Board structure and tail and systemic risk-taking: Evidence from European banks

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Abstract

We study whether the board structure before the crisis is related to the banks' risk exposure under stressed financial market conditions, at both individual and systemic level. Moreover, we investigate whether this relation changes for the Systemically Important Banks (SIBs), characterized by a higher complexity and the implicit too-big-to-fail guarantee. Based on a sample of 40 European banks, we find that banks with larger boards and lower number of meetings are associated with higher tail and systemic risk. After controlling for the systemic relevance of banks in our sample, we find that board size is especially important for SIBs, while there is no evidence for board independence. Overall, our results reveal the specialness of SIBs' corporate governance mechanisms.

Keywords: corporate governance; systemic risk; financial crisis; G-SIBs

EFM codes: 130; 150; 510; 570

1. Introduction

The financial crisis can be to a large extent attributable to excessive risk-taking by banks and to shortcomings in bank corporate governance (Kirkpatrick, 2009), affecting banks' performance and risk during the financial turmoil (Diamond and Rajan, 2009; Bebchuk and Spamann, 2010). In particular, it revealed the potential underestimated consequences of the absence of an ad hoc regulation on the banks exposures to systemic risk, but also the failures of corporate governance routines to safeguard against excessive risk-taking. Because of an excessive risk-taking, banks with poor governance are likely to experience larger losses during the crisis, relative to banks characterized by more effective governance systems. However, as suggested by de Andres and Vallelado (2008), regulators' efforts in reducing systemic risk might conflict with bank shareholders' objective to increase the value of their stocks, especially when the latter is pursued through excessive risk-taking. In particular, we focus on the characteristics of the board of directors, which is a crucial component of a sound and effective corporate governance system, and their relationship with the banks' risk during the financial crisis, by considering measures of banks' total risk but also their exposure to extreme events.

Recent initiatives by banking supervisors, central banks and other international authorities have emphasized the importance of several corporate governance practices in banking (see e.g. Basle Committee on Banking Supervision, 2010; Board of Governors of the Federal Reserve System, 2010 Organization for Economic Co-operation and Development, 2010). Overall, the board of directors is a crucial component of a sound and effective corporate governance system and its role as a governance mechanism is even more critical in credit institutions, relative to other non-banking firms, because its fiduciary responsibilities extend beyond shareholders to depositors and to regulators (Macey and O'Hara, 2003. According to de Andres and Vallelado (2008), the role of boards as a mechanism for corporate governance in banking takes on special relevance in a framework of limited competition, intense regulation, and higher informational asymmetries, due to the complexity of the banking business. Thus, the board becomes a key mechanism to monitor managers' behavior and to advise them on strategy identification and implementation. Bank directors' specific knowledge of the complex banking business enables them to monitor and advise managers efficiently. According to Caprio and Levine (2002), a bank's board plays a vital role in achieving effective governance because neither dispersed shareholders/debtholders nor the market for corporate control can impose effective governance. More importantly, the banking regulation has assigned to the board of directors a special role, both in the risk governance and management processes. For instance, the second pillar (supervisory review process) of Basel II identifies the role of the board of directors as an integral part of risk management (Basel Committee on Banking Supervision, 2005). As the entity in charge of reviewing and guiding risk policy, it can be considered the ultimate responsible for the safeguard against excessive risk-taking so that the significant failures of risk management systems and internal controls registered during the crisis, made worse by incentive systems that encouraged and rewarded high levels of risk taking, point to ineffective board oversight (Kirkpatrick, 2009). Hence, analysing the board of directors' characteristics could provide a more in depth comprehension of the significant failures in corporate governance and their effect on bank risk exposure.

These considerations are generally valid for the banking system as a whole, but it has been argued that, failures in corporate governance mechanisms at global systemically important banks (G-SIBs) can be considered among the main causes of the crisis (National Commission on the Causes of the Financial and Economic Crisis in the United States, The Financial Crisis Inquiry Report, 2011, pp. xvii)). However, so far there is no evidence that these institutions are characterized by different governance mechanisms. The specialness of G-SIBs in terms of corporate governance could be explained first by the higher complexity of these institutions in terms of business models, organizational structures and interconnectedness with other banks, and secondly by their implicit too-big-to-fail guarantee from governments, which implies that neither regulatory supervision nor traditional external market discipline can limit their excessive risk-taking (Acharya et al. (2009)).

The bank board plays a vital role in the sound governance of complex banks: in the presence of opaque bank lending activities, the board role is more important, as other stakeholders, such as shareholders or debt holders, are not able to impose effective governance in banks (Levine, 2004). Based on Pathan’s (2009) definition of ‘strong board’, i.e., a board characterized by small size and more independent directors, as a board more effective in monitoring bank managers and more representing bank shareholders interest, we aim to provide empirical evidence on the effects of strong bank boards on proper measures of tail and systemic bank risk-taking during the financial crisis. Academics and regulators have developed different concepts and methodological proposals to assess systemic risk. We choose to focus on the measure developed by Acharya et al. (2010), defined as the Marginal Expected Shortfall (MES), because it is developed within the same conceptual framework as the Expected Shortfall (ES) (Acerbi et al., 2001), that is a consistent measure of bank tail risk. Next to these two measures, we analyze the relation between bank board structure and risk-taking by focusing also on a traditional measures of risk, the Volatility (VOL), defined as the annualized daily standard deviation of the stock returns, and the leverage (LEV). This allows us to contribute to the existing literature by adding further evidence on the role of bank boards on bank risk-taking during the recent financial turmoil, both in terms of their individual and systemic contribution to the stock market instability. In contrast to the previous other two measures; MES explicitly incorporates the bank sensitivity to the adverse market conditions (the left tail). To the best of our knowledge, there is no evidence to date on whether the bank board relates to this specific measure of bank risk-taking.

In the second part of our research, we extend our analysis to investigate whether the relation between board structure and bank risk changes for systemically important banks (SIB) in Europe. As mentioned before, governance failures at many systemically important banks have been considered as one of the key causes of the credit crisis, together with excessive risk-taking prior to the onset of the crisis. However, to the best of our knowledge, no empirical evidence supports this position yet. We investigate this aspect specifically referring to the relationship between SIB boards structures and measure of bank tail risks.

By using data on 40 large publicly traded European banks, we examine whether and how banks with stronger boards are characterized by higher systemic risk. Since the summer of 2007, the financial system has faced two severe systemic crises and European banks have been at the center of both of them (Acharya and Steffen, 2012). Therefore, by analyzing the European banking system, we should consider as a period of financial turmoil the years from 2007 to 2010. However, as the previous literature suggests that the bank performance during the crisis is related to the risk taken before the crisis, we also include the year 2006 in order to control for this aspect. To identify which banks in our samples can be considered systemic in each year of our period of investigation we refer to the Top 10 ranking of European systemic banks as reported in Acharya and Steffen (2012).

We focus on three corporate governance factors: (1) the board size (BS), (2) the board independence (BI), and (3) the frequency of the board meeting per year (BM), as a proxy of the board functioning, measured as of December 2006. Given that the prior literature (see e.g. Black et al. 2006; Cremers and Ferrell, 2010) suggests that the corporate governance structures change slowly, following Erkens et al. (2012), we use data for year 2006, prior to the onset of the crisis. Hence, we assume that the strength of the governance mechanism in 2006 is reflected in bank risk-taking during the 2006-2010 period. In addition, we control for banks' total asset and leverage ratio in a parsimonious version of our estimations, and then we add also proxies for business model and exposures to credit and funding liquidity risk. Finally, this latter model is modified to investigate whether the three corporate governance factors mentioned above affect European SIBs' risk differently from other European banks.

The research contributes to the empirical literature on corporate governance and bank risks in several respects. First, the time horizon under investigation allows us to shed a light on the relationship between corporate governance and European banks' risk exposures during a persistent period of financial distress. In this sense, the recent financial crisis provides an opportunity to explore whether and how better governed banks (in terms of 'stronger' boards) perform during the crisis providing a quasi-experimental setting and thus reducing any endogeneity concerns on explanatory variables. Second, we contribute to the large literature on corporate governance, which is mainly focused on US, by investigating whether and how corporate governance had a significant impact on European banks during the crisis by influencing their risk-taking behavior. Thirdly, we contribute to the existing literature (Akhigbe and Martin, 2008; Fortin et al., 2010; Pathan and Faff, 2013; Peni and Vahamaa, 2012; Adams and Mehnar, 2013) because, as far as it could be ascertained, this is the first study to employ market-based systemic and tail risk measures referring to corporate governance structure in a single study. This is notably relevant given that the turmoil has illustrated how excessive risk-taking could lead to financial instability by contributing to an increase in probability the occurrence of banking crises. There is so far very little research on the main drivers of bank tail risk (only exception are De Jonghe 2010; Knaup and Wagner, 2012). Understanding these drivers is important for both regulators and market participants.

Finally, our investigation on European SIBs could have several policy implications, by recognizing the specialness of SIBs' corporate governance with respect to other banks, and thus, eventually, suggest this aspect to be adequately considered within the on-going debate on the definition of the regulatory framework for these banks (see BCBS, 2011, revised in 2013). Moreover, the specialness of SIBs' corporate governance could also help to explain the mixed results in the prior literature on strong boards.

Our main finding can be summarized as follows. Overall, our results suggest that the board structure has an important impact on bank tail and systemic risk-taking. In particular some characteristic of the board structure seems to be more effective in influencing a specific type of bank risk exposure. Board size and meeting frequency have an effect on tail and systemic risk exposure, while board independence is almost irrelevant. More specifically, when controlling for the systemic importance of our sample banks, we find that the board size is especially important for SIBs, whereas larger boards are associated with greater tail and systemic risk exposure. Moreover, we find that there is no influence of the board independence on systemic risk both for SIBs and non-SIBs. Finally, there is a different influence of the number of board meeting: a positive influence on SIB risks and a negative influence on non-SIB risks.

The remainder of the paper is organized as follows. In Section 2, we analyze the relevant literature on corporate governance and systemic risk. In Section 3, we describe the estimation framework, our sample and the model variables. In Section 4, we present and discuss the empirical analysis and its results. Section 5 concludes.

2. Related literature and empirical hypotheses

An extensive banking empirical literature has documented that stronger corporate governance mechanisms are generally associated with better financial performance, higher firm valuation and higher stock returns (Caprio et al., 2007; Cornett et al., 2009 de Andres and Vallelado, 2008; Hanazaki and Horiuchi 2003; Jirapron and Chintrakarn, 2009; Laeven and Levine, 2009; Macey and O'Hara, 2003; Mishra and Nielsen, 2000; Pacini et al., 2005; Sierra et al., 2006; Webb Cooper, 2009; Pathan and Faff, 2013; Adams and Mehnar, 2013). A recent stream of literature investigates these issues analyzing periods of financial turmoil. Peni and Vahamaa (2012) show that large publicly traded US banks with stronger corporate governance mechanisms have been characterized by higher profitability, higher market valuations and less negative stock returns during the 2008 financial crisis. On the contrary, by considering banks from 31 countries, Beltratti and Stulz (2011) document those intermediaries with strong boards perform worse over the period July 2007 - December 2008. Erkens et al. (2012) find that financial firms with more independent boards and larger institutional ownership gain lower stock returns during the period January 2007 - September 2008. By examining a panel of large US bank holding companies over the period 1997–2011, Pathan and Faff (2013) conclude that both board size and independent directors decrease bank performance, and that pre-crisis board size and independence affect bank performance in the crisis period.

In order to get a more comprehensive understanding of the effects of bank corporate governance during the crisis, many authors also take into account the bank risk-taking level, but their analyses lead to controversial results. Akhigbe and Martin (2008) show that banks managed by stronger boards are characterized by a lower risk level. Conversely, according to both Pathan (2009) and Fortin et al. (2010), banks characterized by strong governance mechanisms may take more risk: in particular, Pathan (2009) finds that smaller boards are associated with more risk, whereas a higher number of independent directors seem to imply a lower risk exposure. Erkens et al. (2012) find that institutional investors have encouraged financial firms' managers to increase shareholder returns through greater risk-taking in the pre-crisis period, and this helps to explain why firms with larger institutional ownership have experienced worse stock returns during the crisis; conversely, board independence has not had any impact in terms of firms' risk-taking behavior.

Based on prior literature, we focus on the relationship between risk-taking and the board size, the number of independent directors and the frequency of board meetings per year. Board of directors' role is to monitor and advise managers (Hermalin and Weisbach, 2003). Larger boards of directors are expected to better supervise managers and bring more human capital to advise them, relative to smaller ones. However, boards with too many members can suffer from coordination issues that can waste their control ability and result in excessive power to the CEO (Yermack, 1996; Eisenberg et al., 1998). Furthermore, large boards can also lack of flexibility in the decision-making process. . Therefore, the trade-off between advantages and disadvantages associated with large boards has to be taken into account. Given the pronounced financial markets instability of the period that we account for, we believe the two following hypotheses reasonably possible: on the one hand, the expected greater expertise and knowledge, as well as their supposed better monitoring ability, could explain a reduction in a bank's risk exposure when it is managed by larger boards; on the other hand, since a flexible attitude towards events occurring in stressed financial markets could be crucial in preventing from excessive risk-taking, larger boards could be associated with higher risk due to the previously mentioned coordination issues. Consequently, as to the relationship between tail and systemic bank-risk taking and board size, we do not have a strong a priori and let the data tell their story.

Corporate governance literature offers no conclusive evidence on the effect of independent directors on bank risk-taking (Bhagat and Black, 2002; Hermalin and Weisbach, 1991; John and Senbet, 1998; de Andres and Vallelado, 2008). Independent directors are believed to better monitor managers as they value maintaining reputation in directorship market but empirical research do not find conclusive evidence (Fama and Jensen, 1983; Bhagat and Black, 2002). An excessive proportion of independent directors, which are often outside directors, could make boards' advisory less effective, since it might prevent bank executives from joining the board. Inside directors are able to provide the board with valuable information that outside directors would find difficult to gather (Adams and Ferreira, 2007; Harris and Raviv, 2008; Coles et al., 2008). We could expect boards with more inside directors to be perceived as more able to support the managers in the difficult decision-making process associated with extreme market conditions. However, according to Pathan (2009), when the monitoring function is prevalent, we should expect a positive link between the presence of independent directors and bank risk-taking. Moreover, Hermalin and Weisbach (2003) point out that the board independence is not important on a day to day basis and propose that it should only matter for certain board actions, 'particularly those that occur infrequently or only in a crisis situation' (Hermalin and Weisbach 2003, p. 17). Since we are investigating a crisis period, we could expect thus a negative relationship between the number of independent directors and the bank tail and systemic risk. Again, we formalize our hypothesis for our two proxies of bank risk in stressed market conditions as follows:

Hypothesis 2 (H_2): Tail and systemic bank risk-taking are negatively related to the number of independent directors.

We investigate the effect of the frequency of board meetings per year, as a proxy of the better functioning of the board (Vafeas, 1999). Francis et al. (2012), find that non-financial firm stock performance is positively related to the number of board meetings, consistent with Adams and

Ferreira (2007), who, among others, argue that board meetings are important channels through which directors obtain firm-specific information and fulfill their monitoring role. de Andres and Vallelado (2008) suggest that meetings provide board members with the chance to come together, to discuss and exchange ideas on how they wish to monitor managers and bank strategy. Hence, the more frequent the meetings, the closer the control over managers and the more relevant the advisory role of the board. Furthermore, the complexity of the banking business and the importance of information both increase the relevance of the board advisory role, especially during stressed market conditions. To effectively perform its role, the board meetings frequency has to ensure a timely and thorough review of the bank strategy and risk profile, and the discussion of any remedial action that might be required. Again, given our focus on extreme market conditions, we expect that a higher number of meetings is necessary to guarantee a prompt response of the board to market events and is expected to be associated with a lower level of tail and systemic risk.

Hypothesis 3 (H_3): Tail and systemic bank risk-taking are negatively related to the number of meetings of the board of directors.

Finally, we aim to test whether the predicted relations differ in comparing systemically important banks (SIBs) with other banks. By definition, SIBs are more complex institutions characterized by larger size and higher degree of interconnectedness with other SIFIs (systemically important financial institutions), SIBs or financial institutions. After the credit crisis broke out in the second half of 2007, failures in corporate governance mechanisms at SIFIs have been identified as one of the main issues in explaining their unexpected fragility during the financial crisis and have also been associated with excessive risk-taking in the pre-crisis period. As the board of directors can be seen as the governor of all governance mechanisms, we could expect that a strong board structure to have more influence on the bank tail and systemic risk-taking of SIBs, compared to other banks, in light of their complexity and interconnectedness. Hence, our general hypothesis about SIBs is formalized as:

Hypothesis 4 (H_4): Compared to non-SIBs, the expected relation between strong board structure (small board size, board independence and more board meetings) and bank tail and systemic risk is more pronounced for SIBs.

3. Sample, variables and econometric models

In this section, first we describe our sample and the selection strategy adopted to build it up, and then we describe and analyze the variables used in the models we implement. Finally, we focus on the explanation of the estimation framework.

3.1 Sample and selection strategy

Our initial sample consists of the largest publicly listed commercial banks, bank holdings and holding companies headquartered in the European Union over the period 2006-2010. The empirical analysis requires data on corporate governance structures, financial information and stock prices. Information on banks' board structures are hand collected from their annual reports, financial information and data on stock prices and market capitalization are obtained from Bankscope™ and Bloomberg™ database, respectively.

In particular, to build our sample up, we first focus on commercial banks, bank holdings and holding companies whose stocks have been publicly traded over the entire 2006-2010 period in the European Union. This results in 123 financial firms. Secondly, we consider only firms with a market capitalization at the end of 2006 greater than EUR 1 billion, because large financial institutions have been at the center of public debate since the beginning of the financial crisis due to their systemic nature, and size is one of the main factors to assess their systemic relevance. Consequently, the number of firms included in our sample shrinks to 52. Third, we lose 12 firms because they lack of the needed corporate governance information at the end of 2006, prior to the onset of the crisis. Finally, we obtain a sample comprising 40 individual banks and holding companies and 200 firm-year observations for the fiscal years 2006–2010.

The financial firms included in our sample are presented in Appendix A (Table A.1). Despite the small number of individual banks, our sample intermediaries' total assets was about 15,565,731 million at the end of 2006, and thereby the sample covers a substantial proportion of the total amount of the EU banking system.

3.2 Variables

Key independent variables: board variables

Our key independent variables are the governance variables relating to the definition of strong board. Following Pathan (2009), the effectiveness of the board of directors in monitoring and advising managers determines its power and we use the term "strong board" to indicate a board more representing firm shareholder interest. Thus, a strong bank board is expected to better monitor bank managers for shareholders. Our proxies of strong boards are board size (the smaller the size, the stronger the board), the number of independent directors (the higher the number, the stronger the board) and the frequency of board meetings (the higher the frequency, the stronger the board). In detail, we define the variable board size (BS) as the number of directors of the board. The variable independent directors (IND) is simply the number of the board independent directors. An independent director has only business relationships with the bank and his or her directorship, i.e. an independent director is not an existing or former employee of the banks or its immediate family members and does not have any significant business ties with the bank. The frequency of the board meetings (BM) is measured as the median of the number of the meetings held the in the years 2004, 2005, 2006 (before the crisis). To identify systemically important banks in each year of our period of investigation (DUMMY_SIB) we refer to the Top 10 annual ranking of European systematic banks, as reported in Acharya and Steffen (2012), which are based on the systemic expected shortfall (SES) measure. This allows us to avoid assuming as systemic those banks that show the highest MES in our sample. Clearly, this assumption would have been biased by our selection strategy and data availability. The rankings refer to June 30th, for 2007; to May 5th, for 2009 (US stress tests); to July 23rd, for 2010 (Europe stress test). For both 2006 and 2008 we hypothesize that the Top 10 ranking is the same as in 2007 for 63 European banks. Alternatively, we could have used the Top 20 ranking reported in the same research or the 2011 Financial Stability Board list that ranks the global systemically important financial institutions (FSB, 2011). In the first case, the assumption that the banks which are systemic in 2007 remain systemic until 2010 would have been unrealistic given that those banks have been the most affected by the crisis and often had to or were forced to reduce their risk exposures. In the second case, the assumption that the banks, which are systemic in 2011, correspond to those that are systemic 2007 would have led to consider as systemic only those that survived to the financial crisis.

Dependent variables: bank risk measures

We use multiple proxies of bank risk to show whether strong boards have any impact on the bank risk-taking. In particular, our three measures of bank risk-taking include Volatility (VOL), Expected Shortfall (ES) and Marginal Expected Shortfall (MES). All these measures are based on market or quasi-market data.

First, we adopt Volatility (VOL) of banks' stock returns over the period 2006-2010. Following Peni and Vahamaa (2011), VOL is calculated as the annualized standard deviation of a bank's daily stock returns (R_{it}) for each fiscal year. The daily stock return is calculated as the natural logarithm of the ratio of equity return series, i.e. $R_{it} = ln\ (P_{it}/P_{it-1})$, where the stock prices account for any capital adjustment, including dividend and stock splits. VOL captures the overall variability in a bank's stock returns and reflects market perception about the risks inherent in its assets, liabilities, and off-balance-sheet positions. Both regulators and bank managers frequently monitor this total risk measure.

In order to investigate the impact of strong board on banks' risk, which could have significant financial stability implications, we adopt the Expected Shortfall (ES) and the Marginal Expected Shortfall (MES), developed by Acharya et al. (2010), to measure tail and systemic risk, respectively. Since the Expected Shortfall (ES) is the expected loss conditional on the loss being greater than the Value at Risk (VaR), we estimate it as follows:

$$ES_{\alpha} = -E\left[R \middle| R \leq -Var_{\alpha}\right] \qquad (1)$$

where we consider α equal to 0.05.

Computing ES for the overall banking system, Acharya et al. (2010) and Brownlees et Engle (2010) derive the Marginal Expected Shortfall of bank *i* as the derivative of the market Expected Shortfall with respect to bank *i* weight in the market index, and ultimately define MES as:

$$\frac{\partial ES_{\alpha}}{\partial y_i} = -E(r_i \mid R \leq VaR_{\alpha}) \equiv MES_{\alpha}^{i} \qquad (2)$$

where r_i is the return of bank *i*, α is equal to 0.05 and MES^{i}_{α} is bank *i* 's Marginal Expected Shortfall, measuring how bank *i* 's risk taking adds to the bank's overall risk. In other words, MES can be measured by estimating group *i* 's losses when the market is doing poorly.

The main rationale behind MES with respect to the standard measures of firm-level risk, such as VaR, expected loss, or Volatility, is that they have almost no explanatory power, while beta has only a modest explanatory power in detecting systemically risky banks. We recall that the difference between MES and beta arises from the fact that systemic risk is based on tail dependence rather than on average covariance. Therefore, MES better fits the definition of systemic risk in terms of expected losses of each financial institution in a future systemic event in which the overall financial system is experiencing losses. Moreover, the great advantage of MES is given by the possibility of linking the dynamic properties of market returns to the behavior of single equity returns, possibly using bivariate models, and without the need of large system estimation compared to other measures of systemic risk.

Control variables

Following prior studies, we include in our models a set of control variables in order to account for size, business mix, bank credit and liquidity risks and also to take into consideration differences among countries in terms of regulation.

A first group of control variables measures differences in bank business structure. One of these control variables is bank size (SIZE), that is measured by the natural log of total assets book value (Pathan, 2009; Peni and Vahamaa, 2012). Following Acharya et al. (2010), the variable LEV is given by the ratio of quasi-market value of assets to market value of equity, where the quasi-market value of assets is equal to book assets minus book equity plus market value of equity. Knaup and Wagner (2012) find no relation between tail risk and leverage. The variable LOANSTA measures differences in banking business model, and it is constructed as the ratio of loans to total assets at book value (de Andres and Vallelado, 2008). It allows us to control for the potential differences between commercial and holding banks. We expect a negative coefficient for this variable to be consistent with the evidence by Knaup and Wagner (2012) that traditional banking activities, such as lending, are associated with lower perceived tail risk, while several non-traditional activities, on the other hand, are perceived to contribute to tail risk.

Our second group of control variables accounts for differences among countries in terms of regulation. We include country dummies to control for differences in the level of our risk measures across countries: they take the value of one for each of the countries from which the analyzed banks come from, and zero otherwise (de Andres and Vallelado, 2008). However, the country variable does not take into account that there are similarities among the countries in legal and institutional aspects or in investors' protection rights.

Finally, a third group of control variables accounts for bank risk-taking in terms of credit and liquidity risks. In particular, our proxy of a bank's liquidity risk is the liquidity ratio (LIQUID) measured by the ratio of liquid assets to customer and short-term funding, (LIQUID) that here has to be considered as an inverse measure of the liquidity risk. The impaired loans ratio (IMP, impaired loans/gross loans) accounts for banks' credit risk, as it can be considered as a proxy of credit portfolio quality (Casu et al., 2011).

The detailed construction of the models variables and their expected sign are presented in Table 1, in which we do not include the country and the year dummies.

Table 1. Definition of models variables

Variable	***Definition***	***Construction***	***Expected sign***
MES	Marginal Expected Shortfall	$\frac{\partial ES_{\alpha}}{\partial y_i} = -E(r_i \vert R \leq VaR_{\alpha}) \equiv MES_{\alpha}^{i}$	Dependent variable
ES	Expected Shortfall	$ES_{\alpha} = -E\left[R \vert R \leq -Var_{\alpha}\right]$	Dependent variable
VOL	Standard deviation of banks return	Annualized standard deviation of its daily stock returns	Dependent variable
LEV	Quasi-Leverage	Quasi-market value of assets / Market value of equity	Positive
BS	Board size	Number of directors	Positive
BM	Frequency of board meetings	Number of the meetings held during the fiscal year	Negative
IND	Independent directors	Number of the board independent directors	Negative
SIZE	Bank size	Ln of total assets	Positive
LOANSTA	Bank business activity	Loans/ Total assets	Negative
LIQUID	Bank liquidity	Liquid assets/Customer and short	Negative

	position	term funding	
IMP	Bank credit risk	Impaired loans/ Gross loans	Positive
DUMMY_SIB	Systemically Important banks	European Top 10 ranking based on SES by Acharya and Steffen (2012)	-

Notes: This table presents definition, construction, and expected signs on the variables used for the regressions. The expected sign of *LIQUID* refers to the liquidity ratio, so the expected sign is positive when considering the liquidity risk.

Table 2 presents the descriptive statistics for the data used in the regressions.

< Insert Table 2>

The board structure variables in Panel A show that the mean BS is 13.45, with a minimum of 4 and a maximum of 31 units. As to the number of independent directors, IND varies from 0 to 20, with a mean of 5.925. The mean of the board meetings is 10.425, with a minimum of 1 and a maximum of 36.

For brevity, the descriptive statistics of control variables presented in Panel B are omitted. Turning to the descriptive statistics of the bank risk measures, Panel C shows that the annualized stock return (VOL) has a mean of 44.13 per cent during the sample period. Not surprisingly, Table 2 demonstrates that the volatility of bank stocks was extremely high during the crisis. The mean of MES, ES and LEV respectively of 4.46, 6.33 and 32.32 per cent are comparable to the ones reported by Acharya and Steffen (2012), however we analyse the 2006-2010 period, while their research focuses on the period from June 2006 to June 2007.

Table 3 presents the Pearson's pair-wise correlation matrix between the independent variables. Multicollinearity among the regressors should not be a concern as the maximum value of the correlation coefficient is -0.4286, which is between liquidity ratio (LIQUID) and bank size (LOANSTA).

< Insert Table 3>

3.3 Econometric models

The primary estimation method is generalized least square (GLS) random effect (RE) technique (Baltagi and Wu, 1999). This technique is robust to first-order autoregressive disturbances (if any) within unbalanced-panels and cross-sectional correlation and/or heteroskedasticity across panels. In the presence of unobserved bank fixed-effect, panel 'Fixed-Effect' (FE) estimation is commonly suggested (Wooldridge, 2002).

However, such FE estimation is not suitable for our study for several reasons. First, time-invariant variable like IND, BS and BM cannot be estimated with FE regression, as it would be absorbed or wiped out in 'within transformation' or 'time-demeaning' process of the variables in FE. Second, for large '*N*' (i.e. 40) and fixed small '*T*' (i.e. 5), which is the case with this study's panel data set, FE estimation is inconsistent (Baltagi, 2005, p. 13). Furthermore, in case of a large *N*, FE estimation would lead to an enormous loss of degrees of freedom (Baltagi, 2005, p. 14). Thus, an alternative to FE, i.e. RE, is proposed here.

Referring to the endogeneity concern, we underline that it is a common issue in governance studies that makes interpretation of the results very difficult. As pointed out by Hermalin and Weisbach (2003), the relation between board characteristics and firm performance may be spurious because firm's governance structure and performance are endogenously determined. This issue is less likely to be problematic in our setting because the financial crisis is largely an exogenous macroeconomic shock and also because we relate corporate governance variables referred to the 2006 year to bank risk-taking measures estimated for the 2006-2010 years. As argued by Pathan and Faff (2013), the financial crisis is an exogenous shock to a firm's investment choices and thus it provides an opportunity (albeit one dimensional) to explore the first-order relation between board structure and bank performance during the crisis years in a 'quasi-experimental' setting (Francis et al., 2012). Studying the relation between governance in the pre-crisis period and performance during the crisis period would be robust to any endogeneity concerns on the explanatory variables.

First, we employ three different measures of bank risk-taking: Marginal Expected Shortfall (MES), Expected Shortfall (ES), Volatility (VOL); second, for each risk measure, we estimate two baseline equations: Model 1 and Model 2. We specify that Model 1 is a parsimonious version of Model 2, which includes only two control variables (SIZE and LEV), year and country effects. The control variables of Model 2 are SIZE, LEV, LOANSTA, IMP, LIQUID, year and country effects. Third, following de Andres and Vallelado (2008), we introduce in both models the squared board size (BS_SQ). In particular, we find that there is an inverted U-shaped relation between board size and bank risk-taking (for further comments, see section 4). In the detail:

Model (1)

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_4 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \delta_1 D\_YEAR + \\ + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t} \tag{3}$$

Model (2)

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_3 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \gamma_3 LOANSTA_{i,t} + \\ + \gamma_4 IMP_{i,t} + \gamma_5 LIQUID_{i,t} + \delta_1 D\_YEAR + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t} \tag{4}$$

where y_{it} is our dependent variable (i.e. MES, ES, VOL); the β, γ and δ parameters are the estimated coefficients respectively for the key independent variables (board variables), the control variables and the year and country dummies. We split the error term in our estimations into two components: n individual effects (η_i) to control for unobservable heterogeneity and stochastic disturbance ($\upsilon_{i,t}$).

4. Empirical Results

4.1 The impact of board structure on bank risk

Tables 4, 5 and 6 present the results of RE estimates of Model 1 and Model 2 regressions, when considering MES, ES, and VOL as our the dependent variables.

< Insert Table 4>

< Insert Table 5>

< Insert Table 6>

The regression for Model 1 is well-fitted with an overall R-squared of 59, 62 and 63 per cent for MES, ES and VOL respectively, while the regressions for Model 2 have an overall R-squared of 64, 68 and 70 per cent for MES, ES and VOL respectively. For both models, we have statistically significant Wald Chi-square statistics.

As concerns bank board variables, we find that the coefficient of BS is positive and statistically significant across all the measures of tail, systemic and total risk. This illustrates that, after controlling for bank characteristics, a small bank board is associated with less bank risk-taking, both in terms of tail and systemic risk and stock return volatility. This latter evidence for the dependent variable VOL, the only variables we have in common with previous studies, is in contrast with the results of Pathan (2009) for US-market though for a pre-crisis period but in general terms in line with Akhigbe and Martin (2008). This result seems to support the idea that the market might perceive a smaller board to have a greater ability to coordinate and control managers and ensure the flexibility in the decision-making process required during extreme market conditions. The positive relationship we find suggests that banks with larger boards have higher stock market volatility, but more importantly, they experience higher losses during the crisis at an individual level but also in terms of contribution to the market's losses. This may be because larger boards have more difficulties to supervise managers and to overcome conflicts of interest within the group of directors and between directors and managers. Moreover, managers could have an incentive to focus on "normal times" risk and be more linked to the market poor performance in case of extreme events, by increasing their systemic risk, to hide their true performance during the crisis.

Our results show an inverted U-shaped relation between board size (BS) and our risk measures. This suggests that the addition of new directors is positively related to banks' risk-taking, although the increase in risk shows a diminishing marginal growth. Thus, the negative and significant coefficient of BS_SQ shows that there is a point at which adding a new director reduces bank risk-taking. According to de Andres and Vallelado (2008), boards with many directors are able to assign more people to supervise and advise on managers’ decisions. Having more supervisors and advisors either reduces managers’ discretionary power or at least makes it easier to detect managers’ opportunistic behavior.

With regards to the number of independent directors, we find an interesting result. The coefficient on IND is negative across all measures of risk and statistically significant, except for MES. A higher number of independent directors is associated with a lower level of bank risk, but there is no relation on systemic risk. This result is only partially consistent with our second hypothesis and similar to Pathan (2009). It illustrates that the role of independent directors might be more valuable in a crisis event that is specifically related to the bank (as bank-specific tail - ES), than in the case of a systemic crisis (market tail - MES). However, it is surprising the absence of any influence of board independence on systemic risk.

We find a negative relation between the number of board meetings (BM) and bank risk-taking (H3). The coefficient of BM is negative and statistically significant for our measures of tail, systemic and total risk. This result supports our third hypothesis that high frequency of bank board meetings is perceived to play a more proactive role than reactive during the crisis, and thus are associated with less tail and systemic risk.

The coefficients of the other bank characteristics variables all have the expected sign and offer some significant insights. For instance, we observe that the SIZE is positively associated with MES with a significant coefficient, but not to the ES (as in Acharya and Steffen, 2012). This is consistent with the idea to consider the size as one of the main conditions used to identify systemically important risky banks and the leverage as the major concern of the risk management at individual bank-level. We also find a negative and significant coefficient for LOANSTA for all three measures of risk. This illustrates that banks more involved in credit activities than trading activities, are associated with less tail and systemic risk. Finally, we find coherent sign and significant coefficients for our proxy of credit risk and (funding) liquidity risk, IMP and LIQUID. As expected, in both cases, we find that the bank exposures on these two risks were among the main drivers of bank risk-taking during the financial crisis.

4.2 Robustness checks

In order to verify if our results are insensitive to the operational definition of the dependent variable and to the choice of the modelling technique, we implement a robustness check concerning the estimation method, by using a random effect probit model. In detail, we adopt a binary probit model, in which the dependent variable (i.e. MES, ESand VOL) takes on the value 1 if its value is above its yearly median and zero otherwise.

Moreover, following Pathan (2009), we perform Glejser's (1969) heteroskedasticity tests to show the effect of boards on banks risk-taking. The estimates with Glejser procedure are robust to both within and across bank correlations of residuals. In detail, we perform Glejser heteroskedasticity tests for all the dependent variables (MES, ES and VOL) in two steps. First, we derive the absolute residuals from the pooled-OLS estimation of Model 2 regression, but without IMP and LIQUID. In the second step, the absolute value of the residuals obtained in the first steps are used as a proxy for risk, and we re-estimate Model 2 for all the dependent variables using pooled-OLS. The results remain qualitatively unchanged. These tables are available upon request.

4.3. Extended analysis: European SIB versus non-SIB

As a preliminary investigation on the relationship between corporate governance and SIBs' risk exposure, we present univariate tests of differences in characteristics between SIBs and non-SIBs in Table 7.

< Insert Table 7>

Referring to the board variables, we find that SIBs have a lower number of board meetings and of independent directors if compared to non-SIBs (8.419 versus 10.793 and 3.419 versus 6.385, respectively) with the difference being statistically significant. The board size for SIBs is lower on average but not significantly different from non-SIBs.

If we turn to analyze the control variables, as expected, the results suggest that the SIBs have a higher value of SIZE (13.659 versus 11.711) and a lower value of LOANSTA compared to non-SIBs (34.506 versus 56.233), with the difference being statistically significant.

Finally, we compare risk measures. We find that SIBs are more risky according to all the measures used (MES, ES and LEV), with the differences being statistically significant.

To test our fourth hypothesis, we include in the Model 2 a dummy variable (DUMMY_SIB), which is equal to 1 for the systemically important banks belonging to the Top 10 ranking in Acharya and Steffen (2012) in each year, and 0 otherwise. Second, next to the dummy, we include three interaction terms progressively for each corporate governance factor under investigation: INT_DUMMY_SIB_IND, INT_DUMMY_SIB_BS and INT_DUMMY_SIB_BM, respectively. Tables 8, 9 and 10 report our results.

< Insert Table 8>

< Insert Table 9>

< Insert Table 10>

After adding the interaction term INT_DUMMY_SIB_IND, we find that (Table 9) the relationship between the number of independent directors (IND) and bank risk is confirmed across all measures of risk, except for MES, as in the previous results (negative and significant at 5 per cent). Moreover, there is no evidence of a different relation for SIBs and non-SIBs. The role of independent directors is important because it is associated with lower tail risk, but not more important for SIBs. It is to notice that the board independence, one of the main recommendations in governance debate, is unrelated to bank systemic risk exposure and neutral to bank systemic relevance.

We find that the after adding the interaction term INT_DUMMY_SIB_BS to the Model 2 (Table 10), the significance for the BS variables in the previous results disappears, while we have positive and significant (1%) coefficients of the interaction terms for MES and ES. This suggests that the presence of SIBs in the sample mainly drives the previous results. For the SIBs a larger board size before the crisis implies a higher risk-exposure during the crisis (H4).

Finally, in Table 10 we report our estimations after adding the interaction term INT_DUMMY_SIB_BM. These results confirm the previous finding for the relation between boards meeting and bank risks (BM has a negative and significant coefficient at the 1% confidence level) for the non-SIBs across our measures of tail, systemic and total risk. However, we find interesting results for the relation between boards meeting and SIBs risks. The effect of board meeting on SIBs risk is positive and significant at 1%. This result suggests that SIBs with greater tail and systemic risks during the crisis are associated with a higher number of meetings before the crisis.

5. Conclusions

We provide empirical evidence on how corporate governance mechanisms before the crisis affected the risk of European banks during the financial crisis.

We find that banks with larger boards and lower number of board meetings per year are associated with higher tail risk, but also that they contributed more to the losses of the banking system as a whole. After controlling for the systemic relevance of banks in our sample, we find that the board size is especially important for SIBs, whereas larger boards are associated with greater tail and systemic risk exposure. No evidence for board independence on MES and only weak evidence for ES and VOL. Finally, board meetings reduce risk for non-SIBs and increase risk for SIBs.

Overall, our results confirm the specialness of SIBs' corporate governance during the crisis and shed a light on how the board characteristics contributed to the systemic relevance of those institutions.

Table 1. Definition of models variables

Variable	*Definition*	*Construction*	*Expected sign*
MES	Marginal Expected Shortfall	$\frac{\partial ES_\alpha}{\partial y_i} = -E(r_i \mid R \leq VaR_\alpha) \equiv MES_\alpha^i$	Dependent variable
ES	Expected Shortfall	$ES_\alpha = -E\left[R \mid R \leq -Var_\alpha\right]$	Dependent variable
VOL	Standard deviation of banks return	Annualized standard deviation of its daily stock returns	Dependent variable
LEV	Quasi-Leverage	Quasi-market value of assets / Market value of equity	Positive
BS	Board size	Number of directors	Positive
BM	Frequency of board meetings	Number of the meetings held during the fiscal year	Negative
IND	Independent directors	Number of the board independent directors	Negative
SIZE	Bank size	Ln of total assets	Positive
LOANSTA	Bank business activity	Loans/ Total assets	Negative
LIQUID	Bank liquidity position	Liquid assets/Customer and short term funding	Negative
IMP	Bank credit risk	Impaired loans/ Gross loans	Positive
DUMMY_SIB	Systemically Important banks	European Top 10 ranking based on SES by Acharya and Steffen (2012)	-

Notes: This table presents definition, construction, and expected signs on the variables used for the regressions. The expected sign of *LIQUID* refers to the liquidity ratio, so the expected sign is positive when considering the liquidity risk.

Table 2. Descriptive statistics

Variables	Obs.	Mean	St. Dev.	Min	Max
Panel A: board variables					
BS (No)	200	13.45	5.252	4	31
BM (No)	200	10.425	6.288	1	36
IND (No)	200	5.925	4.440	0	20
Panel B: control variables					
SIZE	200	12.012	1.688	7.135	14.765
LOANSTA	193	52.743	18.200	0.033	92.277
LEV	200	32.317	48.551	1.790	435.453
IMP	178	3.2997	2.612	0.19	12.94
LIQUID	196	47.026	47.721	6.78	441.82
Panel C: dependent variables					
MES	200	0.044	0.028	0.000	0.176
ES	200	0.063	0.042	0.015	0.267
VOL	200	0.441	0.270	0.117	1.717

Notes: This table reports the descriptive statistics of the board variables (Panel A), the control variables (Panel B) and the dependent variables (Panel C). See Table 1 for variables definition.

Table 3. Correlation matrix

	LEV	IND	BS	BM	SIZE	LOANSTA	IMP	LIQUID
LEV	1.00							
IND	-0.19	1.00						
BS	0.04	**0.37**	1.00					
BM	0.01	0.04	-0.07	1.00				
SIZE	**0.23**	0.17	0.22	0.10	1.00			
LOANSTA	-0.06	0.07	0.08	0.06	**-0.28**	1.00		
IMP	**0.27**	0.20	0.02	0.14	0.17	0.01	1.00	
LIQUID	-0.10	-0.15	-0.14	-0.04	-0.21	**-0.43**	-0.14	1.00

Notes: The table shows Pearson pairwise correlations for the variables used in the empirical analysis. See Table 1 for variables definitions. Bold texts indicate statistically significant at 5% level

Table 4. Model 1 and Model 2: Random effects (RE) - GLS estimates of MES

Random-effects GLS regressions - Dependent variable MES	MODEL(1) Coeff.	*p*-value	Robust st. errors	MODEL(2) Coeff.	*p*-value	Robust st. errors
Key independent variables						
IND	-0.00024	0.544	0.0004	-0.00067	0.151	0.00047
BS	0.00206*	0.069	0.0011	0.00272**	0.03	0.00125
BS_SQ	-0.00007**	0.021	0.00003	-0.00008**	0.013	0.00003
BM	-0.0006***	0.001	0.00021	-0.0005**	0.016	0.00023
Control variables						
SIZE	0.00375***	0.001	0.00116	0.00387***	0.004	0.00133
LEV	0.00012**	0.027	0.00005	0.00007	0.164	0.00005
LOANSTA				-0.00039*	0.081	0.00022
IMP				0.00159*	0.058	0.00084
LIQUID				-0.00027**	0.031	0.00012
CONS	-0.02784*	0.055	0.01451	-0.00437	0.849	0.02293
R-Square (overall)	0.5882			0.6459		

Wald χ2 test	1005.49	302.31
Number of banks	40	40

Dependent variable - Model 1 and Model 2: MES

Notes: The table reports estimates from random effects (RE) - GLS panel regressions for MES as specified in Model 1 and Model 2. Model 1 is the parsimonious model, in which the explanatory variables are IND, BS, BS_SQ, BM, SIZE and LEV.

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_4 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \delta_1 D\_YEAR + \\ + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t}$$

The independent variables of Model 2 are IND, BS BS_SQ, BM, SIZE, LEV, LOANSTA, IMP and LIQUID:

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_3 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \gamma_3 LOANSTA_{i,t} + \\ + \gamma_4 IMP_{i,t} + \gamma_5 LIQUID_{i,t} + \delta_1 D\_YEAR + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t}$$

See Table 1 for variables definitions.

Columns 3 of Model 1 and Model 2 report robust standard errors; time and country effects are included in all estimates.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Table 5. Model 1 and Model 2: Random effects (RE) - GLS estimates of ES

Random-effects GLS regressions - Dependent variable ES	MODEL(1) Coeff.	p-value	Robust st. errors	MODEL(2) Coeff.	p-value	Robust st.errors
Key independent variables						
IND	-0.0010159	0.133	0.0007	-0.00197***	0.006	0.0007
BS	0.0032241*	0.075	0.0018	0.005068***	0.004	0.0017
BS_SQ	-0.00009**	0.035	0.00004	-0.00014***	0.002	0.00004
BM	-0.0007***	0.003	0.00025	-0.000704**	0.01	0.00027
Control variables						
SIZE	0.00073	0.618	0.00147	0.00057	0.712	0.00154
LEV	0.00033***	0.000	0.00009	0.00026***	0.006	0.00009
LOANSTA				-0.00051*	0.062	0.00027
IMP				0.00367***	0.002	0.00117
LIQUID				-0.00038**	0.024	0.00017
CONS	0.00823	0.67	0.01932	0.0376018	0.176	0.0278157
R- Square	0.6229			0.6863		

(overall)		
Wald χ2 test	1158.12	375.81
Number of banks	40	40

Dependent variable - Model 1 and Model 2: ES

Notes: The table reports estimates from random effects (RE) - GLS panel regressions for ES as specified in Model 1 and Model 2. Model 1 is the parsimonious model, in which the explanatory variables are IND, BS, BS_SQ, BM, SIZE and LEV.

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_4 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \delta_1 D\_YEAR + \\ + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t}$$

The independent variables of Model 2 are IND, BS BS_SQ, BM, SIZE, LEV, LOANSTA, IMP and LIQUID:

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_3 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \gamma_3 LOANSTA_{i,t} + \\ + \gamma_4 IMP_{i,t} + \gamma_5 LIQUID_{i,t} + \delta_1 D\_YEAR + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t}$$

See Table 1 for variables definition.

Columns 3 of Model 1 and Model 2 report robust standard errors; time and country effects are included in all estimates.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Table 6. Model 1 and Model 2: Random effects (RE) - GLS estimates of VOL

Random-effects GLS regressions - Dependent variable VOL	MODEL(1) Coeff.	*p*-value	Robust st. errors	MODEL(2) Coeff.	*p*-value	Robust st.errors
Key independent variables						
IND	-0.0067	0.114	0.0042	-0.0128***	0.004	0.0044
BS	0.0204*	0.074	0.0114	0.0321***	0.004	0.0109
BS_SQ	-0.0006**	0.028	0.0002	-0.0008***	0.001	0.0002
BM	-0.0052***	0.002	0.0016	-0.0046***	0.008	0.0017
Control variables						
SIZE	0.0045	0.627	0.0093	0.0025	0.794	0.0098
LEV	0.0021***	0.000	0.0005	0.0016***	0.003	0.0005
LOANSTA				-0.0041**	0.024	0.0018
IMP				0.0232***	0.001	0.0067
LIQUID				-0.0028**	0.011	0.0011
CONS	0.1007	0.405	0.1208	0.10074	0.405	0.1208
R- Square	0.6346			0.7001		

(overall)		
Wald χ2 test	1329.25	433.76
Number of banks	40	40

Dependent variable - Model 1 and Model 2: VOL

Notes: The table reports estimates from random effects (RE) - GLS panel regressions for VOL as specified in Model 1 and Model 2. Model 1 is the parsimonious model, in which the explanatory variables are IND, BS, BS_SQ, BM, SIZE and LEV.

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_4 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \delta_1 D\_YEAR + \\ + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t}$$

The independent variables of Model 2 are IND, BS BS_SQ, BM, SIZE, LEV, LOANSTA, IMP and LIQUID:

$$y_{it} = \alpha + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_3 BM_{i,2006} + \gamma_1 SIZE_{i,t} + \gamma_2 LEV_{i,t} + \gamma_3 LOANSTA_{i,t} + \\ + \gamma_4 IMP_{i,t} + \gamma_5 LIQUID_{i,t} + \delta_1 D\_YEAR + \delta_2 D\_COUNTRY + \eta_i + \upsilon_{i,t}$$

See Table 1 for variables definition.

Columns 3 of Model 1 and Model 2 report robust standard errors; time and country effects are included in all estimates.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Table 7. Summary statistics for all sample banks and univariate tests of differences in characteristics between SIBs and non-SIBs

	All banks			SIB			Non-SIB			Difference in means		
Variable	N	Mean	Std.Dev	N	Mean	Std.Dev	N	Mean	Std.Dev	(abs)	(t)	(p-values)
Board variables												
BS	200	13.450	5.252	31	12.742	4.008	169	13.580	5.450	0.838	1.006	0.319
BM	200	10.425	6.288	31	8.419	3.085	169	10.793	6.653	2.374	3.147	0.002
IND	200	5.925	4.440	31	3.419	2.680	169	6.385	4.550	2.965	4.982	0.000
Control variables												
SIZE	200	12.013	1.689	31	13.659	0.813	169	11.711	1.633	-1.948	-10.113	0.000
LOANSTA	193	52.743	18.200	31	34.506	16.602	162	56.233	16.351	21.727	6.692	0.000
IMP	178	3.300	2.613	30	3.921	2.723	148	3.174	2.581	-0.748	-1.383	0.174
LIQUID	200	27.564	27.241	31	31.410	16.557	169	26.859	28.755	-4.551	-1.228	0.224
Dependent variables												
MES	200	0.045	0.028	31	0.067	0.041	169	0.041	0.023	-0.026	-3.464	0.002
ES	200	0.063	0.043	31	0.096	0.067	169	0.057	0.034	-0.039	-3.127	0.004

VOL	200	0.441	0.270	31	0.660	0.423	169	0.401	0.210	-0.259	-3.335	0.002

Note: The table presents descriptive statistics for (i) all banks, (ii) SIB and (iii) non-SIB. Mean and Std. Dev. stand for the cross-sectional mean and standard deviation values of the individual bank time-series averages, accordingly. The last three columns report the comparison analysis of bank-specific characteristics between SIB and non-SIB. Difference in means is calculated as the difference between non-SIB and SIB means, in absolute (abs) values, with the t-tests and the corresponding p-values on the equality of means reported in the last column. See Table 1 for variables definition.

Table 8. RE estimates of bank risk on board structure for SIB vs. non-SIB. The effect of board independence.

Variables	MES (1)	ES (2)	VOL (3)
DUMMY_SIB	0.750	0.582	0.678*
INT_DUMMY_SIB_IND	0.170	-0.104	-0.134
IND	-0.039	-0.124*	-0.117*
BS	0.361	0.515**	0.499**
BS_SQ	-0.398*	-0.454***	-0.453***
BM	-0.106*	-0.08*	-0.086*
SIZE	0.210**	-0.001	-0.018
LEV	0.077	0.239**	0.227***
LOANSTA	0.035	0.078	0.062
IMP	0.095	0.169**	0.166**
LIQUID	-0.314*	-0.150	-0.200
MES			
CONS	-0.824***	-0.680***	-0.735***
R- Square (overall)	0.684	0.7158	0.738
Wald χ2 test	335.6	358.34	407.92
Number of banks	36	36	36

Dependent variables: MES, ES and VOL

Notes: The table reports the RE estimates for Model 2. The dependent variables are shown in columns 1, 2 and 3, respectively. See Table 1 for variables definition.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

$$y_{it} = a + b_1 IND_{i,2006} + b_2 BS_{i,2006} + b_3 BS\_SQ_{i,2006} + b_3 BM_{i,2006} + b_4 DUMMY\_SIB_{i,t} + b_5 INT\_DUMMY\_SIB_{i,t}\_IND_{i,2006} +$$
$$+ g_1 SIZE_{i,t} + g_2 LEV_{i,t} + g_3 LOANSTA_{i,t} + g_4 IMP_{i,t} + g_5 LIQUID_{i,t} + d_1 D\_YEAR + d_2 D\_COUNTRY + h_i + u_{i,t}$$

Table 9. RE estimates of bank risk on board structure for SIB vs. non-SIB. The effect of board size.

Variables	**MES** **(1)**	**ES** **(2)**	**VOL** **(3)**
DUMMY_SIB	0.628**	0.651***	0.725***
INT_DUMMY_SIB_BS	0.647**	0.835***	0.851***
BS	0.095	0.140	0.118
BS_SQ	-0.207	-0.18	-0.176
IND	-0.012	-0.105	-0.103
BM	-0.133**	-0.123***	-0.128***
SIZE	0.263***	0.077	0.067
LEV	0.052	0.202**	0.191**
LOANSTA	-0.028	0.030	0.013
IMP	0.073	0.147*	0.145**
LIQUID	-0.444***	-0.340*	-0.385**
MES			
CONS	-0.800***	-0.654***	-0.653***
R- Square (overall)	0.695	0.733	0.738
Wald $\chi 2$ test	339.17	402.99	407.92
Number of banks	36	36	36

Dependent variables: MES, ES, VOL and LEV

Notes: The table reports the RE estimates for Model 2. The dependent variables are shown in columns 1, 2 and 3, respectively. See Table 1 for variables definition.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

$$y_{it} = a + b_1 IND_{i,2006} + b_2 BS_{i,2006} + b_3 BS\_SQ_{i,2006} + b_3 BM_{i,2006} + b_4 DUMMY\_SIB_{i,t} + b_5 INT\_DUMMY\_SIB_{i,t}\_BS_{i,2006}$$
$$+ + g_1 SIZE_{i,t} + g_2 LEV_{i,t} + g_3 LOANSTA_{i,t} + g_4 IMP_{i,t} + g_5 LIQUID_{i,t} + d_1 D\_YEAR + d_2 D\_COUNTRY + h_i + u_{i,t}$$

Table 10. RE estimates of bank risk on board structure for SIB vs. non-SIB. The effect of board meetings

Variables	**MES** **(1)**	**ES** **(2)**	**VOL** **(3)**
DUMMY_SIB	0.862***	0.833***	0.949***
INT_DUMMY_SIB_BM	0.897***	0.901***	0.919***
BM	-0.133***	-0.117***	-0.120***
BS	0.175	0.302	0.280
BS_SQ	-0.267	-0.300*	-0.294*
IND	-0.018	-0.120*	-0.114*
SIZE	0.242***	0.048	0.036
LEV	0.064	0.230**	0.216**
LOANSTA	-0.042	0.016	0.007
IMP	0.082	0.163**	0.158**
LIQUID	-0.486***	-0.352*	-0.398**
MES			
CONS	-0.798***	-0.643***	-0.699***
R- Square (overall)	0.689	0.720	0.742
Wald $\chi 2$ test	326.36	373.24	418.79
Number of banks	36	36	36

Dependent variables: MES, ES, VOL and LEV

Notes: The table reports the RE estimates for Model 2. The dependent variables are shown in columns 1, 2 and 3, respectively. See Table 1 for variables definition.

* Significant at 10%. ** Significant at 5%. *** Significant at 1%

$$y_{it} = a + b_1 IND_{i,2006} + b_2 BS_{i,2006} + b_3 BS\_SQ_{i,2006} + b_3 BM_{i,2006} + b_4 DUMMY\_SIB_{i,t} + b_5 INT\_DUMMY\_SIB_{i,t}\_BM_{i,2006} + \\ + g_1 SIZE_{i,t} + g_2 LEV_{i,t} + g_3 LOANSTA_{i,t} + g_4 IMP_{i,t} + g_5 LIQUID_{i,t} + d_1 D\_YEAR + d_2 D\_COUNTRY + h_i + u_{i,t}$$

Appendix A

Table A.1. List of European banks in our sample

1.Aareal Bank AG	21.Erste Group Bank AG
2.Allied Irish Banks plc	22. HSBC Holdings Plc
3.Azimut Holding SpA	23. ING Groep NV
4.Banca Carige SpA	24. Intesa Sanpaolo
5.Banca Monte dei Paschi di Siena SpA-Gruppo Monte dei Paschi di Siena	25. Jyske Bank A/S (Group)
6. Banco Bilbao Vizcaya Argentaria SA	26. Lloyds Banking Group Plc
7.Banco BPI SA	27. National Bank of Greece SA
8.Banco de Sabadell SA	28. Natixis
9.Banco Espanol de Crédito SA, BANESTO	29. Nordea Bank AB
10. Banco Espirito Santo SA	30. Paragon Group of Companies Plc
11. Banco Santander SA	31. Pohjola Bank plc-Pohjola Pankki Oyj
12. Bank of Ireland-Governor and Company of the Bank of Ireland	32. Raiffeisen Bank International AG
13.Bankinter SA	33. Royal Bank of Scotland Group Plc
14. Barclays Plc	34. Sampo Plc
15.BNP Paribas	35. Schroders Plc
16. Commerzbank AG	36.Skandinaviska Enskilda Banken
17. Crédit Industriel et Commercial - CIC	37. Standard Chartered Plc
18. Credito Emiliano SpA-CREDEM	38. Svenska Handelsbanken
19. Danske Bank A/S	39. Sydbank A/S
20.Deutsche Bank AG	40. UniCredit SpA

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