2). After estimating the banks' efficiencies in the first stage, we determine the following corporate governance variables: board size (the number of directors on the board), independent directors as a percentage of board size, number of board meetings, number of committee meetings (risk, audit, remuneration, nomination, etc.), and the largest share of the individual shareholders as discussed in Section 3. In addition, the following control variables are also included:

Size = Log of total assets

In order to achieve higher performance, larger bank size might be a prerequisite to gain scale and scope-related economies. Larger banks might also possess higher-skilled management teams and face higher pressures from shareholders to optimise profits (Evanoff and Israilevich, 1991). Therefore, bank size represented by the natural log of total assets is expected to have a positive relationship with bank efficiency.

Capital strength = Total equity / Total assets

The previous literature generally found a positive association between capital strength (measured as total equity over total assets) and efficiency (Berger and Mester, 1997, Tanna et al., 2011). This could result from the fact that more efficient banks achieve higher profits, leading to a higher equity-to-asset ratio. For banks with a lower level of equity, managers are encouraged to take higher risks to bet the bank. This explanation is in line with moral hazard theory: prior to bankruptcy an owner with lower stakes might have few incentives to ensure the bank runs efficiently. Reduced monitoring from shareholders allows managers to consume perks. This suggests a positive relationship between capital strength and efficiency.

Liquidity = Total loans / Total deposits

The ratio of loans to deposits proxies 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. We expect a positive relationship with efficiency.

Profitability = ROA

In line with the corporate governance literature, this study also uses return on assets (ROA - EBIT divided by total assets), as control measure for financial performance. Tariq and Abbas (2013) found a significant positive association of firms' compliance with the corporate governance code with their performance (ROA). Yet under GLS specification, they found a negative relationship resulting in two explanations. First, an increase in mandatory compliance might require more extensive corporate governance structures and thus higher costs for the firm. Second, the relationship between firm performance and corporate governance might not be linear. That is, beyond a certain point more compliance does not lead to improved performance. We expect ROA to have a positive relationship with the efficiency of Australian banks.

Time Trend

The time trend (TT) takes the value 1 for 1999, 2 for 2000, and so on to capture the evolving nature of efficiency.

The data is mainly collected from the OSIRIS and Morningstar databases and the missing data are collected from banks' online available annual reports. The studied sample consists of eleven Australian banks: the big four–the major banks–the Australian and New Zealand Banking Group (ANZ), the Commonwealth Bank (CBA), the National Australia Bank (NAB)

and Westpac Bank (WBC); and seven regional banks which are Adelaide Bank (ADB), Bank of Queensland (BOQ), Bank of Western Australia (BWA), Bendigo Bank (BEN), Macquarie Bank (MQG), Suncorp (SUN) and St. George Bank (SGB).

The Bank of Western Australia and Adelaide Bank were delisted on 19/9/2003 and 29/9/2008, respectively. Westpac Bank and St. George Bank completed a merger in December 2008 but St. George Bank continued to operate as a wholly owned Westpac Bank subsidiary. After the first half of 2010, the assets, liabilities and business of St. George Bank were transferred to Westpac Bank, and St. George was deregistered as a separate company immediately after the transfer. These banks are treated as two individual banks in this study.

7. Empirical Results

First stage of the analysis: DEA efficiency results

We use DEA to estimate profit-oriented efficiency scores for each Australian bank via equation (2) with T estimated as in equation (3). Table 1 provides a summary of the estimated efficiency levels of aggregate groupings of individual banks during the period 1999 to 2013. First to note from Table 1 is that the bias-corrected estimates of interest are all larger than those based on the original DEA estimates. Also, the original efficiencies are not included in the confidence intervals (CI Low and CI Up) and lie just below the lower bounds (CI Low). These findings reflect the theory behind the construction of such confidence intervals (see Simar and Wilson (1998) for a detailed explanation). Results presented in Table 1 reveal apparent differences in the (bias-corrected) efficiencies reported for major and regional banks in the favour of major banks for almost all years, as their efficiency scores are closer to unity. Although major banks are, on average for most years, more efficient than regional banks, the average efficiency of both groups and therefore the industry's efficiency levels are considerably higher in the post-PGCG era (2004–2013). In other words, Australian banks showed an extensive efficiency improvement after 2003 following the introduction of the PGCG which aimed for improved governance mechanisms and thus better control over bank management. Another observation is that the average technical efficiency of the major banks remains consistently high and close to unity for the period 2004 to 2013 (with 2011 as an exception). Regional banks became highly inefficient in the period after 2006 (with 2008 as an exception). However, because of the overlapping confidence intervals we cannot make

very clear conclusions here about the differences between major and regional banks or about their performance in different periods.

< TABLE 1 ABOUT HERE >

In order to test the significance of differences in efficiency of major and regional banks, we utilise the kernel density estimator to obtain the estimates of the true density of the efficiency scores, using a version of the Li (1996) test (adapted to DEA context by Simar and Zelenyuk, 2006). For this purpose, we pool the data over time and treat each observation as an independent realization from the same data-generating process (including the same technology). The resulting bootstrap *P*-value is found to be virtually zero, indicating that the null hypothesis that the underlying distributions are equal can be rejected. Visualization of the estimated density for major and regional banks also indicates that the estimated density of the distribution of efficiency scores obtained from major banks is considerably different to that of regional banks (Fig. 1). Over the period 1999 to 2013, Australian major banks were closer to the efficient frontier compared with regional banks and were in general significantly more efficient than their regional rivals. This finding is also tested using Simar and Zelenyuk (2007) weighted group efficiencies for major and regional banks (Table 2). The weighted efficiency results show the confidence intervals for major and regional banks do not overlap (for both 95 and 99 per cent) and the major banks' lower bounds are strictly greater than the regional banks' upper bounds. Also, the relative difference (RD) statistic computed for these two bank groups (shown in the third row of Table 2) is greater than unity and its confidence interval does not overlap with one—hence the null hypothesis that the aggregate efficiencies of the two groups are equal is rejected in favour of the alternative hypothesis that the aggregate efficiency of regional banks is inferior to that of the major banks. This finding confirms our previous findings that, first, there is a statistically significant difference between these two groups' efficiency levels, and second, the major banks have performed more efficiently in terms of maximising their profit over period 1999 to 2013. To check the robustness of these results we also compared the estimated aggregate bank efficiencies with those we obtained using a Cobb-Douglas stochastic frontier production function. The comparison with the results of the bootstrapped DEA estimations also points to the model's robustness; the stochastic frontier findings show that major banks are more efficient than regional banks, with an average efficiency score of 0.930 compared with 0.879 for their regional rivals.

< TABLE 2 ABOUT HERE >

Fig. 2 shows the estimated density curves of the individual Australian banks' efficiencies for the pre- and post-GFC periods. The estimated density of distribution of efficiency scores shows that the number of 'fully' efficient banks increases after the GFC.[3] The overlapping confidence intervals for the Färe–Zelenyuk aggregate efficiencies for pre- and post-GFC periods and their corresponding RD statistic's confidence interval (which overlaps with unity), however, do not support the claim that the efficiency of Australian banks changed after the GFC. In other words, although we can see that the density of the distribution of efficiency scores has changed, we cannot conclude how the GFC affected the banks' efficiencies.

<FIGURES 1–3 ABOUT HERE >

Fig. 3 shows the estimated density curves of banks' efficiencies for the pre- and post-PGCG periods. The dotted curve represents the period 1999 to 2002 and the solid curve represents the period 2003 to 2006. The period 2006 to 2013 is excluded to avoid the effect of GFC on the distributions of the efficiency scores. Fig. 3 reveals that the number of fully-efficient banks is greater in the 2003 to 2006 period that in the pre-PGCG period. The Li test's *P*-value is also found to be 0.004, hence, we have sufficient evidence to conclude that the density of the distribution of efficiency scores changed after 2003. Furthermore, the Färe–Zelenyuk aggregate efficiencies presented in Table 2 confirm that Australian banks became meaningfully more efficient after the introduction of the PGCG as the upper bounds of all banks' aggregate efficiency post-PGCG is smaller than the lower bound pre-PGCG and the RD statistic for pre- and post-PGCG is greater than one (see Table 2).

Overall, our results indicate that PGCG tends to positively influence corporate governance and management oversight in Australian banks to improve efficiency. This empirical result is supportive of the arguments by Chhaochharia and Grinstein (2007) and Linck et al., (2009) that more corporate governance-focused regulation can result into higher firm value (see also Yermack 1996) as well as the regulatory intent. Our findings are in line with the fact that the introduction of the Australian Principle of Corporate Governance in 2003 aimed for better control over management and improved governance. Several other studies also indicate that the SOX regulations had positive impact on firm value in the US (e.g., Chhaochharia and Grinstein, 2007; Linck et al., 2009). Akhigbe and Martin (2006) state that there is a positive effect on bank valuation where audit committee members have financial expertise, and there

[3] The bootstrap *P*-value is 0.008 indicating that the null hypothesis of equal density of efficiency scores' distributions in pre- and post-GFC periods can be rejected.

are high incentives for insider and block shareholdings. Our findings also show that Australian major banks are technically more efficient than regional banks, consistent with the findings of Neal (2004). Our results also reveal that Australian banks have not been significantly affected by the GFC. This is in line with the findings of Vu and Turnell (2011) but different than those of Moradi-Motlagh and Babacan (2015) that found a negative impact of GFC on Australian banking performance."

Analysis of determinants of efficiencies: Truncated regression

Table 3 lists the results of the regression analysis for model (5) and (6). In all our models banks' output-oriented technical *inefficiency* estimates are used as dependent variables. For the sake of robustness of our claims, we have modelled three specifications. The first specification includes ten regressors: the five corporate governance indicators and five control variables described before. We found some of the corporate governance regressors to be insignificant according to bootstrap confidence intervals even at 10 per cent level of significance. We therefore re-estimated the same model without some or all of these regressors. In all cases, we control for time, profitability, capital strength, liquidity, and bank size.

< TABLE 3 ABOUT HERE >

All four specifications generated quantitatively-similar coefficients, and hence unanimously suggest the same qualitative conclusions. First of all, coefficients for two of the corporate governance variables (InDiR and BMs) were insignificant in all specifications. The insignificance of independent board directors is in line with stewardship theory that inside-board directors possess better knowledge to steer the company and to achieve higher performance. In the vein of Jensen (1993), independent board members might not contribute to management oversight since they are short of time to exchange their knowledge among themselves, other board members or even the management. Also board meetings may be so heavily scheduled with repeating tasks by the CEO that independent board members may not be able meaningfully represent the interests of shareholders.

The specification results show that board size (NDr) has a positive and statistically significant relationship with bank efficiency, suggesting that a larger board contributes towards efficient utilisation of input resources (the expenses) to meet given output (revenue) targets in the Australian banking industry (Table 3). This finding is in line with resource dependent theory suggesting that larger boards provide more specialist knowledge from different fields and

therefore contribute to better decision making (Pfeffer and Salancik, 1978; Zahra and Pearce, 1989; Kiel and Nicholson, 2003; Xie et al., 2003). Consistent with our expectations, the number of committee meetings (TNCMs) has a statistically significant and positive correlation with efficiency, suggesting that the higher the number of meetings, the better the banks' performance. Thus, while the number of board meetings has no significant effect on management performance, committees are the main contributors to boards' most important decisions. This finding is consistent with those of Vance (1983), Kesner (1988), Xie (2003), Jiraporn et al. (2009). This underpins the idea that a larger board can bring more knowledge into committees to facilitate better decision making to supervise and monitor managers more efficiently (de Andres and Vallelado 2008). Another corporate governance indicator, the largest share of the individual shareholders (LargeShare), has a positive sign as expected (negative relationship with efficiency) but is not significant in any of the specifications.

Among the control variables, ROA has a significant and positive relationship with technical efficiency showing that a higher profitability contributes to bank performance. Banks with high profitability can implement efficient corporate governance and attract skilled members for their boards to uphold performance. As such there is a reinforcing effect of profitability on performance. The significance of capital strength (Capital, measured as total equity over total assets) is positively reflected on the banks' technical efficiency measures. Similar to ROA, capital strength has a similar reiterating effect, with more efficient banks achieving higher profits, leading to a higher equity-to-asset ratio (Berger and Mester, 1997, Tanna et al. 2011). On the contrary, managers of banks with low equity tend to take higher (default) risk, in line with moral hazard theory, again reinforcing the effect of lower capital strength and lower performance. As for the size of banks (LogTA), Table 1 shows significant structural differences between major (relatively larger) and regional (relatively smaller) banks. This finding that larger banks' size is a prerequisite to gain economies of scale and scope is also supported by findings of our regression analysis (Table 3) and Evanoff and Israilevich (1991) who argue that larger banks employ higher-skilled managers and face higher pressure from shareholders to maximise profits. Further, liquidity is negatively associated with efficiency for all specifications which is contrary to the expected results. This can be a consequence of the fact that the efficiency level is defined using the revenues of the loans and the cost of the deposits. Thus this finding could be more related with the level of competition of the banking industry than the intermediation process. The effect of the time trend (TT) on the technical inefficiency of banks is statistically insignificant but with the expected negative sign.

8. Conclusion

Major corporate collapses in the last decade emphasised the need for effective corporate governance mechanisms to control management and preserve shareholder rights. In Australia, several regulations emerged to supervise financial markets, stock exchange and financial institutions and to avoid corporate collapses. In particular the Australian Principles of Good Corporate Governance, introduced in 2003, obliged all ASX-listed firms to follow new corporate governance regulations requiring certain board attributes, including, for example, board size and board composition. No study has yet investigated the effectiveness of these corporate governance measures and their effect on bank performance in Australia. In order to fill this gap we draw on financial, board structure and ownership data for 11 Australian banks over the period 1999 to 2013. We employed Simar and Zelenyuk's (2007) aggregate efficiencies as well as the two-stage double-bootstrap DEA model proposed by Simar and Wilson (2007) under variable returns to scale to infer the relationship between bank inefficiency and various indicators of corporate governance, bank-specific control variables as well as a time trend dummy variable.

We observed improvements in the technical efficiency of the banking industry after the 2003 introduction of the PGCG, but no statistically significant impact of the GFC. Our results also reveal that major banks were more technically efficient than their regional competitors in almost all the years in our study (1999 to 2013). In line with several previous studies, our findings show a significant and positive association of board size and committee meetings with bank efficiency. This suggests that larger boards bring higher knowledge into the decision and supervisory process. The importance of committees is underpinned as the main influence on boards' most important decisions for the control over management. In the line with agency theory and stewardship theory the number of independent board-members and board meetings had no significant impact on bank technical performance. The influence of larger shareholdings was also found to be insignificant. Finally, our findings support the reinforcing effects of ROA, capital strength and liquidity on bank performance.

Finally, it should be noted that our results are focused on technical efficiency and do not take into account financial risk or board compensation. Both areas could provide fruitful ground for further investigations to gain understanding of the corporate governance mechanisms in the Australian financial market.

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Table 1

Measures of output-oriented technical efficiency for bank categories (1999–2013)

		Major Banks				Regional Banks				All Banks			
Year	No. of banks	Orig. Eff.	Bias-Cor. Eff.	CI Low	CI Up	Orig. Eff.	Bias-Cor. Eff.	CI Low	CI Up	Orig. Eff.	Bias-Cor. Eff.	CI Low	CI Up
1999	11	1.090	1.403	1.122	1.694	2.245	2.908	2.324	3.508	1.825	2.361	1.887	2.848
2000	11	1.396	1.735	1.434	2.050	1.825	2.261	1.875	2.683	1.669	2.069	1.715	2.453
2001	11	1.946	2.440	1.989	2.904	2.602	3.414	2.681	4.222	2.364	3.060	2.430	3.743
2002	11	1.198	1.369	1.211	1.572	1.842	2.161	1.868	2.604	1.608	1.873	1.629	2.228
2003	10	2.017	2.421	2.060	2.848	1.667	2.121	1.704	2.583	1.807	2.241	1.846	2.689
2004	10	1.016	1.024	1.017	1.050	1.118	1.185	1.119	1.404	1.066	1.104	1.068	1.222
2005	10	1.037	1.056	1.038	1.103	1.008	1.031	1.009	1.082	1.020	1.041	1.022	1.091
2006	10	1.000	1.109	1.007	1.309	1.333	1.507	1.343	1.779	1.200	1.348	1.209	1.591
2007	10	1.000	1.108	1.007	1.302	1.333	1.507	1.342	1.779	1.200	1.347	1.208	1.588
2008	9	1.012	1.020	1.013	1.044	1.002	1.011	1.002	1.043	1.006	1.015	1.007	1.044
2009	8	1.000	1.076	1.003	1.262	1.220	1.300	1.223	1.535	1.110	1.188	1.113	1.398
2010	8	1.000	1.076	1.003	1.262	1.220	1.300	1.223	1.535	1.110	1.188	1.113	1.398
2011	8	1.095	1.214	1.102	1.430	1.188	1.319	1.195	1.542	1.141	1.267	1.148	1.486
2012	8	1.027	1.078	1.029	1.275	1.209	1.263	1.210	1.465	1.118	1.171	1.120	1.370
2013	8	1.000	1.062	1.002	1.280	1.116	1.174	1.118	1.364	1.058	1.118	1.060	1.322

Notes: **Orig. Eff.** and **Bias-Cor. Eff.** values are the original efficiency and the bias-corrected efficiency scores, respectively. **CI Low** is the lower confidence interval and **CI Up** is the upper confidence interval.

Table 2

Färe–Zelenyuk aggregate efficiencies (1999–2013)

	Number of Observations	DEA Estimation	Standard Error	Bias Corrected Estimation	Confidence Interval Bounds 95%	
Regional banks	83	1.055	0.010	1.085	1.061	1.100
Major banks	60	1.021	0.004	1.033	1.024	1.039
RD for Major and Regional*	143	1.033	0.010	1.049	1.018	1.073
All banks pre-GFC	83	1.049	0.017	1.065	1.025	1.091
All banks post-GFC	59	1.025	0.004	1.037	1.028	1.045
RD for pre and post-GFC	143	1.023	0.017	1.027	0.987	1.083
All banks pre-PGCG	44	1.039	0.011	1.061	1.036	1.075
All banks post-PGCG	40	1.013	0.003	1.023	1.014	1.026
RD for pre and post-PGCG*	84	1.025	0.010	1.037	1.012	1.054

Notes: * indicates the rejection of the null hypothesis of $H_0 : \overline{AE_1} = \overline{AE_2}$ at 5% level of significance and hence shows that the difference between the two groups is significant. We also estimated our confidence intervals at 1% and 10% levels of significance and the results remained the same. To conserve space, we do not present them here, but they are available from the authors upon request.

Table 3

Results of truncated regression analysis

	Estimated coefficients			
Regressors	Specification 1	Specification 2	Specification 3	Specification 4
Constant	1.7612***	1.7963***	1.7726***	1.7913***
NDr	-0.0171***	-0.0162***	-0.0178**	-0.0110**
InDiR	0.0239	---	0.0175	---
BMs	0.0330	0.0010	---	---
TNCMs	-0.0013***	-0.0012***	-0.0013***	-0.0014***
LargeShare	0.0005	0.0006	0.0005	0.0006
TT	-0.0008	-0.0012	-0.0011	-0.0010
ROA	-0.0311***	-0.0325***	-0.0317***	-0.0320***
Capital	-0.0170***	-0.0172***	-0.0169***	-0.0166***
Liquidity	0.0211***	0.0196***	0.0201***	0.0186***
LogTA	-0.0657***	-0.0658***	-0.0660***	-0.0660***
No. of Obs.	143	143	143	143

Notes: (1) The regressand is the bootstrap-biased-corrected DEA estimate of the unobserved *inefficiency* score of firm *j*; (2) ** and *** indicate statistical significance from zero at the 5% and 1% levels, respectively, according to the estimated bootstrap confidence intervals; (3) Estimations are obtained based on Algorithm 2 of Simar and Wilson (2007), with 2000 bootstrap replications; (4) **NDr** is the number of directors on the board; **InDiR** is the independent directors as a percentage of board size; **BMs** is the number of board meetings; **TNCMs** is the total number of committee meetings (risk, audit, remuneration, nomination, etc.); **LargeShare** is the largest share of the individual shareholders; **TT** is time trend; **ROA** is the ratio of net income to total assets and a proxy for profitability; **Capital** is the bank equity as a percentage of total assets; **Liquidity** is the ratio of loans to deposits; **LogTA** is the natural log of total assets.

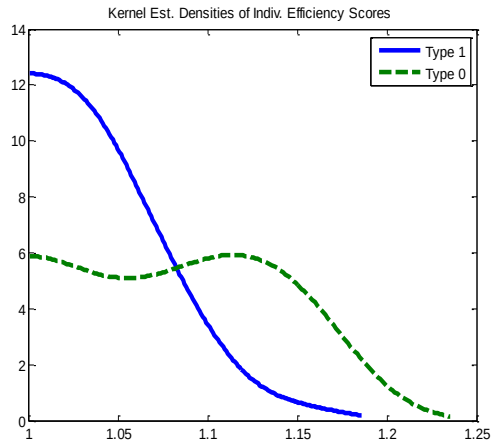

Fig. 1. Kernel estimated density for distribution of efficiency scores for major (solid curve) and regional banks (dotted curve)

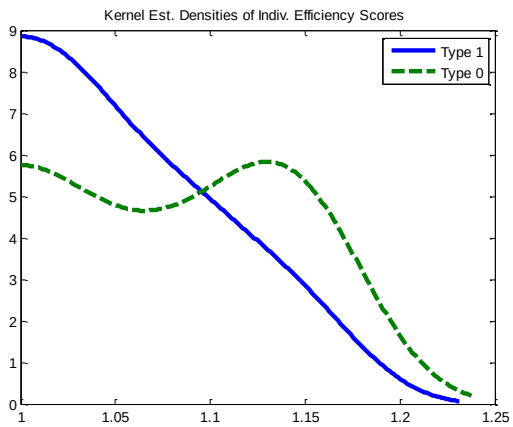

Fig. 2. Kernel estimated density for distribution of efficiency scores for all individual banks in pre- (dotted curve) and post-GFC (solid curve) periods

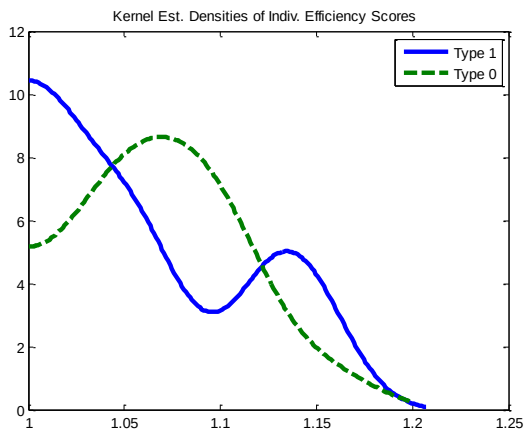

Fig. 3. Kernel estimated density for distribution of efficiency scores for all individual banks in pre- (dotted curve) and post-PGCG (solid curve) periods