The effect of board size and composition on bank efficiency

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8 October 2009

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ABSTRACT

This paper analyzes the relationship between board structure, in terms of board size and composition, and bank performance. Unlike previous studies, the present analysis is carried out within a stochastic frontier framework. To this end, bank performance is proxied by both cost and profit efficiency, measures that present considerable advantages over simple accounting ratios. The empirical framework formed is applied to a panel of large European banks operating during the period 2002-2006. We find that board size negatively affects banks' cost and profit efficiency, while the impact of board composition on profit efficiency is non-linear. Finally, introducing risk-taking (credit risk) as an interaction component of board size and composition does not affect the robustness of the results.

JEL classification: G21; G34; C23; K23

Keywords: Corporate governance; Board size and composition; Bank cost and profit efficiency; Stochastic frontier analysis

1. Introduction

Banks' multifaceted and pivotal role in the economic system has attracted, not without valid reasons, much regulatory attention in an effort to inspire sound corporate governance standards and address the unique features of and risks faced by credit institutions. The size and composition of the board of directors constitute of the most essential corporate governance themes and have caught the attention of academics and regulators alike. The latter, in particular, appear remarkably confident that smaller and more outsider-dominated boards are critical drivers of better corporate management and, thus, contribute positively to corporate performance. The present study innovates in that the board structure (in terms of board size and composition)–performance relationship in banking is examined within a stochastic frontier framework, while performance is measured in terms of cost and profit efficiency of banks. This places the present paper within the large literature that analyzes bank performance using

frontier methodologies (for reviews see Berger and Humphrey, 1997; Hughes and Mester, 2008).

According to the generic definition offered by the Organization for Economic Co-operation and Development, corporate governance involves a set of relationships between corporate management, the board of directors, shareholders and other stakeholders, while also providing the structure through which corporate objectives are set, and the means of accomplishing those objectives and monitoring performance are determined (OECD, 2004). Essentially, by establishing internal mechanisms inciting corporate management to promote company's interests and facilitating effective monitoring, corporate governance systems enhance investors' protection and confidence, thus contributing to the proper functioning of the market economy and the improvement of economic efficiency and growth (OECD, 2004; Basel Committee, 2006). Upgrading corporate board structure, in terms of both size and composition, has been one of the core themes in all corporate governance initiatives undertaken by international fora (e.g., EU Commission Communication, 2003; OECD, 2004; Basel Committee, 2006).

Despite this renowned interest in the role of board size and composition, a full review of the relevant literature concerning the impact of board structure on banks' performance reveals that empirical findings are mixed. A common element of these studies is that bank performance is proxied by simple accounting ratios that have been proved limited measures of bank performance. Phrased differently, the empirical studies on the board structure-bank performance relationship have not embraced the large literature on the measurement of bank performance using stochastic frontier methods. This seems odd because most bank performance studies have reached consensus that frontier efficiency measures are superior for most regulatory and other purposes to the standard financial ratios from accounting statements, which are commonly employed by regulators, financial institution managers and industry consultants to assess performance. The main reasoning is that frontier measures use statistical techniques that remove the effects of differences in prices and other exogenous market factors affecting the standard performance ratios and, therefore, they are capable of characterizing the underlying production relationship (e.g., Fried, Lovell and Schmidt, 1993; Bauer, Berger, Ferrier and Humphrey, 1998).

In the context of present analysis, the above consideration has at least three implications that justify analyzing the impact of board size and composition on bank

performance within a frontier efficiency framework. First, financial ratios such as the return on assets (ROA) and the return on equity (ROE) suffer from the well-known conceptual shortcomings relating to the evaluation of inventories and depreciation (Fisher and McGowan, 1983; Pi and Timme, 1993; Destefanis and Sena, 2007). To a different extent among banks, these ratios under-represent a bank's value because of the so-called investment myopia problem (that is, when executives overextend the useful life of their assets and delay needed new investments). If executives indulge in myopic behavior, longer-term investment decreases and frontier efficiency is capable of capturing this effect, since inventories and depreciation are accounted for in the production relationship. Furthermore, corporate governance theory on separation between management and ownership implies that executives may have incentives to undertake projects yielding increased bargaining power, which may not be associated with increased productivity or profitability (Shleifer and Vishny, 1997). Again this behavior will be immediately reflected in the efficiency indicator, while measures of performance like the Tobin's Q may remain in higher levels in the short-run. Finally, and as regards Tobin's Q, if market efficiency deviates from the standards of the Anglo-Saxon markets and/or many banks trade their equity in thin, secondary markets, assessment of the market value of assets (needed to construct Q) is either misleading or not readily available (Destefanis and Sena, 2007; Kapopoulos and Lazaretou, 2007). The above arguments imply that a study of the relationship between board structure and bank performance within a stochastic frontier framework is worthwhile, as it may shed some light on the diverse character of the findings in the relevant literature.

Two final distinguishing characteristics of this study are worth noting. First, advances in stochastic frontier analysis (SFA), which is the method used in the present paper, allow controlling for a number of bank-level and industry determinants of bank efficiency. In particular, and given the fact that the choice on the size and composition of bank boards may be made on the basis of better risk management, we are very much interested to control for credit risk when evaluating the impact of board size and composition on bank performance. In addition, we augment the usual stochastic frontier methods to account for the possible endogeneity between bank performance, board structure and risk, which is an issue of significant debate in the recent literature.

The present study comprises five sections. The following section demarcates the general framework of the debate by providing a concise theoretical basis of the increased regulatory and academic interest on banks' corporate governance systems, while also reviewing the relevant literature concerning the relationship between board structure (i.e., board size and composition) and bank performance. The third section explains the empirical model and discusses the dataset used in the present study. The study proceeds with the empirical results and relates them to the different strands of the literature. Finally, the last section concludes the paper.

2. Corporate governance and banks: Setting the discussion in context

2.1. Rationalizing the regulatory emphasis upon banks' corporate governance

The comparatively heavy regulation of the banking industry has conventionally been attributed to the multifaceted and, by extension, sensitive role that banks perform in the economic system as liquidity guarantors, originators of non-market finance, information brokers between lenders and borrowers and payment system operators (for an overview of the special functions performed by banks and the relevant literature see inter alia Gorton and Winton, 2003 and references therein). Effectively, however, the essential of banking, i.e., the transformation of short-term, payable-on-demand deposits into illiquid, long-term loans, coupled with asymmetric information on the quality of the inherently opaque bank assets and the application of the 'first-come, first-served' rule permeating deposit withdrawals renders credit institutions particularly susceptible to runs by their depositors. To make things worst, the failure of an individual bank may spill-over to other banks, either via inter-bank linkages with the ailing bank or because of panic provoking bank runs on other, non-distressed banks, thus destabilizing the economic system as a whole (for an overview of the theories and literature on bank runs and contagion risk see, inter alia, Calomiris, 2007 and references therein).

Special, public safety-nets in the form of deposit insurance and liquidity injection by the central bank in times of crises (lender-of-last-resort operation) underlines the 'special' role of banks in the economy and manifests the weight that regulators attach in maintaining public confidence in the smooth operation of the banking system. On the other hand, however, public guarantees engender moral hazard as they erode depositors' incentives to monitor credit institutions, while, at the same time, encourage increased risk-taking by banks.[1] Phrased differently, the special

character of banks appears to inspire a 'regulatory cycle': banks' distinctive functions call for equally special regulatory attention, which, however, stimulates unique moral hazard risks necessitating, in turn, a new layer of regulation (Bhattacharya and Thakor, 1993; Ceccheti, 1999). Internal corporate governance mechanisms (e.g., appointing non-executive, independent directors, introducing internal control systems, establishing board committees, monitoring directors' remuneration) present themselves as one of the most popular devices to discipline corporate management and curtail banks' increased risk-taking appetite.[2] Moreover, prudently run banks produce positive externalities in the sense that they induce efficient corporate governance of the firms with which they are associated either as creditors or, most importantly, as shareholders (Barth, Caprio and Nolle, 2004).

Indeed, the Basel Committee (2006) has explicitly recognized that the important financial intermediation role of banks, their sensitivity to failures stemming from inefficient corporate management and the need to safeguard and align the (often conflicting) interests of shareholders and other stakeholders, including supervisors, governments and depositors, render banks' corporate governance of great importance to the financial system.[3] Drawing from international experience, the Basel Committee (2006) underlines, in particular, the key role of the board of directors and senior management for the safety and soundness of banks, placing, inter alia, emphasis on the board structure (including size) that "promotes efficiency and real strategic discussion" as well as on the appointment of an adequate number of directors "capable of exercising independent judgment of the views of management, political interests or inappropriate outside interests".

In a similar vein, John and Senbet (1998) corroborate the prominent position that board structure and organization occupy in the corporate governance discussion, concluding that the board of director's effectiveness in monitoring corporate management is fundamentally determined by its independence and size. Nevertheless, as already noticed, notwithstanding the 'popularity' of the particular corporate governance field, empirical research regarding the effect of board structure (i.e., board size and composition) upon bank performance is not only comparatively scarce but, most importantly, has failed to reach consensus.

2.2. Board size and bank performance

Simpson and Gleason (1999) elaborated upon a sample consisting of those banking firms listed in the SNL Quarterly Bank Digest 1993 and found that the number of board directors did not have a significant bearing on the probability of banks' financial distress. Adams and Mehran (2005) examined the relation between board size and firm performance using a sample of 35 large publicly-traded US bank holding companies (BHCs) during 1959-1999. Contrary to the evidence for non-financial firms, they concluded that banking firms with larger boards do not under-perform their peers in terms of Tobin's Q and that, as a result, constraints on board size in the banking industry may be counter-productive. On the same line, Belkhir (2006) studied a sample of 260 US bank and savings-and-loan holding companies for 2002, inferring that internal corporate governance mechanisms (i.e., manager and block-holder ownership, proportion of outside directors, CEO-Chairman duality, board size) are, to a considerable degree, endogenously determined and they exert a non-significant impact upon banks' performance.

Likewise, Zulkafli and Samad (2007) analyzed a sample of 107 listed banks in the nine countries of Asian emerging markets (Malaysia, Thailand, Philippines, Indonesia, Korea, Singapore, Hong Kong, Taiwan, India), also deducing that board size is not significantly correlated with performance measures, such as the Tobin's Q and ROA. Finally, in their updated version of the 2005 research, Adams and Mehran (2008) used a sample of 35 large publicly traded BHCs over the period 1959-1999 and concluded that board size does not have a negative effect on performance.

More recently, Andres and Vallelado (2008) examined information on the characteristics of the boards of directors for 69 commercial banks operating in Canada, US, UK, Spain, France and Italy over the period 1995-2005. After controlling for the ownership structure, the weight of the banking industry, or differences in the regulatory and institutional setting, they found that the inclusion of more directors is positively associated with performance, which is measured by Tobin's Q, ROA and shareholder market return (SMR). However, they added that beyond a certain limit (i.e., 19 directors) the coordination, control and decision-making problems encountered by larger boards offset the benefits.

On the other hand and using a somewhat different approach, Sierra, Talmor and Wallace (2006) constructed a board strength index on the basis of 76 bank holding companies (BHCs) that operated during the period 1992-1997. The index

consisted of seven variables, including board size and independence under the assumption that larger and more insider-dominated boards are associated with less monitoring and higher CEO compensation and that, as such, denote weaker boards. Their findings indicated that stronger boards (i.e., BHCs with a higher score on the index) display higher performance measured in terms of ROA. The work of Staikouras, Staikouras and Agoraki (2007) examined a sample of 58 out of the 100 largest, in terms of total assets, credit institutions operating in Europe for the period between 2002 and 2004. Their analysis inferred that bank profitability – measured in terms of ROA, ROE and Tobin's Q – is negatively and significantly related to the size of the Board of Directors. Finally, Pathan, Skully and Wickramanayake (2007) using a dataset of the Thai commercial banks over the period 1999-2003, also obtained a negative relation between board size and both ROE and ROA.

2.3. Board composition and bank performance

The same puzzling picture is attained when empirically assessing the relationship between board composition and bank performance. A string of literature inferred that the proportion of directors maintaining an employment relationship with the bank (inside directors) and all other directors (outside directors) does not have a significant impact upon bank performance as measured in terms of Tobin's Q, ROA and ROE (Pi and Timme, 1993; Adams and Mehran, 2005, 2008; Belkhir, 2006). Staikouras et al. (2007) reached the same conclusion after examining the effect of the executive and non-executive directors' ratio upon bank performance. In the particular study, "directors that are currently employed by the firm, retired employees of the firm, related company officers or immediate family members of firm employees are classified as executives", while "[n]on-executive directors are members of the Board who are not top executives, retired executives, former executives, relatives of the CEO or the chairperson of the Board, or outside corporate lawyers employed by the firm". On the same line, Simpson and Gleason (1999) found that enhancing the participation of inside directors (i.e., corporate officers also serving as board directors) does not have a bearing on the banks' probability to become financial distressed, while Griffith, Fogelberg and Weeks (2002) also concluded that banks' performance, measured in terms of market value added (MVA), economic value added (EVA) and Tobin's Q, is not significantly influenced by the number of inside directors (i.e., officers, ex-employees, persons related to an officer of the bank).

Finally, the more recent work of Andres and Vallelado (2008) found an inverted U-shaped relation between the proportion of outsiders, defined as the number of non-executive directors, and bank performance, suggesting that an optimum combination of executive and non-executive directors would be more effective in securing value for banks than excessively independent boards.

In contrast, Sierra et al. (2006), after denoting inside directors as the number of executive directors and associating their presence with less board independence and accountability, concluded that a positive correlation subsists between stronger boards (i.e., BHCs with a higher value for a composite board index also comprising board independence and accountability) and performance measured in terms of ROA. The research of Busta (2007) examined a sample of 69 listed banks from France, Germany, Italy, Spain and UK over the period 1996-2005 and a sample of 125 banks operating in EU-15 and Switzerland during 2004. The results from the first sample indicated that banks with a higher presence of non-executives (i.e., independent directors) in their boards perform better in terms of the market-to-book value and return on invested capital (ROIC) as far as the Continental Europe is concerned, while the opposite holds for the UK; no significant correlation was detected in terms of ROA. On the same line, Pathan et al. (2007) reached the conclusion that more board independence, determined as the number of outside/non-executive directors maintaining no material (employment or shareholding) relationship with the firm, is associated with better performance of Thai banks, implying that independent directors improve board accountability.

2.4. Bank efficiency and corporate governance: New paths for exploration

The empirical literature on bank efficiency and corporate governance parameters is outstandingly meager and is completely absent (to the best of our knowledge) when the broader measure of profit efficiency is considered. Pi and Timme (1993) employed, for the first time, not only ROA but also cost efficiency (derived from a stochastic frontier cost model) as a performance measure, arguing that cost efficiency is negatively related to the combination of the Chairman and CEO roles and unrelated both to institutional and large ownership, as well as to the proportion of outside and inside board directors. Unfortunately, this early paper has not taken full benefit from the relatively recent econometric advances on stochastic frontiers and in particular of the consistent modeling of the determinants of bank efficiency. Finally, pursuing the

same issue, Tanna, Pasiouras and Nnadi (2008) used a sample of 18 banks operating in the UK between 2001 and 2006 and a combination of data envelopment analysis with Tobit regressions to estimate the technical, allocative and cost efficiency in the first stage and then identify potential correlates of efficiency. They found some evidence that board size is related to efficiency noticing, however, that this impact is not robust across different samples and specifications, while, at the same time, they concluded that a higher proportion of non-executive directors has a robustly positive and significant impact on all measures of efficiency. However, this two-stage approach applied in the study, is subject to severe consistency problems (see Brissimis, Delis and Papanikolaou, 2008).

2.5. Endogeneity issues

A relatively more recent line of literature has been attempting to establish a relation between board size and composition, on the one hand, and firm characteristics, on the other hand, based upon the costs and benefits of the board's monitoring and advising roles (see e.g., Linck, Netter and Yang, 2008; Lehn, Patro and Zhao, 2008; Coles, Daniel and Naveen, 2008). The main thrust of this literature is that each firm structures the board in a way that promotes its own future value, thus offering a plausible explanation for the future size and composition of the board (for a thorough discussion, see also Bhagat and Jefferis, 2002). As a result, a causal relationship between board variables and firm performance when the former are assessed as exogenous should be approached with cautiousness. Given this potential endogeneity, it would appear that modeling board composition in the fashion of most of the previous literature may not be appropriate (see also Garay and Gonzalez, 2008). Therefore, besides using a stochastic frontier approach to proxy bank performance, we also opt for augmenting the estimation technique to account for the aforementioned potential endogeneity.

3. Empirical specification and data

3.1. Methodology

To provide a comprehensive analysis of bank efficiency we estimate both cost and profit efficiency, using the so-called stochastic frontier analysis (SFA). More specifically, we build on the model put forth by Battese and Coelli (1995), as their

framework permits the simultaneous estimation of the profit or cost frontier with the equations including the determinants of efficiency.

Cost efficiency is defined as the deviation of a bank's actual cost from the best-practice in the industry. Thus, the cost efficiency ratio measures the proportion of cost or resources that are used efficiently by the bank. The general Battese and Coelli model specifies a cost frontier with the following properties:

$$\ln TC_{it} = f(W_{it}, Y_{it}) + v_{it} + u_{it} \quad (1)$$

where TC_{it} denotes observed operating and financial cost for bank i at year t (in logarithmic terms), W_{it} is a vector of input prices and Y_{it} is a vector of outputs of the bank. The error term is distinguished in two components: v_{it} corresponds to the random fluctuations, is assumed to follow a symmetric normal distribution around the frontier ($v_{it} \sim iidN(0, \sigma_v^2)$) and captures a phenomenon beyond the control of management; u_{it}, accounts for the bank's inefficiency, which can be controlled by management and is assumed to follow a truncated normal distribution of the form $u_{it} \sim N(m_{it}, \sigma_u^2)$. The SFA approach assumes that the inefficiency component of the error term is positive; that is, higher bank inefficiency is associated with higher cost. For the estimation of the cost function, we follow the literature (see e.g., Lensink, Meesters and Naaborg, 2007) in using the following translog specification:

$$\ln(TC_{it}) = a_0 + \sum_i a_i \ln W_{it} + \sum_j \beta_j \ln Y_{jt} + 1/2 \sum_i \sum_m a_{im} \ln W_{it} \ln W_{mt} + 1/2 \sum_j \sum_k \beta_{jk} \ln Y_{jt} \ln Y_{kt} + \\ + \sum_i \sum_j \delta_{ij} \ln W_{it} \ln Y_{jt} + \lambda D + \kappa T + \kappa' T^2 + v_{it} + u_{it} \quad (2)$$

The standard symmetry restrictions are imposed, i.e., $a_{im} = a_{mi}; \beta_{jk} = \beta_{kj}$ (see also Berger and Mester, 1997). Note that in the above specification we include both country dummy variables (D) and a time trend (T) in the estimation of the frontier. Since a translog function is a second order approximation, a squared term of the trend is also included.

Contrary to the concept of cost efficiency, profit efficiency captures both the cost and revenue dimension of bank operation and therefore accounts for inefficiency originating both in the input and output side (Berger, Hancock and Humphrey, 1993). In other words, profit efficiency is a broader measure of bank performance that identifies how close a bank is to producing the maximum possible profit, given a

particular level of input and output prices (Berger and Humprey, 1997). The profit function of a bank takes the following general form:

$$\Pi_{it} = f(W_{it}, Y_{it}) + v'_{it} + u'_{it} \tag{3}$$

where Π_{it} is total profit of bank i in period *t*, and the error terms (inefficiency and remainder disturbance) follow the same assumptions as above. Note that we employ an alternative profit function in which each bank maximizes profits given output quantities, rather than taking output prices as exogenous (Berger and Humphrey, 1997). In most cases the alternative profit function has provided qualitatively similar results with a standard profit function; however, the alternative profit function can be employed when output price data is missing (for further discussion on this issue, see Berger and Humphrey, 1997; Berger and Mester, 1997 and references therein).

Similarly to the case of the cost function, we specify a translog profit function of the following form:

$$\begin{aligned}\ln(\Pi_{it} + \theta + 1) = a_0 + \sum_i a_i \ln W_{it} + \sum_j \beta_j \ln Y_{jt} + 1/2 \sum_i \sum_m a_{im} \ln W_{it} \ln W_{mt} + 1/2 \sum_j \sum_k \beta_{jk} \ln Y_{jt} \ln Y_{kt} + \\ + \sum_i \sum_j \delta_{ij} \ln W_{it} \ln Y_{jt} + \lambda D + \kappa T + \kappa' T^2 + v_{it} - u_{it}\end{aligned} \tag{4}$$

Notice that, consistent with the profit efficiency literature (see e.g., Berger and Mester, 1997), we add a constant θ to the profits of all banks to avoid having observations with negative net profits that would render estimation unfeasible.

In both the cost and profit efficiency models, the mean of the inefficiency term *m* is modeled as a linear function of a set of explanatory variables:

$$m_{it} = \xi_i Z_{it} + w_{it} \tag{5}$$

where w_{it} is assumed to be truncated normally distributed, with zero mean and variance σ_u^2, ξ is a vector of coefficients to be estimated, and *Z* is a vector of bank-specific and country-level factors that affect efficiency, including the proxies for the governance variables. Finally, in the previous section, we observed a number of reasons explaining that the endogeneity problem of the governance variables is quite relevant and should be dealt with in our empirical framework. A simple way to come around this issue is to follow the transformation of Bhargava (1991). In our empirical model this transformation implies separating the Z-variables into a class of exogenous variables and a class of endogenous variables. In other words, it is assumed that the variables characterizing the board structure and all the other bank-level Z-variables are correlated with *v* in some general way. The country-specific control variables

(given below) serve as exogenous variables. In this framework, a third equation is estimated simultaneously with Eqs. (2 or 4) and (5), which involves regressing the endogenous variable on the exogenous variables. In particular, this third equation takes the form $-Z_2+\xi_1 Z_1=w_2$, where Z_2 and Z_1 are the endogenous and exogenous classes of variables, respectively. The emerging system can be estimated using full information maximum likelihood, under the assumption of normal standard errors.[4] For a proof of the consistency of this system estimator, see Bhargava (1991).

3.2. Data

Having defined the methodological approach to be followed, we focus on the selection of variables. We construct a balanced sample of 57 large European commercial banks operating in the EU-12 countries over the period 2002-2006. These banks were amongst the 100 largest (in terms of book value of assets) banks during the period examined.[5] All data were manually collected from bank accounts and annual reports. The availability of panel data permits us to check the response processes over time and to identify how the changing characteristics of the board affect bank efficiency.

The first problem encountered in evaluating bank efficiency is the definition and measurement of bank output. The two most widely used approaches are the 'production' and the 'intermediation' approaches (for details, see Berger and Humphrey, 1997). While we acknowledge that it would probably be best to employ both approaches to identify whether the results are biased when using a different set of outputs, transaction level data needed to employ the production approach is typically unavailable on a bank-by-bank basis. Hence, our study opts for the intermediation approach. Accordingly, we specify three outputs, namely, total loans, total securities and off-balance sheet items; and three inputs, i.e., interest expenses, personnel expenses and total other expenses. The three input prices are constructed by dividing (i) interest expenses by total deposits and short-term funding, (ii) personnel expenses by total assets[6] and (iii) overheads by total fixed assets (a similar approach has been adopted by many other studies, including, for example, Altunbas, Gardener, Molyneux and Moore, 2001). In order to guarantee linear homogeneity we scale total costs and inputs prices by the price of labor.

The elements Z of main interest in the present study are the measures of board size and composition, comprising the so-called board structure factor. Following the

corporate governance literature (e.g., Yermack, 1996), we define board size as the natural logarithm of the number of directors. However, as bank size exhibits a positive correlation with board size, we also develop an alternative measure to check the robustness of our results by dividing the board size variable by the natural logarithm of total assets (see also Anderson, Mansi and Reeb, 2004). This allows us to avoid the critique that large banks, which naturally face more complex organizational structures, are in need of larger boards.

Turning our attention to the board composition measure, several caveats should be placed in order. To begin with, as a proxy for board composition we use the ratio of non-executive directors over the total number of directors. Definitions of who qualifies as 'executive' and 'non-executive' director vary across legal systems. Nevertheless, a common and generally acceptable denominator could be traced in the EU Commission Recommendation 2005/162/EC, defining an 'executive director' as any member of the administrative body (unitary board) who is engaged in the daily management of the company, and a 'non-executive director' as any member of the administrative body (unitary board) of a company other than an executive director. The fundamental role of non-executive directors evolves around overseeing executive and managing directors while also dealing with situations involving conflicts of interests (OECD, 2004; EU Commission Recommendation, 2005/162/EC). With respect to banks that adopt the 'two-tier' (or dual) board system, the assumption made is that the directors that belong to the supervisory board (i.e., supervisory directors) are non-executives. This is absolutely consistent both with the relevant definitions offered by the EU Commission Recommendation 2005/162/EC, the OECD 2004 Corporate Governance Principles and the 2006 Basel Committee Corporate Governance Principles using the two terms interchangeably and delineating non-executive and supervisory directors' tasks in an identical manner, as well as with the relevant literature (e.g., Van Greuning and Brajovic-Bratanovic, 2003; Busta 2007).

Second, as already evidenced by the relevant literature review, empirical research tends to approach the board composition measure from varying angles, which, in turn, may add an element of confusion to the ensuing conclusions. More specifically, while part of the literature differentiates between 'insiders' and 'outsiders' another part distinguishes between 'executives' and 'non-executives' and, yet, a third portion attempts to separate 'independent' from 'non-independent' directors or even equates 'non-executives' with 'independent' directors. Our position

is crystal clear: our estimates are based upon the unambiguous dichotomization between 'executive' and 'non executive' directors, as already defined in the previous paragraph. Although it is generally considered that board independence is enhanced by including non-executive directors (EU Commission Recommendation 2005/162/EC; Basel Committee, 2006) and that, as a result, the number of non-executives could be used as a proxy for board independence, we take the position that such an approximation is not absolutely robust. For, 'independent directors' are not one and the same with but constitute a sub-group of non-executive directors, bearing distinctive qualitative characteristics typically reflected into national corporate governance principles in the form of 'negative' criteria (e.g., not be employed by the company or its affiliates, not be closely related to the company or its management through significant economic, family or other ties, not be representative of or having close business ties with dominant shareholders, not be significant creditor or supplier of the company, etc.).[7] Understandably, the wide divergence of 'independence criteria' across different jurisdictions in conjunction with the lack of available data on the nomination of particular directors as independent does not allow accurate estimation of the genuine degree of board independence; hence, we avoid using the relevant term preferring, instead, the more pragmatic term 'board composition' (see also Short, 1996; Sierra at al., 2006; Busta, 2007; Kang, Cheng and Gray, 2007).

We also use as *Z* bank-level controls for capitalization and credit risk, so as to capture the potential interrelationship between board size and/or composition with these basic bank characteristics. Capitalization is measured by the ratio of equity to total assets and credit risk by the ratio loan loss provisions to total loans.[8]

Furthermore, note that we estimate a common frontier for all banking systems in our sample, which enables us to compare the bank-level efficiency estimates across countries. To make the global estimation feasible, we employ (as additional Z-variables) country-specific controls, which include GDP per capita as a proxy for differences in the level of economic development, banking market concentration as a proxy for banking industry structure, the ratio of domestic credit to the private sector as a percentage of GDP to control for differences in the development of the financial sector and the nominal interest rate as a proxy for the differing monetary conditions across countries. Data for the macroeconomic variables are collected from the World Bank's World Development Indicators. Concentration is measured by the Herfindahl-Hirschman (H-H) index (obtained from ECB, 2007).

Table 1 provides descriptive statistics for all the potential correlates of bank efficiency (*Z*s). As regards the main variables of interest, the board size variable ranges between 7 and 48 directors and takes a mean value of 17.15. Board composition in terms of non-executive directors' participation in the board also varies widely across banks (from a minimum of 18% to a maximum of 89%) and takes a mean value of approximately 61%. The summary statistics are quantitatively similar with those reported in previous studies of the banking sector (see e.g., Adams and Mehran, 2003; Busta, 2007; Staikouras et al., 2007; Tanna et al., 2008).

(Please insert Table 1 about here)

4. Empirical results

A number of different versions of the models are estimated and the findings of the basic specifications are reported in Table 2. The estimated values for the cost and profit efficiency are fairly reasonable. On average, cost efficiency obtains a mean value of 89% and profit efficiency stands at 84%.[9] Since board size and the proportion of non-executive directors are highly correlated variables (the Pearson correlation for the variables is as high as 88%), we avoid using them simultaneously in the same estimated equations. We further explore two propositions concerning (i) the possible non-linearity in the relationships in hand (see Table 3) and (ii) the interrelationship between board structure and bank risk-taking (see Table 4). In what follows, we discuss these results in turn.[10]

A first hint regarding the good fit of our equations is obtained from the findings on the effect of control variables on cost and profit efficiency. In particular, our results show that GDP per capita has a positive impact on cost and profit efficiency in all cases, implying that an increase in GDP lowers total costs. This appears intuitive considering that in more prosperous countries banks have better access to new technologies (Lensink et al., 2007) or they can offer services of better quality. Consistent with the literature suggesting a tradeoff between concentration and efficiency (see e.g., Fries and Taci, 2005), the H-H index has a negative and significant impact on cost efficiency; however this effect becomes insignificant when profit efficiency is considered. Finally, the capital ratio is negatively and significantly correlated with cost efficiency and positively correlated with profit efficiency. The former result is expected considering that equity capital is an expensive source of funding, while the latter result is consistent with the literature advocating that higher

capital increases bank revenues and thus counterbalances the increased costs (see e.g., Berger, 1995; Brissimis, Delis and Tsionas, 2006).

Turning to the main focus of our study, our findings seem to be more favorably inclined towards the strand of literature suggesting a negative correlation between board size and performance (measured in terms of both cost and profit efficiency). In fact, this negative impact is further strengthened when scaling board size by bank size (see columns II, V of Table 2).[11] A number of theoretical arguments back up these findings. First, larger boards are usually associated with more intense coordination, communication and process problems. In addition, free-rider problems become more acute: larger boards not only entail less time for directors in expressing their opinions within board meetings but also constrain directors' incentives to acquire information and monitor executive management, which essentially renders them more easily controllable by the CEO (Lipton and Lorsch, 1992; Jensen, 1993; Yermack, 1996). Finally, considering that variability constitutes a significant dimension of performance, larger boards are related with more compromises to reach consensus and, by extension, with less direct and instant decision-making and more modest corporate performance (Cheng, 2008).

The results reflecting a negative correlation between board composition and cost efficiency (see column III, Table 2) and an insignificant relationship between board composition and profit efficiency (column VI of Table 2) seem to contradict the conventional wisdom favoring outsider-dominated boards. In fact, combining evidence from the cost and profit efficiency equations and considering that the element of revenue is missing from cost equations, it appears that the increased cost associated with larger bodies of non-executives is counterbalanced by improved revenue for banks with larger proportion of non-executive directors. In other words, one may suspect that within the profit efficiency measure, decreased cost efficiency and increased revenue efficiency owing to a larger share of non-executives yield the non-significant result.

Another plausible explanation for the absence of a noteworthy association between the proportion of non-executive directors and performance is offered by Hermalin and Weisbach (1991) suggesting that it may well be the case that firms optimally weigh their boards between insiders and outsiders, in which case it would be difficult to trace a relationship between board composition and performance.[12] This argument also appears to be in harmony with our additional tests presented

below reporting an inverted U-shaped relationship between board composition and profit efficiency.

(Please insert Table 2 about here)

In order to inquire into the robustness of the basic results presented in Table 2, we estimate a number of alternative regressions. First, we include the square of board size to examine the issue of non-linearity, yet no such a pattern is identified in either the cost or profit efficiency equations (see columns I, II, IV and V of Table 3). In contrast, and as regards profit efficiency, the share of non-executive directors has a positive and significant impact, while the coefficient on its squared term is negative and significant. Thus, profit efficiency and board composition appear to be related in an inverted U-shaped way, which implies that an optimum mix of executives and non-executives could better promote bank efficiency. This effect, combined with the aforementioned finding on the improved revenue efficiency due to the increased presence of non-executive directors, seems to underscore the case made by supervisory authorities and international fora concerning the, rather neglected, advising role of non-executive, independent directors.

In particular, those non-executive directors that have been nominated as independent may have a positive bearing on the quality of corporate decision-making and strategy by (a) bringing new perspectives from other businesses, (b) constructively challenging and enriching company strategies and introducing significant sources of management experience and expertise, and (c) advancing the company's reputation and assisting in the creation of business affiliations (OECD, 2004; Basel Committee, 2006; UK FRC Combined Code, 2008).[13] Nevertheless, it should always be born in mind that, in the presence of too many non-executive directors, the arguments put forward by Lipton and Lorsch (1992), Jensen (1993), Yermack (1996) and Cheng (2008) concerning oversized boards apply in full: nomination of too many non-executives would essentially lead to cumbersome, slack and more cost inefficient boards and, by extension, to reduced bank performance. This observation elucidates our findings on the non-linear relationship between board composition and profit efficiency.

(Please insert Table 3 about here)

A significant element in the determination of the optimal board structure in banking concerns the risk-taking behavior of banks and in particular credit risk. More specifically, it may be that the impact of board size or composition on bank

performance is channeled through the better control of credit risk. To examine this potential relationship, we add interaction terms of credit risk (measured by loan loss provisions/total loans) with the board structure variables. The results, presented in Table 4, indicate that large boards are associated with higher loan-loss provisions in the cost efficiency equation (see column I), while this effect fades away when profit efficiency is considered. Since the latter measure is a more comprehensive reflection of bank performance, we conclude that larger board structures are not associated with better bank performance through better management of credit risk.[14] As regards board composition, the results are qualitatively similar with those presented in Table 3, with the non-monotonic relationship remaining robust in the profit efficiency equation (column VI).[15] It is worth mentioning that using the ratio of non-performing loans to total loans does not alter any of these findings.

(Please insert Table 4 about here)

One final concern might be that these results are somehow an artifact of how the frontier models were implemented in terms of the variables used to shape the frontier. To address this issue we re-estimated the profit efficiency models (which we view as the most informative) using: (i) the capital and risk variables only in the translog specification (and not as determinants of efficiency), (ii) the macroeconomic variables in the translog specification and (iii) the capital, risk and macroeconomic variables in both the translog equation and as determinants of efficiency. These choices for the modeling of bank efficiency are motivated from the fact that the control variables may be thought to have some input characteristics. For example, decisions on the level of risk-taking may be internal choices of bank management, the capital base may be used to finance expensive projects, while macroeconomic factors, if accurately predicted, can influence the production process itself. The results (not reported here but available on request) suggest that only the model that includes all control variables as both inputs and determinants of efficiency produces somewhat different results, especially in connection to the impact of board size (i.e., it becomes insignificant). However, this could simply be the effect of multicollinearity or the violation of the assumption of independence in the structure of the error term. Bearing these issues in mind, we conclude that robust evidence is reported insinuating a negative relationship between board size and profit efficiency, as well as an inverted U-shaped relationship between the proportion of non-executive directors and profit efficiency.

5. Conclusions

Recent scandals in the financial sector have brought corporate governance at the forefront of academic and supervisory attention. Banks' versatile role in the economic system has caught regulatory and supervisory interest around the world in an effort to inspire high quality corporate governance standards. Board structure, in the sense of board size and composition, and its impact on corporate performance constitutes an indispensable and, at the same time, prevalent theme of the corporate governance discussion.

Using a sample of large European banks over 2002-2006, our study innovates in that bank performance is measured in terms of both cost and profit efficiency, while the impact of board size and composition is modelled within a stochastic frontier framework, thus offering a more lucid insight into the sources of efficient performance in the banking industry. Our results strongly suggest that, indeed, smaller boards are more efficient. On the other hand, the effect of appointing non-executive (including independent) directors is not that straightforward. In particular, an increased number of non-executive directors decreases cost efficiency, but apparently increases revenue efficiency, thus rendering the overall impact on profit efficiency questionable. To gain some deeper insights in these patterns we further examine the potential non-linearity in the aforementioned relationships. We find that, while the negative impact of board size is linear, increasing the number of non-executives is negatively associated with banks' profit efficiency beyond a certain point. Hence, our study implies that the regulatory enthusiasm, at least as far as the impact of outsider-dominated boards is concerned, is not a stated truth and, as a result, should be approached with cautiousness. These results, backed up by corporate governance theories on both financial and non-financial firms, are robust to controls for bank size, risk and capital within a wide array of empirical specifications.

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[1] Public guarantees come into operation following the failure of banks. Prudential regulation (e.g., capital adequacy and liquidity requirements, constraints on large exposures, standards on the suitability and quality of management team and requirements concerning the efficiency of internal control systems), on the other hand, operates as an ex ante shield against bank runs and systemic risk. For an overview of the relevant literature on public safety nets and moral hazard, see inter alia the theoretical part of the papers of Hoggarth, Jackson and Nier (2005), VanHoose (2007), Demirgüç-Kunt, Kane and Laeven (2008), and references therein.

[2] The term "internal corporate governance" is employed to distinguish from "external disciplinary devices", including the market for corporate control. In the words of the Basel Committee on Banking Supervision (2006), (internal) corporate governance from a banking industry perspective involves "the manner in which the business and affairs of banks are governed by their boards of directors and senior management, which affects how they set corporate objectives; operate the bank's business on a day-to-day basis; meet the obligation of accountability to their shareholders and take into account the interests of other recognised stakeholders; align corporate activities and behaviour with the expectation that banks will operate in a safe and sound manner, and in compliance with applicable laws and regulations; and protect the interests of depositors".

[3] Kose and Yiming (2003), Baxter (2003) and Adams and Mehran (2003) also stress that a distinctive corporate governance feature of banks arises from the need to align not only managers' and equity holders' interests, but also depositors' interests and the public interest. On the same line, Macey and O'Hara (2003) argue that the special nature of banks' corporate governance essentially entails that board directors should be held to a broader standard of care than other directors.

[4] Luckily, normality is identified using a Jarque-Bera test. If normality was not identified a three-stage least squares estimator would have been the consistent method. For a thorough discussion on the estimation of panel data models with endogenous regressors, see Bhargava (1991).

[5] Only large commercial banks are used so as to avoid potential criticism regarding differential technology structures between banks of different size or type.

[6] It would have been preferable to use the number of employees, instead of total assets, to construct the price of labor. However, the number of employees is not available for many banks in our sample (for a similar implementation, see e.g. Lensink et al., 2007).

[7] See OECD (2004). The EU Commission Recommendation 2005/162/EC states, in generic terms, that a director should be considered to be independent only if he is free of any business, family or other relationship, with the company, its controlling shareholder or the management of either, that creates a conflict of interest such as to impair his judgment. Annex II of the Commission Recommendation identifies a number of situations reflecting the relationships or circumstances usually recognized as likely to generate material conflict of interest (e.g., not be an executive director or employee of the company or associated company, not be or represent a controlling shareholder, not have, or have had within the last year, a significant business relationship with the company or an associated company, not be, or have been within the last three years, partner or employee of the present or former external auditor of the company or an associated company, etc.).

[8] A better measure for credit risk is probably the ratio of non-performing loans to total loans. However, provisions are readily manageable by banks and thus represent an element of choice for the financial institutions. Nevertheless we inquire into the robustness of the results by also using non-performing loans.

[9] Due to space considerations we do not report detailed efficiency results or results for the coefficients on inputs/outputs and interaction terms of Eqs. (2) and (4). However, these results are available on request.

[10] For expositional brevity we report results on efficiency (not inefficiency).

[11] This result remains unaffected in the rest of the equations presented in Tables 3 and 4 below. Therefore, it seems that the board size variables should be scaled by bank size, so as to avoid giving larger banks an unfair advantage. Most of the previous literature simply uses the logarithm of board members.

[12] Adams and Mehran (2003) offer a different explanation: due to regulatory requirements emphasizing the safety and soundness of banks and taking into account that bank supervisors share examination results with the boards of directors and may also perform on-site visits to poorly performing banks, board directors are inclined to direct their advisory role towards maintaining the safety and soundness of the institution rather than value maximization.

[13] On the advisory role of non-executive, independent directors see, inter alia, Daily and Schwenk (1996), Johnson, Daily and Ellstrand (1996), Lawler, Finegold, Benson and Conger (2002), Fich (2005). For the potential limitations of non-executive, independent directors' advisory role see e.g., Adams and Mehran (2003), Song and Thakor (2006), Adams and Ferreira (2007).

[14] Note that the level of the board size variable remains negative and statistical significant throughout.

[15] We reserved the squared term in equation VI of Table 4, because the impact of the percentage of non-executives on profit efficiency was found to be inverted U-shaped (see Table 3 above).

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Table 1
Descriptive statistics (2002-2006)

Variables	Mean	Median	Std. Dev.	Min	Max	Kurtosis	Skewness
Board size	17.15	16.00	26.66	7.00	48.00	3.13	1.42
Board composition	60.98	61.54	14.31	18.18	89.00	0.79	-0.57
Equity/total assets	8.95	5.26	3.32	3.79	46.06	20.42	4.59
LLP	45.35	4.97	5.91	0.85	81.91	49.39	15.61
GDP per capita	17,729.2	18,478.21	11,561	8,148.9	28,742.9	-0.71	-0.11
H-H index	581.83	482.00	259.74	163.00	2,730.00	5.51	2.19
Domestic credit to private sector (% of GDP)	117.65	111.76	129.41	61.09	185.15	-1.09	0.23
Nominal interest rate	5.31	5.48	2.17	2.57	9.70	0.98	0.59

Source*:* Annual reports of the credit institutions.
Note: Board size: Number of directors of banks; Board composition: proportion of non-executives in the board of directors; LLP: loan loss provisions/total loans; H-H index: Herfindahl-Hirschman index. Figures are expressed in percentages for all variables (except of board size and GDP per capita) and in € for GDP per capita.

Table 2
The effect of board structure on bank efficiency

	Cost efficiency			Profit efficiency		
	I	**II**	**III**	**IV**	**V**	**VI**
Constant	3.20	6.81	3.16	2.72	6.96	2.24
	(8.93)***	(12.26)***	(8.97)***	(3.57)***	(5.50)***	(3.02)***
Trend	0.01	-0.01	-0.01	0.08	0.06	0.09
	(0.25)	(-0.08)	(-0.10)	(2.52)	(1.98)**	(2.63)***
ln(equity/total assets)	-0.30	-0.19	-0.30	0.52	0.66	0.48
	(-8.02)***	(-4.98)***	(-7.90)***	(6.77)***	(8.18)***	(6.35)***
ln(board size)	-0.26			-0.35		
	(-3.39)***			(-2.25)**		
ln(board size/assets)		-0.39			-0.44	
		(-8.34)***			(-4.65)***	
ln(% non-executives)			-0.20			-0.01
			(-3.64)***			(-0.05)
GDP per capita	0.01	0.01	0.01	0.01	0.01	0.01
	(4.41)***	(3.92)***	(4.75)***	(2.02)**	(2.65)***	(2.29)***
H-H index	-0.01	-0.01	-0.01	-0.01	0.01	-0.01
	(-3.77)***	(-3.65)***	(-3.62)***	(-0.03)	(0.59)	(-0.15)
Domestic credit to private sector (% of GDP)	0.01	0.01	0.01	-0.01	-0.01	-0.01
	(1.09)	(1.61)	(1.59)	(-1.87)*	(-1.81)*	(-1.80)*
Nominal interest rate	0.03	0.04	0.03	-0.19	-0.18	-0.19
	(1.60)	(2.52)**	(1.38)	(-5.44)***	(-5.42)**	(-5.69)***
Sigma-squared	0.36	0.31	0.35	1.18	1.12	1.24
LR-test	-146.33***	-119.32***	-145.45***	-262.97***	-255.33***	-265.41***

Note: The t-statistics are presented in parentheses. The ***, **, and * indicate 1 per cent, 5 per cent and 10 per cent significance levels, respectively. LR-test: Likelihood ratio test that all parameters in the model are zero.

Table 3
Non-linearity in the relationship between board structure and bank efficiency

	Cost efficiency			Profit efficiency		
	I	**II**	**III**	**IV**	**V**	**VI**
Constant	4.89	6.52	3.27	-0.77	8.30	0.14
	(4.14)***	(10.83)***	(6.14)***	(-0.36)	(5.57)***	(0.15)
Trend	0.01	0.01	-0.01	0.08	0.06	0.08
	(0.44)	(0.02)	(-0.08)	(2.32)**	(1.84)*	(2.54)**
ln(equity/total assets)	-0.30	-0.21	-0.30	0.51	0.68	0.49
	(-7.98)***	(-5.25)***	(-7.88)***	(6.75)***	(8.56)***	(6.60)***
ln(board size)	-1.49			2.24		
	(-1.82)*			(1.48)		
ln(board size/assets)		-0.52			-0.20	
		(-5.93)***			(-1.13)	
ln(board size)^2	0.22			-0.45		
	(1.50)			(-1.72)*		
ln(board size/assets)^2		-0.02			0.04	
		(-1.74)*			(1.70)*	
ln(% non-executives)			-0.29			2.30
			(-0.80)			(3.62)***
ln(% non-executives)^2			0.02			-0.52
			(0.26)			(-3.69)***
GDP per capita	0.01	0.01	0.01	0.01	0.01	0.01
	(4.48)***	(3.78)***	(4.72)***	(2.19)**	(2.43)**	(2.88)***
H-H index	-0.01	-0.01	-0.01	0.00	0.01	0.01
	(-4.10)***	(-3.77)***	(-3.50)***	(0.39)	(0.64)	(0.80)
Domestic credit to private sector (% of GDP)	0.01	0.01	0.01	-0.01	-0.01	-0.01
	(0.87)	(1.43)	(1.60)	(-1.88)*	(-1.53)	(-1.99)**
Nominal interest rate	0.03	0.04	0.03	-0.19	-0.17	-0.20
	(1.71)*	(2.43)**	(1.38)	(-5.74)***	(-5.39)***	(-6.07)***
Sigma-squared	0.37	0.32	0.35	1.23	1.15	1.26
LR-test	-145.27***	-117.77***	-145.42***	-261.67***	-253.89***	-259.78***

Note: The t-statistics are presented in parentheses. The ***, **, and * indicate 1 per cent, 5 per cent and 10 per cent significance levels, respectively. LR-test: Likelihood ratio test that all parameters in the model are zero.

Table 4
The interrelationship of board structure with credit risk

	Cost efficiency			Profit efficiency		
	I	**II**	**III**	**IV**	**V**	**VI**
Constant	2.80 (7.67)***	6.68 (12.09)***	2.79 (7.82)***	2.80 (3.54)***	7.05 (5.51)***	0.14 (0.15)
Trend	0.01 (0.13)	-0.01 (-0.06)	-0.01 (-0.25)	0.08 (2.48)**	0.06 (1.91)*	0.08 (2.50)**
ln(equity/total assets)	-0.32 (-8.83)***	-0.20 (-5.22)***	-0.31 (-8.73)***	0.53 (6.75)***	0.66 (8.19)***	0.50 (6.61)***
ln(board size)	-0.19 (-2.36)**			-0.38 (-2.17)**		
ln(board size/assets)		-0.45 (-8.63)***			-0.42 (-4.01)***	
LLP*ln(board size)	0.02 (3.25)***			-0.01 (-0.40)		
LLP*ln(board size/assets)		-0.01 (-2.44)**			0.01 (0.48)	
ln(% non-executives)			-0.11 (-1.85)*			2.29 (3.61)***
ln(% non-executives)^2						-0.53 (-3.74)***
LLP*ln(% non-executives)			0.02 (3.22)***			-0.01 (-0.54)
GDP per capita	0.01 (4.35)***	0.01 (3.53)***	0.01 (4.82)***	0.01 (1.83)*	0.01 (2.47)**	0.01 (2.64)***
H-H index	-0.01 (-3.03)***	-0.01 (-3.63)***	-0.01 (-2.79)***	0.00 (-0.06)	0.01 (0.59)	0.01 (0.78)
Domestic credit to private sector (% of GDP)	0.01 (1.24)	0.00 (1.70)*	0.01 (1.83)*	-0.01 (-1.86)*	-0.01 (-1.83)*	-0.01 (-1.98)**
Nominal interest rate	0.03 (1.50)	0.04 (2.18)**	0.02 (1.29)	-0.18 (-5.34)***	-0.18 (-5.40)***	-0.20 (-6.07)***
Sigma-squared	0.38	0.29	0.37	1.18	1.12	1.26
LR-test	-141.56***	-116.44***	-140.82***	-262.89***	-255.22***	-259.64***

Note: The t-statistics are presented in parentheses. The ***, **, and * indicate 1 per cent, 5 per cent and 10 per cent significance levels, respectively. LR-test: Likelihood ratio test that all parameters in the model are zero.