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The effect of board size and composition on the efficiency of UK banks

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Abstract

We examine a sample of 17 banking institutions operating in the UK between 2001 and 2006 to provide empirical evidence on the association between the efficiency of UK banks and board structure, namely board size and composition. Our approach is to first use data envelopment analysis to estimate several measures of the efficiency of banks, and then panel data regressions for investigating the impact of board structure on efficiency. After controlling for bank size and capital strength, we find some evidence of a positive association between board size and efficiency, although this is not robust across all our specifications. Board composition, by contrast, has a robustly significant and positive impact on all measures of efficiency.

Keywords: Board size, board composition, banks, corporate governance, efficiency, non-executives

JEL: G21, G34

*The authors' names are listed non-alphabetically due to multiple projects; each author contributed equally to this study.

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1. Introduction

The issue of the structure of board of directors as a corporate governance mechanism has received considerable attention recently from academics, market participants, and regulators. For example, OECD (2004) highlights governance as a key element of economic efficiency, and suggests that “*The corporate governance framework should be developed with a view to its impact on overall economic performance*” (p.17). The Basel committee on Banking Supervision (2006) also mentions that “*Enhancements to the framework and mechanisms for corporate governance should be driven by such benefits as improved operational efficiency, greater access to funding at a lower cost, and an improved reputation*” (p. 21).

However, theory provides conflicting views as to the impact of board structure on the control and performance of firms, while the empirical evidence is inconclusive. Furthermore, despite the volume of research in the area of corporate governance, surprisingly little is known about the effectiveness of boards in banking organisations as most empirical studies tend to focus on corporations and exclude financial firms from their sample (Adams and Mehran, 2008). Nonetheless, studies focusing on banking are necessary due to the distinguishing characteristics of the banking industry and the importance of corporate governance for banks (Adams and Mehran, 2003; Levine, 2004; Barth et al., 2006; Zulkafli and Samad, 2007). For example, banks operate in a heavily regulated industry, which introduces various challenges in the field of corporate governance (Andres and Vallelado, 2008).

The purpose of this paper is to examine the impact of board structure (i.e. board size and composition) on the efficiency of UK banks. Empirical research on the corporate governance for banks is limited, and there is no consensus in the literature about the impact of board structure on bank performance.¹ Furthermore, most of the empirical evidence is based on the use of traditional measures of performance, such as

Tobin's Q and return on assets (ROA). However, the use of these financial measures has recently attracted wide criticisms (see e.g. Halkos and Salamouris, 2004; Destefanis and Sena, 2007; Bozec et al., 2010; Dybvig and Warachka, 2010). In view of the advances in econometric and mathematical programming techniques, frontier efficiency methods have been adopted as an alternative approach to assessing bank performance.² As we discuss in more detail in section 3.2, the efficiency measures have several advantages over the traditional indicators of performance, and they can be of particular relevance in corporate governance studies.

Barth et al. (2006) and Caprio et al. (2007) argue that if bank managers face sound governance mechanisms and are well-managed, it is likely that they will allocate capital and the society's savings more efficiently, which would imply a positive relationship between better governance and efficiency. However, as Isik and Hassan (2003) point out, empirical evidence on this issue is scarce since only a few US and international studies link bank efficiency with corporate control and governance (e.g. Pi and Timme, 1993; Berger and Mester, 1997; Amess and Drake, 2003; Isik and Hassan, 2003).³ Furthermore, to the best of our knowledge, only two studies link board structure to bank efficiency, namely Pi and Timme (1993) for the US and Choi and Hasan (2005) for Korea. This paper adds to this literature by providing evidence for the UK banking sector.

The rest of the paper is as follows. In Section 2 we discuss the related literature. Section 3 describes the data, variables and methodology. Section 4 presents our empirical results. Section 5 concludes.

2. Background discussion

The literature is rich of theoretical perspectives and suggests several conflicting hypotheses about the role and importance of the board of directors. Furthermore, as

Andres and Vallelado (2008) highlight, banking regulations may conflict with the role of the corporate governance mechanism. In the sections that follow, we briefly discuss: (i) some theoretical considerations highlighting the influence of the board of directors based on agency and other theories; (ii) some pertinent issues relating to bank governance due to regulations; and (iii) empirical evidence from the banking industry.

2.1. Theoretical considerations

Foremost here is the role of *agency theory* (Eisenhardt, 1989; Jensen and Meckling, 1976) which assumes the separation of ownership and control and thus implies a conflict between the interests of shareholders and managers. Consequently, the main role of the board of directors in principle is to monitor managers and align their interests with those of the shareholders (Fama and Jensen, 1983; Fama, 1980; Jensen and Meckling, 1976). Arguably, this task is facilitated by a larger board size and one whose composition reflects a higher proportion of outside or independent directors, since the latter could represent a more effective force in monitoring and controlling managerial actions. Nevertheless, agency theory recognises that there is an upper limit to the size of the board of directors, as coordination, communication and decision-making problems are known to impede company performance when the number of directors increases (Yermack, 1996). Thus, a potential trade-off exists between diversity and coordination as an extra member is included in the board.⁴

In contrast, the *stewardship theory* argues that managers are trustworthy and there are no agency costs (Donaldson and Preston, 1995; Donaldson, 1990). Under this approach, inside directors may be better in decision-making and capable of maximising the profits of the firm due to better understanding of the business

(Donaldson and Davis, 1991; Donaldson, 1990). Consequently, the stewardship theory implies that the board should have a significant proportion of inside directors, leading to effective and efficient decisions.

Alternative explanations about the role of the board of directors have also been put forward, as suggested by the *resource dependence theory* (Pfeffer, 1972; Zald, 1969) and the *managerial hegemony theory* (Mace, 1971; Vance, 1983). The former implies that boards can provide additional networking and better access to resources (Kiel and Nicholson, 2003) that should be useful in maximising firm's value; however, the latter articulates that boards are a legal fiction dominated by management, and consequently they play a passive role in strategy and in directing the firm.

2.2. Bank governance and performance

2.2.1. Regulatory conditions

Banks are subject to various regulations and principles, with distinct aims and objectives as regards the conduct of business and the need for prudential analysis and action. The regulation of conduct within the banking system includes the conduct of banks towards their retail customers and the conduct of participants in wholesale financial markets. The aim of the codes of conduct is to, *inter alia*, improve the long term efficiency and fairness of the financial market, ensure that firms treat their customers fairly, and allow for the authorities to intervene (if necessary) in the development of retail products. The regulations, on the other hand, are designed to control the risk-oriented nature of the financial system and can be described as macro-prudential and micro-prudential ones. The macro-prudential regulations are aimed at controlling the systemic risks associated with the interactions of the financial market

and the economy as a whole. The micro-prudential regulations, in contrast, are aimed at controlling the activities of individual financial institutions by adherence to Basel II type regulations (capital adequacy requirements, official supervision, market discipline) and activity restrictions associated with their banking business.

In addition to these types of regulations (which may have an indirect impact on their corporate governance) banks are also subject to various principles and policy recommendations which directly influence the way they are governed. For example, the guidelines on banks' corporate governance published by the Basel Committee (1999, 2006) give particular emphasis on the board of directors by discussing several principles that outline the role and composition of the board. With regard to the governance of UK banks, the Walker (2009) report, commissioned by the UK government in the aftermath of the financial/banking crises in 2007, discusses a number of issues and makes 39 recommendations that relate to: (i) Board size, composition and qualification, (ii) Functioning of the board and evaluation of performance, (iii) The role of institutional shareholders: communication and engagement, (iv) Governance of risk, and (v) Remuneration.

At this point, it should be mentioned that while regulations are seen as a way to shape managerial behaviour, Andres and Vallelado (2008) argue that they may also reduce the effectiveness of other mechanisms in coping with corporate governance problems. A number of studies (e.g. Arun and Turner (2004), Andres and Vallelado (2008), among others) also seem to agree that the agenda of regulatory bodies which aims to reduce systemic risk may be in conflict with the value maximization interests of bank shareholders.⁵ In line with these arguments, the Walker (2009) report highlights that *“A critical balance has to be established between, on the one hand, policies and constraints necessarily required by financial regulation and, on the*

other, the ability of the board of an entity to take decisions on business strategy that board members consider to be in the best interests of their shareholders”.

2.2.2. Empirical evidence

Given the conflicting theoretical views and various perspectives on the likely impact and effectiveness of regulatory policy for bank governance, it is not surprising to find that the evidence on the effect of board size on performance of banking institutions is mixed.

Adams and Mehran (2008) find that the board size of U.S. Bank Holding Companies (BHCs) has a positive and statistically significant effect on Tobin's Q in most of their specifications although no significant relationship is found with ROA. In contrast, for a sample of large European banks, Staikouras et al. (2007) find that board size has a statistically significant and negative effect on ROA and ROE, and also on Tobin's Q (although in the latter case the effect is statistically significant at 10% level in all their specifications). In another European bank study, Busta (2007) finds the effect of board size on performance insignificant in most cases.

For Asian banks, Zulkafli and Samad (2007) find no significant relationship between board size and performance (measured by ROA and Tobin's Q). Finally, for an international sample of banks from six countries (including UK), Andres and Vallelado (2008) report an inverted U shaped relation between performance (Tobin's Q, ROA, annual market return) and board size, implying that the latter has a positive impact on the former up to a certain size beyond which the effect turns negative.

Turning to board composition, Adams and Mehran (2008) and Zulkafli and Samad (2007) find that it has an insignificant impact on the performance of US and Asian banks, respectively. Similarly, Pi and Timme (1993) and Choi and Hasan

(2005), using efficiency measures in addition to traditional profitability indicators, find no significant relationship between the number of outside board directors and bank performance for US and Korea, respectively. Staikouras et al. (2007) also confirm that board composition has no significant influence on ROA and ROE, although they find a positive association between Tobin's Q and board composition, statistically significant (at 5% or 10% level) in three out of their four specifications.

Using a sample from the principal banking sectors of Europe, Busta (2007) finds that banks with a higher presence of non-executives in their boards perform better in terms of the market-to-book value and return on invested capital (ROIC) in Continental Europe, while the opposite is the case in the UK. The author finds no evidence of a significant association between board composition and ROA. However, in a second sample of banks from EU-15 and Switzerland, she finds a positive and significant effect of the proportion of non-executives on ROIC, weak evidence (at the 10% level) of its association with ROA, and no effect on the market-to-book ratio. Furthermore, the interaction effect of the non-executive board ratio with the Anglo-Saxon family is statistically significant and negative in all cases, suggesting that the board composition effect varies for groups of European countries based on their legal foundations. Finally, as with board size, Andres and Vallelado (2008) find an inverted U shaped relation between bank performance and the proportion of non-executive directors.

3. Data and Methodology

3.1. Data

Our starting point for data collection was the list of the Bank of England's "Institutions included within the United Kingdom banking sector – nationality

analysis”. We focussed on institutions classified as UK ones, and excluded banks with no available financial data in the Bankscope database of Bureau van Dijk. We also excluded banks for which we could not find any information on board structure (i.e. board composition or size) either in FAME database of Bureau van Dijk or in the annual reports. Finally, we excluded observations with missing or zero values for the inputs/outputs required for the estimation of the efficiency scores with DEA. The final sample used in estimating efficiency consists of 17 banking institutions operating in the UK between 2001 and 2006.⁶ The number of observations per year is as follows: 15 (2001), 16 (2002), 16 (2003), 17 (2004), 16 (2005), 14 (2006). In the case of the second stage regressions, the sample ranges between 46 and 79 observations.

3.2. Methodology

3.2.1. Rationale for the use of efficiency frontier techniques

As discussed in more detail below, we use data envelopment analysis (DEA) to estimate various efficiency measures. First, we calculate technical efficiency (TE), which in an input-oriented context refers to the minimization of inputs to achieve a given level of output.⁷ As mentioned in Isik and Hassan (2003), TE is also called “managerial efficiency” because it is the one aspect of efficiency over which management can exercise direct control.

Second, we also estimate scale efficiency (SE) which refers to a proportional reduction in inputs if the bank can attain the optimum production level. While scale inefficiency may reflect the adverse effect of market or regulatory forces it is also influenced by managerial choices to achieve an optimum level (Isik and Hassan, 2003).

Third, we calculate allocative efficiency (AE) which refers to the ability of bank managers to use the optimum mix of inputs given their respective prices. Finally, we obtain estimates of cost efficiency (CE) which is an overall measure of efficiency, calculated as the product of TE and AE. In other words, CE illustrates the ability of bank managers to provide services without wasting resources as a result of technical or allocative inefficiency. As an alternative to CE, we also consider a measure of profit-orientated efficiency.

Overall, the aforementioned efficiency measures capture different aspects of managerial performance, thus allowing us to obtain significant additional information that can augment our efforts to reveal the impact of governance on bank efficiency. In principle, efficiency can be improved by management exercising better control over the use of resources and technology, and this may be attributed to good governance associated with active monitoring and advice given by the board of directors in the design and implementation of strategies.

The superiority of efficient frontier approaches over the use of traditional financial measures rests, among other things, on their ability to provide an overall objective numerical score and ranking, an efficiency proxy that complies with an economic optimization mechanism (Berger and Humphrey, 1997; Bauer et al., 1998). Furthermore, frontier techniques like DEA take into account simultaneously all inputs and all outputs of a firm, in contrast to ratios where one input (e.g. total assets) is related to one output (e.g. profits) each time (Thanassoulis et al., 1996). Thus, frontier efficiency measures are more representative in capturing the concepts of “*economic efficiency*” and “*overall economic performance*” as described by OECD (2004), and/or the “*operating efficiency*” as discussed in the report of the Basel committee (2006).

Destefanis and Sena (2007) provide further economic justification for the preference of frontier efficiency measures over traditional ratios with particular emphasis on corporate governance issues. Additionally, a growing number of scholars have recently highlighted various pitfalls in the use of the traditional measures of performance (i.e. Tobin's Q and ROA) in corporate governance studies (Bozec et al., 2010; Dybvig and Warachka, 2010).

3.2.2. Data envelopment analysis

As mentioned earlier, we use DEA which is the most widely adopted non-parametric technique in measuring bank efficiency. The advantages of DEA over parametric techniques (e.g. stochastic frontier) are that it does not require any assumption about the distribution of inefficiency and about the functional form of the efficiency frontier in determining the most efficient decision-making units. On the other hand, the shortcoming of DEA is that it assumes data to be free of measurement error. There is no consensus in the banking literature about the preferred approach for estimating efficiency (Isik and Hassan, 2003; Pasiouras, 2008b). Both techniques have been widely used (Burger and Humphrey, 1997). Goddard et al. (2001) demonstrate that overall efficiency scores obtained from parametric and non-parametric approaches are quite similar. Our main reason for selecting DEA over parametric methods is that it is capable of handling small samples.⁸

DEA uses linear programming for the development of production frontiers and the measurement of efficiency relative to the developed frontiers (Charnes et al., 1978). The best-practice production frontier for a sample of decision making units (DMUs), in our case banks, is constructed through a piecewise linear combination of actual input-output correspondence set that envelops the input-output correspondence

of all DMUs in the sample (Thanassoulis, 2001). Each DMU is assigned an efficiency score that ranges between 0 and 1, with a score equal to 1 indicating the most efficient DMUs relative to the rest of the DMUs in the sample.

Charnes et al. (1978) proposed an input oriented measure of overall technical efficiency (OTE) under the assumption of constant returns to scale (CRS). Banker et al. (1984) suggested the use of variable returns to scale (VRS) that decomposes OTE into a product of two components. The first is technical efficiency under VRS or pure technical efficiency (PTE), and the second is scale efficiency (SE) that refers to exploiting scale economies. The technical efficiency scores under VRS are always higher than or equal to the ones obtained under CRS. SE can alternatively be obtained by dividing OTE with PTE. Most recent studies tend to adopt the VRS assumption as being more realistic and, therefore, we follow that approach. When input prices are available, one can also estimate allocative efficiency (AE) and cost efficiency (CE).

As mentioned in several studies, there is an on-going debate in the banking literature as regards the proper definition of inputs and outputs used in estimating efficiency. The two main approaches are the “*production approach*” and the “*intermediation approach*” (Berger and Humphrey, 1997). The production approach assumes that banks produce loans and deposit account services, using labour and capital as inputs, and the number and type of accounts measure outputs. The intermediation approach, initially developed by Sealey and Lindley (1977), argues that banks act as financial intermediaries collecting purchased funds (i.e. deposits) and transforming them to loans and other assets (e.g. securities). Berger and Humphrey (1997) point out that the production approach may be more suitable for evaluating the efficiency of branches whereas the intermediation approach is more appropriate for entire financial institutions.

In line with the majority of recent studies, we use the intermediation approach and estimate an input-oriented model.⁹ Consistent with previous studies, the three inputs that we use are: fixed assets (X_1), deposits and short-term funding (X_2) and personnel expenses (X_3). The input prices are calculated as: overhead expenses (excluding personnel expenses) to fixed assets (P1), interest expenses to deposits (P2), and personnel expenses to total assets (P3). The two outputs are: net loans (i.e. gross loans net of reserves for impaired loans /NPLs) (Y1), and other earning assets (Y2). The selection of outputs is consistent with that used in most studies (e.g. Casu and Molyneux, 2003; Casu and Girardone, 2004).¹⁰

As in Isik and Hassan (2002, 2003), Casu and Girardone (2006), Pasiouras et al. (2008), Pasiouras (2008a), Ariff and Can (2008), among others, we use an unbalanced sample and estimate annual frontiers.¹¹ While our sample appears to be small in absolute terms for cross-section (DEA) estimations, it is in fact comparable with several studies that have examined efficiency in the banking sector.¹²

3.2.3. Second stage regressions

In the light of the preceding discussion on theoretical and policy perspectives and taking account of the recommendations of the Basel Committee (2006) and Walker (2009) report, we assume that board structure has an impact on performance, although the nature and direction of the impact is unclear as found in previous studies. Accordingly, using board size and composition as the two main dimensions of board structure, we specify and test two general hypotheses:

H1: Other things being equal, the efficiency of banks is related to the size of the board of directors.

H2: *Other things being equal, the efficiency of banks is related to the proportion of non-executive directors on the board.*

The majority of the empirical studies on bank efficiency use either OLS or Tobit regressions in the second stage, with efficiency scores obtained from the first stage. However, Tobit regression can be problematic because the efficiency scores are not based on a truncated distribution. On the other hand, using OLS may be inappropriate because these values are bounded between zero and one. To overcome this problem, we adopt the following transformation (see Atallah and Le, 2006; Gaganis et al., 2009):

$$BEF_{i,t}^* = \ln \left(\frac{BEF_{i,t}}{1 - BEF_{i,t}} \right)$$

where $BEF_{i,t}$ is the bounded efficiency score of the i th bank estimated by DEA, and \ln denotes the natural logarithm.¹³ As Hardwick et al. (2003) mention, one can then use OLS to regress BEF_i^* on the control variables, thus avoiding the limitation of an untransformed OLS regression.¹⁴

Using the transformed bank efficiency estimates as the dependent variable, we employ panel least square regressions with White cross-section standard errors and covariance to estimate the parameters of the following models:

$$BEF_{it}^* = (LNBSIZE_{it}, B_{Qit}, T) \quad (1)$$

$$BEF_{it}^* = (BCOMP_{it}, B_{Qit}, T) \quad (2)$$

$$BEF_{it}^* = (LNBSIZE_{it}, BCOMP_{it}, B_{Qit}, T) \quad (3)$$

where BEF_{it}^* refers to the transformed efficiency measures of bank i in year t ; $LNBSIZE_{it}$ refers to the natural logarithm of the number of directors (executives and non-executives) in the board of bank i in year t ; $BCOMP_{it}$ refers to the proportion of non-executive directors in the board, calculated as the ratio of the number of non-executive directors to the total number of board directors of bank i in year t . In our presentation and discussion of the results below, equation (1) above corresponds to Model 1 where we include LNBSIZE. In model (2), we replace LNBSIZE by BCOMP. Model (3) includes both LNBSIZE and BCOMP. In all three models, we also include a time trend (T) and a set of bank-specific control variables B_{Qit} . The first bank-specific control variable, LNTA, controls for bank size, and is represented by the natural log of total assets. The second bank-specific variable, EQAS, is a proxy for capital strength calculated by the ratio of equity to total assets.¹⁵ The time trend is included to account for the fact that the inefficiency effects may change linearly with respect to time.¹⁶

4. Empirical results

4.1. Base results

Table 1 presents the correlation coefficients among the independent variables. The correlation between board size and bank size is 0.418, suggesting that larger boards tend to be associated with bigger banks. However, the association between bank size and the proportion of non-executive directors on board is not strong (0.172), and also the low correlation between board size and composition (0.08) suggests that these two measures do not necessarily move in parallel. Table 1 also reveals that capital strength (equity to assets) is negatively correlated with bank size (-0.620), and similarly with board size (-0.472) and composition (-0.183). Hence, larger banks tend to be less well

capitalised (or more leveraged), and this negative association may be a function of the board structure.

[Insert Tables 1 and 2 Around Here]

Descriptive statistics for the original (and transformed) efficiency estimates as well as for the independent variables are presented in Table 2. The mean cost efficiency score of 0.852 implies that banks in our sample could improve their cost efficiency by 14.8% on average or, in other words, they could potentially have used 85.2% of the resources actually employed (i.e. inputs) to produce the same level of outputs. Our results reveal that technical efficiency (both pure and overall) is higher than allocative efficiency, with the latter exhibiting much greater variability across the sample and period of study. This indicates that the source of cost inefficiency is more allocative than technical. Thus, banks are relatively more efficient at utilising the minimum level of inputs for given level of outputs as opposed to selecting the optimal mix of inputs given the prices.

The number of board members (BSIZE) across the sample of banks ranges between 5 and 19 with an overall average equal to 12.1.¹⁷ The latter equates to the average reported by Adams and Mehran (2003) for U.S. manufacturing firms (12.1), although not for bank holding companies (18.2). The corresponding figures in Staikouras et al. (2007), de Andres and Vallelado (2008), and Busta (2007) are 17.11, 15.78, and 15.72, which range between ours and those of Adams and Mehran (2003) for US banks. Zulkafli and Samad (2007), on the other hand, report an average of 10.39 over the 9 Asian countries' banks they examine.

The proportion of non-executives in the board ranges between 30% and 76% (approximately) over the sample with an overall average around 56%, which is lower than most of the previous studies.¹⁸ However, de Andres and Vallelado (2008) report a similar figure for the UK (59.94%) although the average over the seven countries they examine is 79.13%.

Table 3 presents the results of the regressions where we use the transformed efficiency estimates as dependent variables. To ensure that the results are not sensitive to one particular efficiency measure we present the regression estimates for all measures of efficiency. Columns 1 and 2 show the results of including board size and board composition individually in regressions (Models 1 and 2), whereas column 3 accounts for the impact of both variables (Model 3). In all cases, we control for capital strength, bank size and time. While the adjusted R^2 lies in the range of 10-20%, the F-tests reported confirm the overall significance of all regressions.

[Insert Table 3 Around Here]

The results in Column 1 show that board size (LNBSIZE) has a positive and statistically significant effect on all measures of efficiency except scale efficiency. This suggests that a larger board contributes to improving technical (both pure and overall), allocative, and most notably cost efficiency of UK banks (where the marginal impact of LNBSIZE is much higher). However, this effect becomes insignificant (and negative) when we control for the proportion of non-executive directors (BCOMP) in the regressions (column 3), although it should be noted that the sample size is reduced as a result.¹⁹ By contrast, BCOMP has a statistically significant and positive impact on all measures of efficiency whether included individually or in

conjunction with LNBSIZE, suggesting that a higher proportion of non-executives in the banking board contribute towards efficient utilisation of input resources to meet given output targets (technical efficiency), as well as towards the optimum use of inputs given their respective prices (allocative efficiency), and thereby towards cost efficiency.

Among the control variables, bank size (LTNA) has a statistically significant and positive effect on allocative and cost efficiency. The significance of capital strength (EQAS) is positively reflected on all measures of efficiency (except scale) but only in the column 1 regressions (with LNBSIZE) where the sample size is larger. The effect of time trend is statistically significant and negative on technical efficiency but insignificant on allocative and cost efficiency (although this effect is positive and statistically significant in the smaller sample with BCOMP included).

Overall, our results indicate that board size and board composition tend to positively influence the ability of UK banks to improve efficiency. This is particularly so when the board reflects a higher proportion of non-executive directors, presumably because non-executive directors render services to the board that avoid wasteful use of input resources, thereby yielding efficiency improvements. This empirical result is supportive of the arguments of Barth et al. (2006) and Caprio et al. (2007) discussed earlier, as well as the theoretical viewpoint of Fama and Jensen (1983). Our results also support the recommendations of the Basel Committee (2006) which suggest that in addition to enhancing independence and objectivity, non-executive directors can bring new perspectives from other businesses, improve the strategic direction given to management, provide insight into local conditions, and be significant sources of management expertise.

4.2. Further analysis: a profit-oriented approach

One could argue that since the objective of banks is to maximize profits, the use of a profit efficiency measure may be more appropriate.²⁰ While, this may be true to an extent, we have nevertheless focussed on the use of a cost-based efficiency model for a number of reasons. First, some studies have documented a positive relationship between measures of technical and cost efficiency and stock returns (e.g. Beccalli et al., 2006; Pasiouras et al., 2008). Hence there appears to be a strong association between technical/cost efficiency and shareholders' wealth maximization, which suggests that the efficiency measures we have used in the present study are reasonably appropriate. Second, there are difficulties associated with the estimation of profit efficiency measures using DEA, such as collecting reliable and transparent information for output prices (see Fethi and Pasiouras, 2010) and disaggregating profit efficiency into technical and allocative efficiency (Coelli et al., 2005). Finally, one can argue that bank managers have better control over inputs (e.g. salary expenses) rather than outputs (e.g. loans, etc). Thus, the more efficient units will be better at minimizing the costs incurred in generating the various revenue streams and, consequently, better at maximizing profits (Drake et al., 2006).

However, as an extension to our analysis, we discuss in this section the results of a profit-oriented approach to efficiency employed in other studies, e.g. Chu and Lim (1998), Avkiran (1999), Sturm and Williams (2004), Das and Ghosh (2006), Drake et al., (2006), Ataullah and Le (2006), Pasiouras (2008a) and Gaganis and Pasiouras (2009). Consistent with most of these studies, we use two inputs (interest expenses, non-interest expenses) and two outputs (interest income, non-interest income). As mentioned in Sturm and Williams (2004), these measures of inputs and outputs are revenue based, and thus this specification may yield different results that

the ones of a traditional specification based on the intermediation approach. We estimated both input (e.g. Sturm and Williams, 2004; Drake et al., 2006) and output (e.g. Ataulloh and Le, 2006) oriented models under the assumption of variable returns to scales.

The efficiency estimates obtained under these two versions of the profit-oriented efficiency model vary only in the case of a few banks with the differences being rather small. The mean profit-oriented efficiency score over the entire sample is equal to 0.973 in both cases, implying that banks could improve their profit-orientated efficiency by 3.7% on average. Furthermore, we find, consistent with the results in columns 1 and 2 of Table 3, that LNBSIZE and BCOMP individually have a positive and statistically significant impact on profit oriented efficiency (i.e. Models 1 and 2 estimated using the profit orientated efficiency scores).²¹ However, in contrast to the results presented in column 3 of Table 3, the simultaneous inclusion of the two variables in the regression does not affect the significance of LNBSIZE (Model 3).²² Thus, the results confirm that larger boards and a higher proportion of non-executives increase the profit-oriented efficiency of banks in our sample.

5. Conclusions and suggestions for future research

The corporate governance of banks is an important issue that has been highlighted in the reports of oversight bodies such as the Basel Committee on Banking Supervision as well as in several recent studies. For example, Levine (2004) emphasises that due to the relevance of banks to the economy, the governance of banks themselves assumes a central role. More precisely, sound governance mechanisms for banks will ensure effective control and monitoring by board of directors over the activities of management and therefore most likely result in an efficient allocation of capital. In

contrast, bank managers who are allowed to act in their own self interest are more likely to allocate resources less efficiently and may not themselves exert effective monitoring over the firms they fund. This moral hazard problem is particularly severe among banks as informational asymmetries are larger (Furfine, 2001). Yet, studies that focus on the impact of governance mechanisms on the banking industry or on the performance of banks are relatively scarce compared to those that examine non-financial firms.

Our study has focussed on a controversial issue that has generated a theoretical debate and delivered mixed empirical results, but more importantly the issue has sparked a renewed interest in both academic and policy circles in recent years. Specifically, in the light of various policy recommendations about the role and function of the board of directors for the governance of UK banks, we have sought to provide evidence relating to the impact of board size and composition on the efficiency of UK banks.

Using financial and board structure data for 17 banks over the period 2001-2006, and combining data envelopment analysis with second stage regressions, we find that a larger board size contributes to technical, allocative, cost and profit-oriented efficiency, although the significance of this association is not robust. Given the conflicting views in the literature about the impact of board size, this finding is not surprising. In his report, Walker (2009) also highlights that there can be no general prescription as to the optimum board size. The report avoids making specific recommendations here, suggesting that decisions on board size will depend on various issues such as the nature and scope of the business of an entity, its organisational structure, and leadership style.

Turning to board composition, we find that a higher proportion on non-executive directors in the board has a robustly positive and significant impact on all measures of efficiency. This finding supports the view that non-executive directors can bring valuable knowledge to a banking organization for efficient utilisation of resources, in addition to enhancing independence and objectivity, as recommended by the Basel Committee on Banking Supervision (2006). The report of Walker (2009) also gives particular emphasis on the role of non-executive directors mentioning that their role is (i) to ensure that there is an effective executive team in place, (ii) to participate actively in the decision-taking process of the board; and (iii) to exercise appropriate oversight over execution of the agreed strategy by the executive team. Walker (2009) also mentions that it is not necessary that all non-executive directors will have industry experience closely relevant to the business of the firm, since the ones with less immediately industry specific knowledge could bring other relevant experience (e.g. senior management in a global business or in a major non-financial trading function) that will broaden and enrich the perspective of decision-taking in the board. Our empirical evidence for UK banks' efficiency tends to support these views.

The evidence we present relates to the period immediately prior to the onset of the banking crises in 2007 and may imply that better monitoring and governance of UK banks would have created more value. For example, Walker (2009) mentions that on both sides of the Atlantic, banks with an effective challenge within the board, and an input from non-executive directors appeared to be in a better position than banks whose strategic decision-making was determined by long-entrenched executives with little external input from non-executive directors.

Nonetheless, as a cautionary remark it should be mentioned that our indicators focus on efficiency and do not measure the risk or financial viability of banks. Our

sample statistics, while not fully representative of all UK banks, show that the average size of UK bank boards is smaller and the composition less skewed towards advisability or appointment of outside directors compared to those of US and other European countries. Hence, there is an argument in favour of increasing board size and the proportion of outside directors in UK banks to conform to the code of good practice elsewhere and fulfill the functions of monitoring and advising in an efficient manner. However, as Andres and Vallelado (2008) show, there is also a trade-off between the advantages of monitoring and advising and the disadvantages in terms of co-ordination, control and decision-making associated with larger boards and more outside directors. Furthermore, as discussed earlier, bank boards have to strike a balance between their dual role aimed at maximizing stakeholder value and meeting the concerns of regulators whose primary function is to reduce systemic risk and safeguard the stability of the banking system. This dual role of bank boards implicitly reflects a trade-off between risk and efficiency that our present analysis does not adequately take into account.

One way in which we could address this complexity between risk and efficiency in future research is to use a systems approach to examine how they are simultaneously determined by the corporate governance mechanisms. This could be of particular interest because the efficiency measures that we used can be related to risk in several ways. For example, the literature suggests a direct link between inefficiency and the risk of bank failure (Wheelock and Wilson, 2000). Furthermore, Berger and DeYoung (1997) discuss four hypotheses, namely “bad luck”, “bad management”, “skimming”, and “moral hazard”. These hypotheses state that inefficiency and problem loans can be related due to numerous reasons such as additional costs of defending the bank’s safety and soundness record to regulators and

market participants, poor skills in credit scoring, inadequate allocation of resources to manage, monitor, and control the loan portfolio, moral hazard incentives, etc. Finally, additional governance variables could be incorporated into our analysis of bank risk-taking and efficiency, such as frequency of board meetings, existence of committees, executives' compensation, CEO power, etc. (e.g. Houston and James, 1995; Simpson and Gleason, 1999; Akhigbe and Martin, 2008; Pathan, 2009).

Notes

1. Adams and Mehran (2008) provide evidence and explanations for a positive effect of board size on performance (proxied by Tobin's Q) for the US banking industry, although, as discussed in Section 2, the evidence for European banks is not positive. Similarly, the evidence on the impact of board composition is mixed.
2. Berger and Humphrey (1997) in their survey of the efficiency of financial firms identified 130 studies dealing with frontier techniques, of which 69 employed the non-parametric Data Envelopment Analysis (DEA) that we use in this study, while Fethi and Pasiouras (2010) identify over 150 DEA applications between 1998 and early 2009.
3. Berger and Mester (1997) use a sample of U.S. commercial banks and examine the relation between bank's highest holder registration for public trading with SEC and the proportion of stock owned by insiders and outsiders with cost and profit efficiency. Isik and Hassan (2003) investigate whether the affiliation of the CEO and public trading of banks have an impact on efficiency in the Turkish commercial banking sector. Amess and Drake (2003) investigate UK building societies but focus on the relationship between total factor productivity change and executive remuneration rather than on board size and composition and efficiency. There are

other studies, such as Hardwick et al. (2003), Zelenyuk and Zheka (2006) and Destefanis and Sena (2007) that relate corporate governance issues with efficiency but provide evidence from non-banking sectors in the UK, Ukraine and Italy respectively. There are also several bank-level studies that define corporate governance more broadly and examine the link between ownership and bank efficiency (e.g. Berger et al., 2005). These studies actually compare the performance of different types of banks (such as cooperative with savings and commercial banks, government-owned with private banks, listed with non-listed banks, foreign with domestic banks) and consequently do not examine the board structure aspects of corporate governance mechanisms.

4. Lipton and Lorsch (1992) recommend a number of board members between seven and eight, which is supported also by Jensen (1993). However, board size recommendations tend to be industry-specific, since Adams and Mehran (2003) indicate that bank holding companies have board size significantly larger than those of manufacturing firms.

5. The investigation of the impact of corporate governance mechanisms on bank risk-taking (see e.g. Akhigbe and Martin, 2008; Pathan, 2009) is outside the scope of this paper. However, considering the interest of regulators on this topic, we discuss in the concluding section the relationship between efficiency and risk, and propose an avenue for future research.

6. The sample includes the following banking institutions: Alliance & Leicester Commercial Bank Plc, Arbutnot Latham & Co. Ltd, Barclays Plc, Bradford & Bingley Plc, Consolidated Credits Bank Ltd, Co-operative Bank Plc, HSBC Bank Plc, Julian Hodge Bank, Reliance Bank Limited, Ruffler Bank Plc, Schroder & Co Limited, Standard Chartered Bank, Standard Life

Bank Ltd, Unity Trust Bank Plc, HBOS Plc, Lloyds TSB Group Plc, Royal Bank of Scotland Group Plc. Thus, we include most of the large UK banks, while the excluded institutions (due to data unavailability) are smaller and most specialized ones such as Tesco Personal Finance Ltd, Vanquis Bank Ltd, Southsea Mortgage & Investment Co Ltd, Marks and Spencer Financial Services plc, Smith & Williamson Investment Management Ltd, etc. Thus, their omission from the analysis is also justified on the basis of their specialization and it should not bias the obtained results. Apparently, some of the banks in our sample conduct business only or mainly in the UK (e.g. Arbutnot) while others have an international presence (e.g. HSBC). However, as mentioned in the main text, they are all classified as UK ones in the Bank of England's "Institutions included within the United Kingdom banking sector – nationality analysis". A point raised by an anonymous referee is that banks with an international presence may use different production technologies, an issue that it is important in the context of efficiency assessment. While acknowledging this issue, it should be mentioned that it was not possible to split the sample and estimate separate frontiers for at least two reasons. The first is the already small sample we have had to use. The second is that after estimating separate frontiers it is by definition then not appropriate to compare the efficiency of the banks with international presence with those of the non-international banks. Furthermore, we believe that the issue of international or no international presence can have only a marginal impact on the results of our study. The reason is that the banks with international presence will tend to be larger than the ones with a domestic focus. The estimation of efficiency under a VRS assumption ensures (with OTE being the only exception) that the i -th bank is not "benchmarked" against units that are substantially larger than it (i.e. possibly banks

with an international presence and different technology), although it may be compared with smaller units.

7. The alternative is to estimate an output-oriented measure of technical efficiency which addresses the question: “By how much can output quantities be proportionally expanded without altering the input quantities used?” (Coelli et al., 2005, p. 137). The vast majority of banking studies obtain efficiency estimates under the input-oriented approach (Fethi and Pasiouras, 2010).

8. According to Maudos et al. (2002), *“Of all the techniques for measuring efficiency, the one that requires the smallest number of observations is the non-parametric and deterministic DEA, as parametric techniques specify a large number of parameters, making it necessary to have available a large number of observations.”* (p. 511).

9. It should be noted that, under constant returns to scale, the input- and output-oriented models will provide the same value. The results differ only when variable returns to scale is assumed. However, as pointed out by Coelli et al. (2005), since linear programming does not suffer from statistical problems such as simultaneous equation bias, the choice of orientation is not as crucial as it is in the case of econometric models, and in many instances, it has only a minor influence upon the scores obtained (Coelli and Perelman, 1996).

10. Some studies propose the use of an additional output, namely non-interest income (e.g. Tortosa-Ausina, 2003) to account for off-balance sheet and other non-traditional activities of banks. Non-interest income, however, is generated from both on-balance sheet and off-balance sheet activities. With limited data availability, it was not possible for us to determine the sources of non-interest income. However, if we assume that an important proportion of non-interest income is generated by on-balance sheet business, then its effect would already be captured in the “other earning

assets” output. In that case, including both other earning assets and non-interest income in the model would lead to a large amount of double counting. To avoid this difficulty, we estimate a traditional model that includes loans and other earning assets, which is the most common approach followed in the literature.

11. Given that DEA efficiency is a relative measure, it might be appropriate to use a balanced sample to avoid potential bias from the entry and exit of banks over the period of examination. However, including only banks with complete data across the whole period would reduce our sample size further. We therefore rely, as in the vast majority of DEA studies in the banking literature, on the use of annual frontiers. Isik and Hassan (2002) argue that this approach has two advantages. First, it is more flexible and thus more appropriate than estimating a single multiyear frontier for the banks in the sample. Second, it alleviates, at least to an extent, the problems related to the lack of random error in DEA by allowing an efficient bank in one year to be inefficient in another, under the assumption that the errors owing to luck or data problems are not consistent over time. Nevertheless, to partly address any concerns we estimate our DEA models and present the results after including in all the annual frontiers, banks for which we had at least one year of corporate governance data. Obviously, this reduces the variability of the sample composition among the years.

12. For example, Apergis and Rezitis (2004) and Rezitis (2006) examine six banks, Pasiouras et al. (2008) examine ten banks, Chu and Lim (1998) examine as few as six banks, Neal (2004) examines twelve banks while in a UK study, Drake (2001) examines only nine banks.

13. For the banks with efficiency score equal to one, we subtract a small figure (i.e. 0.005) from $BEF_{i,t}$ to allow this transformation.

14. Some studies use simultaneous equations estimation methods like two- and three-stage least squares to examine interdependence of relationship between corporate governance variables and firm valuation. However, as Banhart and Rosenstein (1998) point out, theory provides little guidance as regards the specification of the models, and the misspecification of any of the equations in a system may result in serious bias in all of the equations, whereas OLS tends to be less sensitive to misspecification error (Rhodes and Westbrook, 1981).

15. Equity could potentially be included as an input in DEA to control for different risk characteristics of banks. However, adopting this approach would be a deviation rather than the norm in the banking literature that uses DEA for the estimation of efficiency. We are actually aware of four studies that have used equity as an input (Chu and Lim, 1998; Luo, 2003; Sturm and Williams, 2004; Pasiouras, 2008b), but these studies examine technical rather than cost efficiency. One problem with the calculation of cost efficiency is to obtain a reliable and accurate measure of the input price (or cost) of equity. In view of this difficulty, we have used equity to assets in the second stage of our analysis, consistent with Casu and Molyneux (2003), Casu and Girardone (2004), Isik and Hassan (2003), Pasiouras (2008a), among others.

16. The time trend takes T the value of 1 for 2000, 2 for 2001, and so on. We also estimated our specifications with year dummies instead of the time trend. The results remain the same. To conserve space we do not present them here, but they are available from the authors upon request.

17. The yearly averages of board size are as follows: 12.17 (2001), 12.23 (2002), 12.58 (2003), 11.93 (2004), 11.73 (2005), and 12.15 (2006).

18. The yearly averages of board composition are as follows: 61.51% (2001), 55.67% (2002), 56.80% (2003), 55.73% (2004), 51.74% (2005), and 57.06% (2006).

Averages in other studies are 64.4% (Staikouras et al., 2007), 68.7% (Adams and Mehran (2003), 69% (Adams and Mehran, 2005), 71% and 81% (Busta, 2007). In Zulkafli and Samad (2007), the proportions for individual countries range from 9.09% (Taiwan) to 60.46% (Korea), with an overall average of 32.29%.

19. The reduction in the sample size is 33 observations due to missing values for BCOMP. We also re-estimated the model of column 1 with 46 observations as in models 2 and 3, and found an insignificant effect of LNBSIZE on all measures of efficiency, suggesting that the impact of board size is possibly affected by the smaller sample size. It is possible that with a larger sample, both board size and composition may have a positive effect on efficiency, since the low correlations in Table 1 indicate that the results are not susceptible to multicollinearity problems.

20. We would like to thank an anonymous referee for making this point and for motivating the analysis discussed in this sub-section.

21. In the case of Model 1, the coefficients (t-test) for LNBSIZE are equal to 1.453 (3.148) for the input-oriented and 1.451 (3.184) for the output-oriented specification. In the case of Model 2, the corresponding results for BCOMP are 0.019 (1.921) and 0.019 (1.860) for the input- and output-oriented specifications respectively.

22. The coefficient estimates of LNBSIZE and BCOMP included simultaneously in the regressions for profit-orientated efficiency (i.e. Model 3) are 2.080 (t-test = 3.552) and 0.017 (t-test = 3.162) in the case of the input-oriented model, and 1.789 (t-test = 2.727) and 0.013 (t-test = 2.381) in the case of the output-oriented model.

References

- Adams, Renee and Mehran, Hamid (2003) Is corporate governance different for bank holding companies? Federal Reserve Bank of New York, Economic Policy Review, April, pp. 123 – 142.
- Adams, Renne and Mehran, Hamid (2008) Corporate Performance, Board Structure and Their Determinants in the Banking Industry, Federal Reserve Bank of New York Staff Report No. 330, June.
- Akhigbe, Aigbe and Martin, Anna D. (2008) Influence of disclosure and governance on risk of US financial services firms following Sarbanes-Oxley, *Journal of Banking & Finance*, 32, pp. 2124-2135.
- Amess, Kevin and Drake Leigh (2003) Executive Remuneration And Firm Performance: Evidence From A Panel of Mutual Organizations, Discussion Papers in Economics, No. 03/13, University of Leicester, Available at: <http://www.le.ac.uk/economics/research/RePEc/lec/leecon/dp03-13.pdf>
- Apergis, Nicholas and Rezitis, Anthony (2004) Cost Structure, Technological Change, and Productivity Growth in the Greek Banking Sector, *International Advances in Economic Research*, 10, pp. 1-15.
- Ariff, Mohamed and Can, Luc (2008) Cost and profit efficiency of Chinese banks: A non-parametric analysis, *China Economic Review*, 18, pp. 260-273.
- Arun, T.G. and Turner, J.D. (2004) Corporate Governance of Banks in Developing Economies: concepts and issues, *Corporate Governance*, 12, pp. 371-377.
- Ataullah, Ali and Le, Hang (2006) Economic Reforms and Bank Efficiency in Developing Countries: The Case of Indian Banking Industry, *Applied Financial Economics*, 16, pp. 653 -663.
- Avkiran, Necmi Kemal (1999) The evidence on efficiency gains: The role of mergers and the benefits to the public, *Journal of Banking and Finance*, 23, pp. 991-1013.
- Bank of England (2006) Institutions included within the United Kingdom banking sector (at 31 December 2006) – national analysis, <http://www.bankofengland.co.uk/statistics/ms/2007/jan/bklist.pdf>

- Banker, R.D., Charnes, A. and Cooper, W.W. (1984) Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis, *Management Science*, 30, pp. 1078-1092.
- Barth, James R., Bertus, Mark, Hai, Jiang, Hartaska, Valentina and Phumiwasana, Triphon (2006) A Cross-Country Analysis of Bank Performance: The Role of External Governance, FMA Annual Meeting, Utah, October 11-14.
- Basel Committee on Banking Supervision (1999) Enhancing Corporate Governance for Banking Organisations. September, Basel, available at: <http://www.bis.org/publ/bcbs56.pdf>
- Basel Committee on Banking Supervision (2006) Enhancing Corporate Governance for Banking Organisations. February, available at: www.bis.org/publ/bcbs122.pdf
- Bauer, Paul W., Berger, Allen N, Ferrier, Gary D. and Humphrey, David B. (1998) Consistency Conditions for Regulatory Analysis of Financial Institutions: A Comparison of Frontier Efficiency Methods, *Journal of Economics and Business*, 50, pp. 85-114.
- Beccalli, Elena, Casu, Barbara, Girardone, Claudia (2006) Efficiency and Stock Performance in European Banking, *Journal of Business, Finance and Accounting*, 33, pp. 245-262.
- Berger, Allen N. and DeYoung, Robert (1997) Problem loans and cost efficiency in commercial banks, *Journal of Banking & Finance*, 21, 849-870
- Berger, Allen N. and Humphrey, David B. (1997) Efficiency of financial institutions: International survey and directions for future research, *European Journal of Operational Research*, 98, pp. 175-212.
- Berger, Allen N. and Mester, Loretta J. (1997) Inside the black box: What explains differences in the efficiencies of financial institutions? *Journal of Banking and Finance*, 21, pp. 895-947.
- Berger, Allen N., Clarke, George R.G., Cull, Robert, Klapper, Leora and Udell, Gregory F. (2005) Corporate governance and bank performance: A joint analysis of the static, selection and dynamic effects of domestic, foreign and state ownership, *Journal of Banking and Finance*, 29, pp. 2179-2221.
- Bertrand, Marianne and Mullainathan, Sendhil (2003) Enjoying the quiet life? Corporate governance and managerial preferences, *Journal of the Political Economy*, 111, pp. 1043-1075.

- Bozec, Richard, Dia, Mohamed and Bozec, Yves (2010) Governance–Performance Relationship: A Re-examination Using Technical Efficiency Measures, *British Journal of Management*, 21, pp. 684–700.
- Busta, Ilduara (2007) Board effectiveness and the impact of the legal family in the European banking industry, 2007 FMA European Conference, May 30-June 1, Barcelona, Spain, available at: www.fma.org/Barcelona/Papers/BustaFMA2007.pdf
- Caprio, Gerard Jr., Laeven, Luc and Levine, Ross (2007) Governance and bank valuation, *Journal of Financial Intermediation*, 16, pp. 584-617.
- Casu, Barbara and Girardone, Claudia (2006) Bank competition, concentration and efficiency in the single European market, *The Manchester School*, 74, pp. 441-468.
- Casu, Barbara and Molyneux, Philip (2003) A comparative study of efficiency in European banking, *Applied Economics*, 35, pp. 1865-1876.
- Casu, Barbara, and Girardone, Claudia (2004) Financial conglomeration: efficiency, productivity, and strategic drive, *Applied Financial Economics*, 14, pp. 687-696.
- Charnes, A., Cooper W.W. and Rhodes, E. (1978) Measuring the Efficiency of Decision Making Units, *European Journal of Operational Research*, 2, pp. 429-444.
- Choi, Sungho and Hasan, Iftekhar (2005) Ownership, Governance, and Bank Performance: Korean Experience, *Financial Markets, Institutions & Instruments*, 14, pp. 215-241.
- Chu, Sing Fat and Lim, Guan Hua (1998) Share performance and profit efficiency of banks in an oligopolistic market: evidence from Singapore, *Journal of Multinational Financial Management*, 8, pp. 155-168.
- Coelli, Tim (1996) A Guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program, CEPA Working Paper 1996/08, available at: <http://www.une.edu.au/econometrics/cepa.htm>.
- Coelli, Tim J. and Perelman, Sergio (1996) A Comparison of Parametric and Non-parametric Distance Functions: With Application to European Railways. CREPP Discussion Paper no 1996/11, University of Liege, Liege.
- Coelli, Timothy J., Prasada Rao, Dodla Sai, O'Donnell, Christopher J. and Battese, George Edward (2005) *An Introduction to Efficiency and Productivity Analysis*, 2nd edition, Springer, USA.

- Das, Abhiman and Ghosh, Saibal (2006), Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period, *Review of Financial Economics*, 15, pp. 193-221.
- de Andres, Pablo and Vallelado, Eleuterio (2008) Corporate governance in banking: The role of the board of directors, *Journal of Banking and Finance*, 32, pp. 2570-2580.
- Destefanis, Sergio and Sena, Vania (2007) Patterns of corporate governance and technical efficiency in Italian manufacturing, *Managerial and Decision Economics*, 28, pp. 27-40.
- Donaldson, Lex (1990) The Ethereal Hand: Organizational Economics and Management Theory, *Academy of Management Review*, 15, pp. 369–381.
- Donaldson, Lex and Davis, James H. (1991) Stewardship Theory or Agency Theory: CEO Governance and Shareholder Returns, *Australian Journal of Management*, 16, pp. 49-64.
- Donaldson, Thomas and Preston, Lee E. (1995) The Stakeholder Theory of the Corporation: Concepts, Evidence, and Implications. *Academy of Management Review*, 20, pp. 65–91.
- Drake, Leigh (2001) Efficiency and productivity change in UK banking, *Applied Financial Economics*, 11, pp. 557-571.
- Drake, Leigh, Hall, Maximilian J.B., and Simper, Richard (2006), The impact of macroeconomic and regulatory factors on bank efficiency: A non-parametric analysis of Hong Kong's banking system, *Journal of Banking and Finance*, 30, pp. 1443-1466.
- Dybvig, Philip H. and Warachka, Mitch (2010) Tobin's Q Does Not Measure Performance: Theory, Empirics, and Alternative Measures, March, Mimeo available at: <http://ssrn.com/abstract=1562444>
- Eisenhardt, Kathleen M. (1989) Agency Theory: An Assessment and Review, *Academy of Management Review*, 14, pp. 57–74.
- Fama, Eugene F. (1980) Agency Problems and the Theory of the Firm, *The Journal of Political Economy*, 88, pp. 288-307.
- Fama, Eugene F. and Jensen, Michael C. (1985) Separation of Ownership and Control, *Journal of Law and Economics*, 26, pp. 301-325.

- Fethi, Meryem D. and Pasiouras, Fotios (2010) Assessing bank efficiency and performance with operational research and artificial intelligence techniques: A survey, *European Journal of Operational Research*, 204, pp. 189-198.
- Furfine, Craig H. (2001) Banks as monitors of other banks: Evidence from the Overnight Federal Funds Market, *Journal of Business*, 74, pp. 33-57.
- Gaganis, Chrysovalantis and Pasiouras, Fotios (2009) Efficiency in the Greek Banking Industry: A Comparison of Foreign and Domestic Banks, *International Journal of the Economics of Business*, 16, pp. 221-237
- Gaganis, Chrysovalantis, Liadaki, Aggeliki, Doumpos, Michael, Zopounidis, Constantin (2009) Estimating and analyzing the efficiency and productivity of bank branches. *Managerial Finance* 35, pp. 202-218.
- Goddard, John, Molyneux, Philip and Wilson, John (2001) *European Banking: Efficiency, Technology and Growth*, John Wiley & Sons.
- Halkos, George E. and Salamouris, Dimitrios S. (2004) Efficiency measurement of the Greek commercial banks with the use of financial ratios: a data envelopment analysis approach, *Management Accounting Research*, 15, pp. 201-224.
- Hardwick, Philip, Adams, Mike and Hong, Zou (2003) Corporate governance and cost efficiency in the United Kingdom life insurance industry, Working paper EBMS/2003/1, European Business Management School.
- Houston, Joel F. and James, Christopher (1995) CEO compensation and bank risk Is compensation in banking structured to promote risk taking? *Journal of Monetary Economics*, 36, pp. 405-431.
- Isik, Ihsan and Hassan, Kabir M. (2002) Technical, scale and allocative efficiencies of Turkish banking industry, *Journal of Banking and Finance*, 26, pp. 719-766.
- Isik, Ihsan and Hassan, Kabir M. (2003) Efficiency, Ownership and Market Structure, Corporate Control and Governance in the Turkish Banking Industry, *Journal of Business Finance and Accounting*, 30, pp. 1363- 1421.
- Jensen, Michael C. (1993) The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems, *Journal of Finance*, 48, pp. 831-880.
- Jensen, Michael C. and Meckling, William H. (1976) Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure, *Journal of Financial Economics*, 3, pp. 305–360.

- Kiel, Geoffrey C. and Nicholson, Gavin J. (2003) Board Composition and Corporate Performance: how the Australian experience informs contrasting theories of corporate governance, *Corporate Governance*, 11, pp. 189-205.
- Levine, Ross (2004) The Corporate Governance of Banks - a concise discussion of concepts and evidence, World Bank, Policy Research Working Paper No. 3404, September.
- Lipton, Martin and Lorsch, Jay W. (1992) A Modest Proposal for Improved Corporate Governance, *Business Lawyer*, 48, pp. 59-77.
- Luo, Xueming, (2003) Evaluating the profitability and marketability efficiency of large banks An application of data envelopment analysis, *Journal of Business Research*, 56, pp. 627-635.
- Mace, Myles L.G. (1971) *Directors: Myth and Reality*, Boston: Division of Research Graduate School of Business Administration Harvard University.
- Maudos, Joaquin, Pastor, Jose M. and Perez, Francisco (2002) Competition and efficiency in the Spanish banking sector: the importance of specialization, *Applied Financial Economics*, 12, pp. 505-516.
- Neal, Penny (2004) X-Efficiency and Productivity Change in Australian Banking, *Australian Economic Papers*, 43, pp. 174-191.
- Organization for Economic Co-operation and Development (OECD) (2004) OECD Principles of Corporate Governance, <http://www.oecd.org/dataoecd/32/18/31557724.pdf>
- Pasiouras, Fotios (2008a) Estimating the technical and scale efficiency of Greek commercial banks: the impact of credit risk, off-balance sheet activities, and international operations, *Research in International Business and Finance*, 22, pp. 301-308.
- Pasiouras, Fotios (2008b) International evidence on the impact of regulations and supervision on banks' efficiency: an application of two-stage data envelopment analysis, *Review of Quantitative Finance & Accounting*, 30, pp. 187-223.
- Pasiouras, Fotios, Liadaki, Aggeliki and Zopounidis, Constantin (2008) Bank efficiency and share performance: Evidence from Greece, *Applied Financial Economics*, 18, pp. 1121-1130.
- Pathan, Shams (2009) Strong boards, CEO power and bank risk-taking, *Journal of Banking and Finance*, 33, pp. 1340-1350.

- Pfeffer, Jeffrey (1972) Size and composition of corporate boards of directors: The organization and its environment, *Administrative Science Quarterly*, 17, pp. 218-228.
- Pi, Lynn and Timme, Stephen G. (1993), Corporate control and bank efficiency, *Journal of Banking and Finance*, 17, pp. 515-530.
- Rezitis, Anthony (2006) Productivity growth in the Greek banking industry: A non-parametric approach, *Journal of Applied Economics*, 9, pp. 119-138.
- Rhodes, George F. Jr. and Westbrook, Daniel M. (1981) A study of estimator densities and performance under misspecification, *Journal of Econometrics*, 16, pp. 311-337.
- Sealey, Calvin and Lindley, James T. (1977) Inputs, Outputs, and a Theory of Production and Cost at Depository Financial Institutions, *Journal of Finance*, pp. 32, 1251-1266.
- Shleifer, Andrei and Vishny, Robert (1997), A survey of corporate governance, *Journal of Finance*, 52, pp. 737-783.
- Simpson, Gary W. and Gleason, Anne E. (1999) Board structure, ownership, and financial distress in banking firms, *International Review of Economics and Finance*, 8, pp. 281-292.
- Staikouras, Panagiotis K., Staikouras, Christos K. and Agoraki, Maria-Eleni K. (2007) The effect of board size and composition on European bank performance, *European Journal of Law and Economics*, 23, pp. 1-27.
- Sturm, Jan-Egbert and Williams, Barry (2004) Foreign bank entry, deregulation and bank efficiency: Lessons from the Australian experience, *Journal of Banking and Finance*, 28, pp. 1775-1799.
- Thanassoulis, E., Boussofiene, A. and Dyson, R.G. (1996) A Comparison of Data Envelopment Analysis and Ratio Analysis as Tools for Performance Assessment, *Omega*, 24, pp. 229-244.
- Thanassoulis, Emmanuel (2001) *Introduction to the Theory and Application of Data Envelopment Analysis. A Foundation Text with Integrated Software*, Kluwer Academic Publishers, USA.
- Tortosa-Ausina, Emili (2003) Nontraditional activities and bank efficiency revisited: a distributional analysis for Spanish financial institutions, *Journal of Economics and Business*, 55, pp. 371-395.

- Vance, Stanley C. (1983) *Corporate Leadership: Boards, Directors, and Strategy*. New York: McGraw-Hill.
- Walker, David (2009) A review of corporate governance in UK banks and other financial industry entities - Final recommendations, 26 November, http://www.hm-treasury.gov.uk/walker_review_information.htm
- Wheelock, David C. and Wilson, Paul W. (2000) Why do banks disappear? The determinants of U.S. bank failures and acquisitions, *The Review of Economics and Statistics*, 82, pp. 127–138.
- Yermack, David (1996) Higher market valuation of companies with a small board of directors, *Journal of Financial Economics*, 40, pp. 185-211.
- Zald, Mayer N. (1967) Urban differentiation, characteristics of boards of directors, and organizational effectiveness, *American Journal of Sociology*, 73, pp. 261-272.
- Zelenyuk, Valentin and Zheka, Vitaliy (2006) Corporate governance and firm's efficiency: the case of a transitional country, Ukraine, *Journal of Productivity Analysis*, 25, pp. 143-157.
- Zulkafli, Abdul Hadi and Samad, Fazilah Abdul (2007) Corporate governance and performance of banking firms: Evidence from Asian emerging markets, *Advances in Financial Economics*, 12, pp. 49-74.

Table 1 – Correlation coefficients

	LNBSIZE	BCOMP	LNTA	EQAS	TREND
LNBSIZE	1.000				
BCOMP	0.080	1.000			
LNTA	0.418	0.172	1.000		
EQAS	-0.472	-0.183	-0.620	1.000	
TREND	0.038	-0.171	0.056	-0.124	1.000

Notes: LNBSIZE: natural logarithm of number of board directors, BCOMP: non-executive directors / total number of board directors. LNTA: natural logarithm of bank total assets, EQAS: equity/total assets, TREND: time trend.

Table 2 – Descriptive statistics

	Mean	Standard Deviation	Min	Max
Dependent variables				
OTE	0.894	0.135	0.578	1.000
(Transformed OTE)	(3.394)	(2.015)	(0.294)	(5.293)
PTE	0.943	0.109	0.580	1.000
(Transformed PTE)	(4.167)	(1.745)	(0.302)	(5.293)
SE	0.949	0.086	0.642	1.000
(Transformed SE)	(3.934)	(1.600)	(0.562)	(5.293)
AE	0.893	0.180	0.077	1.000
(Transformed AE)	(3.610)	(2.147)	(-2.556)	(5.293)
CE	0.852	0.222	0.060	1.000
(Transformed CE)	(3.372)	(2.396)	(-2.844)	(5.293)
Independent variables				
BCOMP (%)	56.308	10.413	30.000	76.471
LNBSIZE	2.450	0.317	1.609	2.944
LNTAS	15.854	3.382	10.240	20.720
EQAS (%)	10.231	10.209	2.240	44.920
Other				
BSIZE	12.151	3.595	5.000	19.000
TAS (£m)	144,539	231,420	28	996,787

Notes: Figures in parentheses correspond to transformed efficiency measures; OTE = Overall Technical efficiency (i.e. CRS); PTE = Pure Technical Efficiency (i.e. VRS), SE = Scale Efficiency; AE = Allocative efficiency; CE = Cost efficiency; BCOMP = (number of non-executives / total number of board members) x 100; EQAS = (Equity/Total assets) x 100; BSIZE = Total number of board members; TAS = Total assets in th GBP; LNBSIZE = natural logarithm of BSIZE; LNTAS = natural logarithm of TAS

Table 3 – Regression results

Panel A: Dependent variable: OTE			
	Model 1	Model 2	Model 3
Constant	4.281** (2.477)	2.244 (0.577)	4.004 (0.886)
LNBSIZE	0.931** (2.340)	---	-1.789 (-0.894)
BCOMP	---	0.068*** (3.497)	0.069*** (3.147)
LNTA	-0.167** (-2.550)	-0.088 (-0.813)	0.046 (0.269)
EQAS	0.026** (2.121)	-0.180 (-0.828)	-0.094 (-0.579)
TREND	-0.276*** (-21.811)	-0.115*** (-3.058)	-0.114*** (-2.942)
Adj. R ²	0.142	0.101	0.101
F-stat	4.219***	2.265*	2.016*
Panel B: Dependent variable: PTE			
	Model 1	Model 2	Model 3
Constant	-0.139 (-0.071)	-4.470** (-2.134)	-3.670 (-1.191)
LNBSIZE	1.814*** (3.050)	---	-0.783 (-0.417)
BCOMP	---	0.040** (2.232)	0.041** (2.148)
LNTA	-0.015 (-0.542)	0.336*** (3.142)	0.394** (2.116)
EQAS	0.055*** (3.118)	0.112 (1.084)	0.150 (1.594)
TREND	-0.167*** (-3.564)	-0.089 (-1.476)	-0.088 (-1.511)
Adj. R ²	0.113	0.188	0.173
F-stat	3.496**	3.596**	2.885**
Panel C: Dependent variable: SE			
	Model 1	Model 2	Model 3
Constant	6.770*** (5.542)	6.765** (2.103)	8.713*** (2.842)
LNBSIZE	0.226 (0.875)	---	-1.980 (-1.509)
BCOMP	---	0.051*** (3.691)	0.052*** (2.961)
LNTA	-0.191** (-2.570)	-0.254** (-2.398)	-0.106 (-0.821)
EQAS	-0.002 (-0.126)	-0.237 (-1.389)	-0.143 (-1.042)
TREND	-0.133*** (-3.105)	-0.049 (-1.328)	-0.047 (-1.223)
Adj. R ²	0.117	0.088	0.104
F-stat	3.582**	2.092*	2.042*
Panel D: Dependent variable: AE			
	Model 1	Model 2	Model 3
Constant	-6.435*** (-5.165)	-7.562*** (-4.800)	-5.582*** (-4.474)
LNBSIZE	2.015*** (5.890)	---	-2.012 (-1.158)

BCOMP	---	0.043** (2.268)	0.045** (2.460)
LNTA	0.208*** (5.665)	0.4391*** (4.291)	0.589** (2.373)
EQAS	0.128*** (6.718)	0.084 (0.540)	0.181 (1.204)
TREND	0.062 (0.787)	0.129*** (3.056)	0.131*** (3.530)
Adj. R ²	0.179	0.132	0.131
F-stat	5.260***	2.713**	2.361*
Panel E: Dependent variable: CE			
	Model 1	Model 2	Model 3
Constant	-8.108*** (-4.663)	-10.480*** (-8.605)	-9.303*** (-4.717)
LNBSIZE	2.558*** (4.940)	---	-1.197 (-0.541)
BCOMP	---	0.055** (2.660)	0.056** (2.641)
LNTA	0.218*** (5.823)	0.545*** (5.658)	0.634** (2.452)
EQAS	0.145*** (6.426)	0.135 (0.816)	0.192 (1.185)
TREND	-0.014 (-0.192)	0.080*** (1.932)	0.081** (2.073)
Adj. R ²	0.203	0.188	0.174
F-stat	5.978***	3.611**	2.899**
N	79	46	46

Notes: t-values in parentheses; *** statistically significant at the 1% level, **statistically significant at the 5% level, * statistically significant at the 10% level; White cross-section standard errors & covariance (d.f. corrected) are presented; OTE: Overall Technical Efficiency (constant returns to scale), PTE: Pure Technical Efficiency (variable returns to scale), SE: Scale Efficiency, AE: Allocative Efficiency, CE: Cost Efficiency; LNBSIZE: natural logarithm of number of board directors, BCOMP: non -executive directors / total number of board directors. All the models include the following control variables. LNTA: natural logarithm of bank total assets, EQAS: equity/total assets, TREND: time trend. Model 1 includes LNBSIZE, only. Model 2 includes BCOMP, only. Model 3 includes simultaneously LNBSIZE and BCOMP.