Strong boards, Ownership concentration and EU banks' systemic risk-taking: evidence from the financial crisis

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Abstract

We examine the effects of board composition and ownership on traditional measures of bank risk and proxies of bank tail and systemic risk. Both banks' corporate governance shortcomings and systemic risk-taking have been recognized among the potential causes of the 2007 financial crisis. Yet, their interaction has received less attention so far. Based on a sample of 40 European banks over the period 2006-2010, we find that the boards 'characteristics affect banks' systemic risk, except for board independence and that this relation depends on capital regulations, banking systems' ownership structures and bank activity restrictions.

Keywords: board composition; bank ownership; systemic risk; financial crisis

JEL classification: G01; G21; G32

1. Introduction

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The role of corporate governance in banking has been highlighted by academics as well as by regulators and policy makers (see e.g. Basle Committee on Banking Supervision, 2010; Organization for Economic Co-operation and Development, 2010). Many academic studies emphasize how flaws in bank governance played a key role in the performance of banks during the crisis (Diamond and Rajan, 2009; Bebchuk and Spamann, 2010, Beltratti and Stulz, 2012). Since the 2007, an increasing number of proposals and initiatives have attempted to identify and mitigate these flaws revealed by the financial crisis (Kirkpatrick, 2009) aiming to promote better corporate governance standards in banking, while recognizing the special nature of banks when compared to other firms. On the other hand, the financial crisis revealed the dramatic impact of excessive risk-taking behaviour of banks on the global financial stability, especially in terms of underestimated consequences of unregulated systemic risk-taking. As the literature has widely investigated poor or weak corporate governance as well as the increasing systemic nature of the banking sector as major causes of the crisis, to the best of our knowledge there is still a limited understanding of the relationship between corporate governance characteristics and banks' incentive to become more expose to systemic risk. As suggested by de Andres and Vallelado (2008), the aim of banking regulators to reduce the runs and their systemic consequences on the stability of the system might come into conflict with the main purpose of shareholders which is to improve the shareholders value by also increasing risk-taking. Taking on risks and tail and systemic risks, in particular, may enhance bank performance in the short run (i.e. by increasing the leverage), but it can cause significant damage to the institution and the whole system when such risks materialize (i.e. fire sales "effects"). During the global financial crisis, European banks exposed themselves to tail and systemic risks in various ways. Among others, the most recent literature has highlighted how European banks' exposures to tail risks in the form of shadow banking activities were later transformed into severe losses on the balance sheets (Acharya et al., 2013: Arteta et al., 2013).

An increase in systemic and tail risks by large banks could be supported by the implicit too-big-to fail guarantee and the reduced market discipline (Acharya et al.,2010). In fact, it could be difficult, both for outsiders and insiders, to distinguish between risk-taking activities that generate high returns and those that offer high returns as compensation for taking tail risk through complex and opaque activities (Ellul and Yerramilli, 2013). In this context, the presence of a strong and independent board of directors may be crucial for the control of tail and systemic risks exposures and could explain the cross-sectional differences across banks in terms of tail and systemic risks. In other words, to the extent that the board plays its own role, we would expect banks with strong boards to be perceived as less risky and then to performed better during the crisis, when the tail risk occurs. Among several corporate governance characteristics, the Basel Committee on Banking Supervision (2006) in its consultative document "Enhancing Corporate Governance of Banking Industry", places the board of directors as an essential part of the bank regulatory reforms. In addition, the Basel Committee emphasizes the role of the board of directors in the implementation of pillar II and, more generally, for whole risk management architecture (Basel Committee on Banking Supervision, 2005, pp. 163–164). This role is important for banks more than for other firms, because of i) the director's fiduciary responsibilities which are extended beyond shareholders to include a wider range of stakeholders, i.e. depositors and regulators (Macey and O'Hara, 2003); ii) the complexity of the banking business: the presence of opaque bank lending activities reduces the ability of shareholders and debt holders to impose effective governance (Levine, 2004); iii) the limited competition, intense regulation and the higher informational asymmetries (de Andres and Vallelado, 2008). Because the board is a key mechanism to monitor managers' behaviour and to advise them on strategy identification and implementation, the directors' specific knowledge of the complexity of the banking business is crucial to perform these roles efficiently. Pathan (2009) defines a 'strong board' (i.e., small board and more independent directors) as a board that is more effective in monitoring bank managers and that reflects more the bank shareholders' interests. He finds that banks with strong governance attributes may take more risk. Although some studies

document a positive association between board size and bank risk behaviour during the financial crisis period (Fortin, 2010; Minton et al., 2010; Adams, 2012; Peni and Vahamaa, 2012), other authors argue that the risk of financial firms vary inversely with the strength of corporate governance (Akhigbe and Martin, 2008; Beltratti and Stulz, 2012; Wang and Hsu, 2013; Faleye and Krishnan, 2015). Erkens et al. (2012) and Berger et al. (2014) find no support for the proposition that board size is related to bank performance, both in terms of profitability and risk during the crisis. Also the growing stream of literature supporting the importance of non-independent directors for corporate boards show mixed results (Adams and Ferreira, 2007; Baranchuck and Dybvig, 2009). The post-crisis literature does not provide much support that board independence is positively related to performance, in terms of risk and profitability (Cornett et al., 2010; Yeh et al., 2011). Both Minton et al. (2010) and Fernandes and Fich (2016) find a not significant relationship between board independence and firm performance, while the empirical results of Aebi et al. (2012), Beltratti and Stulz (2012), Erkens et al. (2012) and Wang and Hsu (2013) show that the presence of independent directors in negatively related to the risk behavior of financial institutions. Since ownership structures may affect bank performance, both in terms of profitability and risk, a recent stream of research on bank risk-taking typically incorporates information on each bank's ownership structure. Also referring to that topic, the pre and post-crisis literature shows mixed results without offering a conclusive view (Gropp and Kohler, 2010; Beltratti and Stulz, 2012; Ellul and Yerramilli, 2012; Erkens et al., 2012; Berger et al., 2014). This heterogeneity of findings suggests that results may vary with the ownership structure under investigation (i.e. insider ownership, institutional ownership, bank ownership, ownership by lower management, ownership by chief officers and outside directors, etc.). In our research we choose to rely on the works by Laeven and Levine (2009) and Beltratti and Stulz (2012). Laeven and Levine (2012) find that banks with concentrated ownership are riskier than banks with dispersed ownership. Moreover, they suggest that the bank ownership structure strongly affects the relation between bank risk and regulation: while stricter regulation decreases the risk of a bank with dispersed ownership, it

increases the risk of a bank with a large controlling shareholder. Therefore, also in line with Beltratti and Stulz (2012), we estimate the ownership of controlling shareholders and control for the effect of bank regulation. To the best of our knowledge, our paper is one of the first studies to analyse the European banks ownership structure, by using a new dataset provided by Garcia-Kuhner et al. (2013).

By using data on 40 large publicly traded European banks, we examine whether and how banks with strong boards and different ownership concentrations are associated with higher systemic and tail risks. Academics and regulators have developed different concepts and proposals in order to assess systemic risk. We choose the measures of risk developed by Acharya et al. (2010), defined as the Marginal Expected Shortfall (MES). Together with the (quasi-) market Leverage ratio (LEV), the MES is the main determinant of the Systemic Expected Shortfall (SES). Next to the MES, we employ the Expected Shortfall (ES) and two traditional measures of risk: the Volatility (VOL), estimated as the annualized daily standard deviation of the stock returns, and the Z-score, that is the distance to default (the higher the Z-score, the lower the probability of default of the bank and thus the risk of a bank failure). Since the summer of 2007, the financial system has faced two severe systemic crises and European banks have been at the centre of both (Acharya and Steffen, 2012). To avoid a confusing effect of the latter crisis, defined as the sovereign crisis, which origins and implications are different from the the former, we decide to focus only on the period of financial turmoil from 2007 to 2010. Moreover, since the previous literature suggests that the bank performance during the crisis is related to the risk behaviour before the crisis, we decide to include in our analysis also the year 2006. We focus on three corporate governance dimensions related to the board composition and functioning: (1) the board size, (2) the board independence, and (3) the frequency of the board meeting per year, measured as of December 2006. We also analyse the ownership concentration by considering the largest shareholder's percentage ownership of the cash flow rights attributable to a bank's total equity. 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 governance mechanism incorporated in the year 2006 is reflected in bank risk-taking during the period 2006-2010.

We find that banks with larger board size and lower number of board meetings per year experience more severe losses than other banks during the crisis, but also that they contribute strongly to the losses of the banking system as a whole, i.e. to the spread of a systemic crisis. On the other hand, the number of independent directors is relevant for our proxy of the probability of bank insolvency. Moreover, we find that differences in banking regulations and ownership across countries are generally correlated with systemic risk taking. In particular, banks headquartered in European countries with i) more restrictions on bank activities, ii) less restriction on capital and iii) more concentrated banking system took more systemic risk during the crisis.

As it is common in studies of corporate governance, endogeneity could bias our results. We take a number of steps to control for it. First, in all our models we control for bank-specific characteristics that are likely to affect risk-taking decisions, such as size, leverage, gross loans, impaired loans, tier 1 and liquid assets (besides year and country dummies). Moreover, our corporate governance proxies are taken at the year preceding our investigated period. To control for the possibility of omitted variable bias we exploit the insight from Altonji et al.(2005), as in Chalermchatvichien et al. (2014), and find that the endogeneity bias is more unlikely in our results.

We contribute to the existing literature in several respects. First, the investigated period allows us to shed a light on the relationship between corporate governance and banks' risk exposures during persistent years of financial distress. Second, with respect to previous and more recent studies on the topic, mainly focusing on the U.S. banks, we are the first who provide insights into European markets. Thirdly, as far as it could be ascertained, this is the first study to employ market-based

systemic and tail risk measures referring to the board effectiveness in monitoring bank managers (i.e. board size, board independence, number of meetings) in a single research, including ownership concentration. 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 the occurrence of banking crises.

The remainder of the paper is organized as follows. In Section 2, we analyse the relevant literature on corporate governance and systemic risk to develop our testable hypotheses. 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. In Section 5, we describe the robustness tests and Section 6 concludes.

2. Related literature and empirical hypotheses

2.1 Corporate governance and bank risk-taking during the financial crisis

Previously, an extensive empirical literature has documented that banks with strong corporate governance mechanism 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). Yet, the existing literature has only partially investigated the relationship between governance and bank risk-taking, since several studies analyse a specific type of risk and governance dimensions, usually focusing on the United States. More recently, empirical papers look at the above-mentioned relationship over periods of financial turmoil, by focusing on the board characteristics (i.e. size, board independence, CEO-chairman duality, financial expertise of directors), the risk management and culture (i.e. existence of board risk committee, presence of the CRO on board, the professional background of the CEO) and the ownership structure. Although

their evidence is not conclusive, their results provide empirical evidences of the following: larger and more diverse boards have sometimes been associated with more risk; the number of the independent directors does not affect risk-taking and, moreover, the results on board financial expertise are mixed; stronger risk management functions and culture are related to less risk; empirical results on the relationship between performance-linked remuneration in the form of options and risk are mixed, even if this kind of compensation tend to be associated with more risk; several studies show a positive association between institutional or insider ownership and bank risk-taking referring to the financial crisis, but the evidence is not conclusive for other periods.

Before moving on the analysis of the various studies, it is worth to notice that only few researches analyze the influence of governance on bank tail and systemic risks during the credit crisis. In particular, we refer to the works by Adams and Ragunathan (2013) and Ellul and Yerramilli (2013). Moreover, we point out that none of these studies focuses on the relationship between the boards effectiveness in monitoring bank managers (i.e. board size, board independence, number of meetings) and ownership concentration, on one hand, and bank tail and systemic risk, on the other hand.

For the purposes of our research, our literature review will focus on the analysis on the most recent and relevant studies, investigating the relationship between both board characteristics and ownership concentration, on one hand, and bank risk-taking, on the other hand, over the financial crisis period.

Referring to the board size, the sample investigated by Adams (2012) compares US banks that were bailed out during the credit crisis with those that were not showing that financial institutions that received TARP support in either 2008 or beginning of 2009 had larger boards than those that did not. By analyzing a sample of US publicly-traded banks with total assets greater than $ 1 billion, Minton et al. (2010) report similar findings, as larger boards are associated with increases in the likelihood of receiving TARP funds. The authors argue that their results on TARP support can be

interpreted differently: on the one hand, receiving TARP money may reflect poor performance, but, on the other hand, TARP funds could also be viewed as a unique opportunity for banks to raise relatively cheap funds during the crisis. If riskier banks were the ones that were bailed out, this implies that financial institutions with larger boards took more risk. However, we specify that these results are not consistent with those reported by Minton et al. (2010) for their non-crisis period, as they find that bank board size is negatively related to risk-taking. Using a sample of large U.S. bank holding companies in the financial crisis period, Fortin et al. (2010) suggest that banks characterized by strong governance mechanisms may take more risk. These results are in line with those of Pathan (2009), who, by analysing a sample composed of 212 large US bank holding companies during the pre-crisis period (1997-2004), finds that a small bank board is associated with more bank risk, proxied by several risk measures (total risk, idiosyncratic risk, systematic risk, assets return risk, Z-score) whereas a high number of independent directors seem to imply less risk exposure by banks. Peni and Vahamaa (2012) find a positive and significant relationship during the 2008 financial crisis for large publicly traded US banks. In particular, they show that banks with stronger corporate governance (small boards and more independent directors) mechanisms have higher profitability, higher market valuations and less negative stock returns amidst the crisis.

Several papers show a negative impact of the board size on bank risk. Akhigbe and Martin (2008) argue that corporate governance is inversely related to bank risk behavior. Beltratti and Stulz (2012) focus on banks in 31 countries and document that large banks with lower leverage ratios have less negative stock returns during the crisis, but also that banks with strong boards perform worse over the period from July 2007 to December 2008 than other banks. Wang and Hsu (2013) investigate the relationship between board composition and operational risk events of 68 U.S. financial institutions in the period from 1996 to 2010. Their findings suggest that board size is negatively and non-linearly associated with the possibility of operational risk events. Faleye and Krishnan (2015) employ three measures of bank risk-taking in lending decisions, namely the borrower's long-term S&P credit rating, the inclusion of financial covenants in loan contracts and the bank's decision to

diversify its lending risk through syndication. Their sample includes 340 bank-years for 80 banks over 1994–2008. They find that banks with smaller boards provide fewer junk loans and are less likely to underwrite speculative loans. The inclusion of financial covenants is not related to board size.

Unlike the results of the previous studies, both Erkens et al. (2012) and Berger et al.(2014) find no support for the proposition that board size is related to bank performance, in terms of profitability and risk during the crisis. In particular, by investigating a dataset composed of 296 large financial firms, including non-banks, across 30 countries during the 2007-2008 turmoil, Erkens et al. show that the relationship between the board size (i.e. number of directors) and their measure of bank risk behavior, proxied by the expected default frequency and the standard deviation of weekly banks' stock returns, is not significant. Likewise, Berger et al.(2014) argue that management structures of US commercial banks, including board size, are not decisive for banks' stability (i.e., propensity to default) during the recent financial crisis. In particular, by focusing on a sample composed of 85 default and 256 no default US commercial banks, they show that the board size is not related to the probability of default of the financial intermediaries.

As we have mentioned before, the post-crisis literature does not provide much support that board independence is positively related to performance. Both Minton et al. (2010) and Fernandes and Fich (2016) find a not significant relationship between board independence and firm performance, while the empirical results of Aebi et al. (2012), Erkens et al. (2012) and Wang and Hsu (2013) show that the presence of independent directors is negatively related to their banks' performance measures. Consistently with the evidence provided by Beltratti and Stulz (2012), who find a negative correlation between board independence and risk-taking, also Erkens et al. (2012) show that firms with more independent boards experience worse stock returns during the crisis, by arguing that this is not caused by higher risk-taking, as board independence is not related to the expected default frequency and stock return volatility. One exception is the study of Cornett et al.

(2010), that explores the relation between several corporate governance mechanisms and bank performance, by analyzing a sample composed of all US publicly-traded bank holding companies, that operate at any time during the 2003 through 2008 period. The authors find that a more independent board is positively related to banks' performance during the crisis period, while the governance variable is not significant before the credit crisis. As highlighted by the empirical findings of Beltratti and Stulz (2012) and Erkens et al. (2012), the post-crisis research show some evidence that board independence is negatively related to risk-taking. Similar results are reported by Minton et al. (2010). Likewise, Faleye and Krishnan (2015) find that board independence reduces the bank's riskiness measured as the borrower's long-term S&P credit rating and the inclusion of financial covenants in loan contracts, but it is not related to the bank's decision to diversify its lending risk through syndication. Finally, Yeh et al. (2011) investigate if the performance during the recent financial crisis is better for financial institutions with more independent directors who sit on board committees. By analyzing data on financial institutions from the G8 countries, their results suggest that independence in auditing and risk committees is positively related to the crisis performance. This effect is particularly significant for civil law countries, which are characterized by poor shareholder protection practices. In addition, these authors find that the positive relationship between committee independence and banks' performance is more relevant for those financial institutions having more excessive risk-taking behaviors.

Since ownership structures may affect bank performance, both in terms of profitability and risk, many post-crisis studies focus on the analysis of this relationship. As outlined by the IMF (2014), in general, institutional ownership is related to less risk-taking, while insider ownership is associated with more risk. However, the IMF study (2014) states that the presence of institutional investors and of large insider ownership correlates with more risk in 2008. The underlying idea is that banks with higher percentage of insider or institutional investors hold a higher fraction of the ownership of the company and reduce their risk exposure, since they have a lot to lose. On the other hand, when

the firm is close to default (as many did in 2008), managers take on more risk, as they have less to lose. Referring to that topic, the post-crisis studies show conflicting results. By analysing an international sample of banks, Beltratti and Stulz (2012) find that ownership by large shareholder is not associated with better performance during the 2007 crisis; however, their evidence shows a positive relationship between manager ownership and the stock performance referring to the same period. The results of Berger et al. (2014) suggest that defaults are strongly influenced by a bank's ownership structure: high shareholdings of lower-level management, such as vice presidents, increase default risk significantly. In contrast, shareholdings of outside directors and chief officers (managers with a "chief officer" position, such as the CEO, CFO, etc.) do not have a direct impact on the probability of failure. By analyzing a sample including 1.100 banks from 25 OECD countries over the period 2000-2008, Gropp and Kohler (2010) report that savings banks suffered larger losses during the crisis than cooperative or mutual banks. Moreover, they find that aligning the interests of managers and shareholders increases banks' risk-taking, measured by the deviation of long term average ROE.

In contrast to these findings, Ellul and Yerramilli (2012) show that banks with higher institutional ownership take less risk as measured by their Risk Management Index (RMI). However, in the presence of deposit insurance, they document the effect reverses and a positive correlation between tail risk and institutional ownership. Erkens et al. (2012) report that financial institutions with more independent boards and higher institutional ownership experience worse stock returns during the crisis period.

2.2 Testable Hypotheses

Based on the prior literature, we focus on the relationship between risk-taking and the following characteristics of the board of directors: the board size, the percentage of independent directors and the frequency of board meetings per year. The board of directors is an economic institution that, in theory, helps to solve the agency problems inherent in managing an organization (Hermalin and

Weisbach, 2003). Hence, the role of the board of directors in the banking industry is to monitor and advise managers. Larger boards of directors could better supervise managers and bring more human capital to advise them. However, boards with too many members may suffer from problems of coordination, control, and flexibility in the decision-making process. Large boards also give excessive control to the CEO, harming efficiency (Yermack, 1996; Eisenberg et al., 1998; Fernández et al., 1997). Therefore, the trade-off between advantages (monitoring and advising) and disadvantages (coordination, control and decision-making problems) has to be taken into account. Given the time horizon we investigate, which is characterized by financial instability, we expect coordination and control functions to gain considerable importance compared to monitoring and advising and thus that small boards are associated with less risk-taking. In particular, we expect this idea to be confirmed by our measures of tail and systemic risks, which refer to extreme conditions of the individual banks and of the market, respectively, whereas the flexibility in decision-making is even more valuable. To summarize, the formal specification of our first hypothesis is the following:

Hypothesis 1 (H_1): Tail and systemic bank risk-taking are positively related to board size.

As we have previously argued, the post-crisis corporate governance literature offers no conclusive evidence on the effect of independent directors on bank risk-taking. Moreover, also the extensive pre-crisis literature on the topic provide mixed results. Independent directors are believed to be better monitors of managers as independent directors value maintaining reputation in directorship market but the findings in this instance are mixed (Fama and Jensen, 1983; Bhagat and Black, 2002). According to Pathan (2009), when the monitoring function is prevalent, we expect a positive link between the presence of independent 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 board independence should only matter for certain board actions, 'particularly those that occur infrequently or only in a crisis situation' (Hermalin and Weisbach 2003, p. 17). However, an excessive proportion of outside directors could damage the advisory role of boards, 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. In other words, insider directors facilitate the transfer of information between board directors and managers (Adams and Ferreira, 2007; Harris and Raviv, 2008; Coles et al., 2008). We assume that a board with more inside directors is perceived as abler to support the managers in the difficult decision-making process needed in extreme market conditions. Thus, the formal specification of our second hypothesis is 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 meeting per year, as a proxy of the better functioning of the board (Vafeas, 1999). It is worth to notice that while in the pre-crisis literature several researches deal with this corporate governance dimension, there are no empirical studies analyzing the relationship between the number of the board meetings and the banks' risk during the financial crisis period. As mentioned by de Andres and Vallelado (2008), 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 (as for the insider directors) both increase the relevance of the board advisory role. By contrast, frequent meetings might also be a result of the board reactions to poor performance. Once again, given our focus on the effect of corporate governance on extreme market conditions, we expect that a higher number of meetings to be perceived as a proxy of a more timely response of the board to the external conditions and thus to be associated with a lower level of tail and systemic risks.

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 turn to analyse the ownership structure effect on bank risk-taking. The empirical evidence of our literature review show conflicting results. Moreover, also referring to this corporate governance dimension, the extensive pre-crisis literature provide mixed results. Laeven and Levine (2009) find that more powerful owners with substantial cash flows have the power and incentives to induce bank's managers to increase risk-taking, in line with the agency theory. The idea is that when a bank has a concentrated share ownership, the tendency of managers (with bank-specific human capital and private benefits of control) to engage in less risky activities may be capped by shareholders (the resulting prediction is a positive relation between ownership concentration and bank risk). Beltratti and Stulz (2012) find that greater shareholder influence through board of directors was not associated with better performance in the period after the 2007 crisis. Contrary to the agency theory, Li and Song (2010) find a negative relation between concentrated ownership and bank insolvency risk. This evidence is consistent with Burkart et al. (1997), who suggest that the monitoring effect exerted by the large shareholders deprives the managers of their private benefits, thereby reducing managerial initiatives.

By assuming that more powerful owners of large banks can exploit greater bargaining power with regulators and governments in the event of a financial distress, we would expect concentrated ownership to be associated with higher systemic and tail risks than banks with dispersed ownership. However, large shareholders can also impose a better monitoring on managers and, more in general, obtain a better insight into the complex and opaque activities, which lead to bear tail and systemic risk. Thus, the formal specification of our fourth hypothesis is as follows:

Hypothesis 4 (H_4): Tail and systemic bank risk-taking are negatively related to ownership concentration.

2.3 Systemic risk measures

The literature on systemic risk is recent and can be broadly separate into those taking a structural approach, using contingent claims analysis of the financial institutions' assets (Lehar, 2005; Gray et al, 2009; Gray and Jobst, 2009), and those taking a reduced-form approach based on the statistical tail behaviour of institutions' asset returns. In particular, referring to the latter strand of the literature, Brunnermeier et al. (2009) claim that a systemic risk measure should identify the risk to the system posed by "individually systemic" institutions, which are so interconnected and large that they can cause negative risk spillover effects on others, as well as by institutions that are "systemic as part of a herd". Adrian and Brunnermeier (2008) refers to the financial sector's Value at Risk (VaR) of a bank as a given VaR loss (CoVaR) by using quantile regressions on asset returns computed by using data on market equity and book value of the debt. Hartmann et al. (2005) use multivariate extreme value theory to estimate the systemic risk in the US and European banking systems. Similarly, De Jonghe (2010) presents estimates of tail betas as a systemic risk measure for a sample of European financial firms. Goodhart and Segoviano (2009) look at how individual firms contribute to the potential distress of the system by using the CDSs of these firms within a multivariate copula setting.

Our research will focus on the systemic risk measure referred to as Marginal Expected Shortfall, proposed by (Acharya et al. 2010). In comparison with other measures of firm-level risk, the MES is the only systemic risk measure based on market data, specifically accounting for extreme events in the left tail. MES has shown a higher predictive power in detecting a bank's contribution to a crisis (Acharya et al. 2010). MES can be defined as the expected equity loss per dollar invested in a particular bank if the overall market declines by a certain amount and it is computed as the average return of each bank during the 5% worst days of the market. We first note that MES has been originally proposed by Tasche (2000) and later used by Yamai and Yoshida (2002). One example of this approach is provided in Engle and Brownlees (2010). They show that the banks with the

highest MES are the banks that contribute the most to the market decline. Therefore, those banks are the most notable candidates to be systemically risky. Equity holders in a bank that is systemically risky will suffer major losses during a financial crisis and, consequently, will reduce positions if a crisis becomes more likely. MES measures this effect and it clearly relies on investors recognizing which bank will do badly in a crisis.

3. Sample, variables and econometric models

In this section, first we describe our sample and the selection strategy we adopt in order to build up it, then we describe and analyse the variables (dependent variables, key independent variables and control variables) of 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 active commercial banks, bank holdings and holding companies headquartered in the European Union over the period 2006-2010. This time period includes the financial crisis but allows us to avoid data inconsistency related to the introduction to Basle II in 2005 and the broke out of the sovereign debt crisis in 2010. The empirical analysis requires data on the banks corporate governance structures, banks and holdings financial information and stock prices, regulatory and macroeconomic information at country-level. In detail, information on bank board structures are hand-collected from the annual reports, the financial information and the data on stock prices and market capitalizations of banks are mostly obtained from Bankscope and from Bloomberg database, respectively. Regulatory and macroeconomic variables are from Caprio et al. (2007) using data in 2007 database (revised in June 2008) downloaded from the World Bank database.

After eliminating the banks with limited market price, financial and/or board-level information, we obtain a sample comprising 40 individual banks and holdings companies and 200 firm-year observations for the fiscal years 2006–2010. In particular, we adopt the following criteria to build up our sample. First, we restrict our sample to commercial banks, bank holdings and holding companies that were publicly traded for the overall analysed period (i.e. 2006-2010) in the European Union. This results in 123 financial firms. Then, we consider only firms with a market capitalization at the end of 2006 greater than EUR 1 million. This because large financial institutions were at the centre of public attention during the financial crisis and, more importantly, the size in terms of total assets is identified as one of the main factors to assess the systemic relevance of a financial institution. This additional limitation reduces our sample to 52 units. Third, we lose 12 firms because they lack of corporate governance information at the end of 2006 (prior to the onset of the crisis).

Data on the ownership concentration of European banks is not readily available in Bankscope, where only current ownership information is reported, but it is not provided on an historical basis. Moreover, the computation of the ultimate shareholders implies the use of other databases because a large portion of European banks is owned by non-financial companies. Garcia-Kuhner et al. (2013) build a database on ownership of European banks. They use the entire universe of Bankscope (DVDs) and Amadeus Top 250,000 to track the ultimate shareholders of European banks. Before tracing back the ultimate shareholders of each bank, they cleaned the database from all those entries where the shareholders are recorded with a generic name ("Institutions", "Management", "Private shareholders") for which they cannot identify a specific individual/ company as a shareholder[1]. When they find that a bank is owned by another company (either financial or non-financial), they identify the owners of that company and so on until they cannot trace back any further. Contrarily to

[1] This is the case for one of the banks in our dataset, i.e. National Bank of Greece SA. The only entry available for this bank is recorded as "Autocontrole", a generic name. Nonetheless, for this bank, they retrieved from an old file the generic name of the shareholder and the corresponding ownership and have included it in the file they sent to us.

Laeven and Levine (2009) they do not impose any threshold (they impose a threshold of 10% in each link along the ultimate control chain). So they retrieve the ultimate shareholders of each bank at any level of ownership. Once they have identified all ultimate shareholders, for each of them they compute the cash flow rights and voting rights. Following Laeven and Levine (2009) we include the data on cash flow rights in our analysis. Despite the small number of individual banks, the amount of total assets of our sample totalled about 15,565,731 million at the end of 2006, this because it covers a substantial proportion of the total amount of banking assets in the European Union by construction.

3.2 Variables

Key independent variables: board variables and ownership

Our key independent variables are the governance variables relating to the definition of strong board and ownership. 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 a small board size, a high percentage of independent directors in the board and a high frequency of board meetings. In detail, we define board size (BS) as the number of directors on the board. Independent directors (IND) is measured as the percentage of independent directors in the board. An independent director has only business relationship 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). This variable takes into account the internal functioning of the board (de Andres and Vallelado, 2008) and how the board operates. Since meetings provide board

members with the chance to come together and discuss on how they wish to monitor managers, we can argue that more frequent meetings imply closer control over managers.

As to our proxy of ownership concentration (CFR), following Leavin and Levine (2009), we construct a dummy variable that assumes a value equal to 0 if the cash-flow rights of the largest ultimate shareholder are less than 10% (the bank is widely-held).

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 four measures of bank risk-taking include Marginal Expected Shortfall (MES), Expected Shortfall (ES), the Volatility (VOL) and the Z-score. All these measures are based on market data but the Z-score.

To allow for comparison with previous studies (see Beltratti and Stulz, 2012; Erkens, 2012), we include the risk measure Volatility (VOL) based on banks market returns over the period 2006-2010. Following Peni and Vahamaa (2011), bank VOL is calculated as the annualized standard deviation of its daily stock returns (R_{it}) for each fiscal year. The daily stock return is calculated as the natural logarithmic of the ratio of equity return series, i.e. $R_{it} = ln\ (P_{it}/P_{it-1})$, where the stock prices are adjusted for any capital adjustment, including dividend and stock splits. VOL captures the overall variability in bank stock returns and reflects the market's perceptions about the risks inherent in the bank's assets, liabilities, and off-balance-sheet positions. Both regulators and bank managers frequently monitor this total risk measure.

Another traditional measure of bank risk used in the literature is the Z-score (e.g., Laeven and Levine 2009), defined as the distance to default, which equals the average of the return on assets (ROA) plus the equity-asset ratio divided by the volatility of ROA. For cross-sectional analysis, the equity asset ratio, average and the volatility of ROA are computed for each bank over the entire

sample period (2006-2010) (Garcia-Kuhnert et al. 2013). It indicates the number of standard deviations that ROA would need to fall in order to exhaust equity and force a bank failure. The distance to default (DD) is closely linked to the probability of default (PD) so that the higher the distance to default, the lower the PD and thus the risk of a bank failure. As Leaven and Levine (2009), we take the natural logarithm of the Z-score, which is normally distributed, to smooth the effect of extreme values.

In order to measure a bank exposure to tail risk, we use the Expected Shortfall (ES). ES is coherent and more robust than Value at Risk (VaR) as largely investigated by the literature on the topic. Moreover, since we investigate the effect of governance structure on risk-taking decisions of banks during the crisis, we want to focus on the tails of the distribution whereas VaR only measures the distribution quantile and disregards extreme loss beyond the VaR level. This means that it fails to take into account the risk referred to as "tail risk". To alleviate the problems inherent in VaR, Artzner et al (1999) propose the use of Expected Shortfall. Starting from the same measure, the Expected Shortfall, but computing it for the overall banking system, Acharya et al. (2010) and Brownlees et Engle (2010) derive the Marginal Expected Shortfall of a bank as the derivative of the market Expected Shortfall with respect to each bank's weight in the market. The main rationale behind the MES with respect to the standard measures of firm-level risk, such as VaR, Beta, 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 (Acharya et al. 2010).

Control variables

Following prior studies, we include in our models a set of control variables in order to account for bank characteristics, differences in terms of regulation across countries and pre-crisis macroeconomic conditions. A first group of control variables measures differences in bank business structure. One of these control variables is bank size (SIZE), which we measure by the natural log

of total bank assets (Pathan, 2009, Peni and Vahamaa, 2012) at the book value. The variable LOANSTA measures differences in banking business model across banks, 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 also add an M&A variable to account for mergers and acquisition over the sample period because they might affect bank governance (Schranz 1993 and Berger et al. 1998). We trace the bank history on Bankscope and identify whether the bank has undergone a major acquisition or merger between 2006 and 2010. The M&A variable is a dummy coded 1 if the bank *i* is involved in an M&A in the analysed year and zero otherwise.

Next to these variables, we include a set of variables that are likely to affect risk-taking decisions. In particular, our proxy of 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) takes into account for the banks credit risk, as it can be considered as a proxy of portfolio quality (Casu et al., 2011). We also include Tier 1 as a proxy of bank capitalisation and the leverage (LEV). In particular, following Acharya et al. (2010), we compute the variable LEV as the quasi-market leverage ratio (quasi-market value of assets divided by market value of equity).

Together with the MES, the quasi-market leverage is the determinant of a bank systemic risk according to Acharya et al. (2009). Differently from the traditional accounting-based measures of leverage, it also takes into account market conditions and deleveraging decisions. To account for country as source of heterogeneity, we include country dummies in our analyses. We also include year dummies to account for time trend over the sample period. The detailed construction of 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	$\frac{\partial ES_\alpha}{\partial y_i} = -E(r_i \mid R \le VaR_\alpha) \equiv MES_\alpha^i$	Dependent variable
ES	Expected Shortfall	$ES_\alpha = -E\left[R \mid R \le -Var_\alpha\right]$	Dependent variable
VOL	Bank returns volatility	Annualized standard deviation of bank daily stock returns	Dependent variable
Ln Z-score	Distance to default	ROA plus equity-total assets ratio/volatility of ROA	Dependent variable
Key independent variables			
BS	Board size	Number of board of directors	H_2: Positive
IND	Independent directors	Percentage of the independent board directors	H_1: Negative
BM	Frequency of board meetings	Number of the meeting held during the fiscal year	H_3: Negative
CFR	Ownership concentration	Cash flow rights of the largest ultimate shareholder. CFR equals zero if the bank is widely held (10% cut-off)	H_4: Negative
Control variables			
M&A	Mergers and Acquisitions	Dummy coded 1 if the bank is involved in a M&A in a year and zero otherwise	Negative
SIZE	Bank size	Ln of Total assets	Positive
LOANSTA	Bank business activity	Loans/ Total assets	Negative
LEV	Quasi-Leverage	Quasi-market value of assets / Market value of equity	Positive
IMP	Bank credit risk	Impaired loans/ Gross loans	Positive
TIER 1	Tier 1 Capital ratio	Core equity capital / Total risk-weighted assets	Positive
LIQUID	Bank liquidity position	Liquid assets/Customer and short term funding	Negative

Notes: This table presents definition, construction, and expected signs on the variables used for the regressions (Model 1). We do not include year and country dummies.

However, the country variables do not take into account that there are similarities among the countries in legal and regulatory aspect. Therefore, in an extended model we add a set of variables related to country-level institutional setting and bank regulation. Following Beltratti and Stulz (2012) and Leaven and Levine (2009), we add PRIVATE MONITORING (an index of monitoring on the part of the private sector of the banking system), RESTRICT (an index of regulatory restriction on bank activities of banks) and CAPITAL (index of regulatory oversight of bank capital). We do not include a variable for deposit insurance because the vast majority of the

European countries have deposit insurance. We also add the GDP at 2006 to control for pre-crisis economic conditions.

Finally, to control for the possibility that the relation between ownership structure and bank risk taking reflects cross-country differences rather than cross-banks differences, we include a country-level variable defined as LARGESHARHOLDER. We obtain this data from Erkens et al. (2012). It is computed, for each country, as the average of a set of dummy variables equal to 1 if a bank in that country has a large owner with direct and indirect voting rights greater than 10%, and 0 otherwise (at December 2006).

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. The mean of the board meetings is 10.425, with a minimum of 1 and a maximum of 36. As to the number of independent directors, in absolute terms, IND varies from 0 to 20, with a mean of 5.925. CFR is on average quite low, but with a high dispersion and a maximum value equal to 73.13.

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 bank stock return (VOL) has a mean of 44.13% during the sample period. Not surprisingly, Table 2 demonstrates that the volatility of bank stocks was extremely high during the crisis. The mean MES and ES (4.46% and 6.33%) are comparable to the ones reported by Acharya and Steffen (2012), considering that we analyse the period 2006-2010, while their research focuses on the period from June 2006 to June 2007. Finally, the Z-score mean is line with Laeven and Levine (2009) but with a lower volatility.

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 -0.5487, which is between the liquidity ratio (LIQUID) and the bank lending activity (LOANSTA).

< Insert Table 3>

3.3 Econometric models

To examine the effects of corporate governance variables on bank risk during the financial crisis and test our four hypotheses, given the literature discussion in section 2, we use panel regressions. We estimate alternative versions of the following panel regression specification:

$$RISK_{i,t} = \beta_0 + \beta_1 IND_{i,2006} + \beta_2 BS_{i,2006} + \beta_3 BS\_SQ_{i,2006} + \beta_4 BM_{i,2006} + \beta_4 CFR_{i,2006} + \beta_5 GDP_{j,2006} + \beta_6 Bank\_controls_{i,t} + \beta_7 Regulation_j + \beta_{78} YEAR_t + \beta_9 COUNTRY_j + \varepsilon_{i,t} \quad (1)$$

where RISK denotes one of the alternative bank risk measures (MES, ES, VOL and Z-score) for bank *i* at time *t*; the β parameters are the estimated coefficients for the constant and each of the independent variables included in the model; IND BS, BM and CFR are our set of corporate governance key independent variables at 2006 as defined in Table 1; GDP at 2006 for each country *j* to control for pre-crisis macroeconomic conditions; *Bank_controls* is a set of time-varying bank specific control variables (M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID); *Regulation* is a set of country-level institutional and regulatory variables (CAPITAL, RESTRICT, PRIVATE MONITORING, LARGE SHAREHOLDERS); YEAR is a dummy variable for fiscal years controlling for the possible change in bank risk over time, and COUNTRY is a dummy variable for each country *j*. Following de Andres and Vallelado (2008), we introduce the board size squared (BS_SQ) to account for nonlinear relation. Throughout the panel regressions, we use standard errors that are corrected for clustering at the bank-level to allow for correlation of error terms within banks. We winsorize all variables at 1%. First, we estimate a parsimonious version of Equation (1) that includes all control variables but country-level institutional and regulatory variables (Model 1). Model 2 includes the full set of our control variables.

4. Results

Tables 4-7 present the results of Pooled OLS estimates of Model 1 and Model 2 regressions, when considering MES, ES, VOL and Z-score as our dependent variable. As mentioned in the previous section, Model 1 is a parsimonious version of Model 2, which excludes country-level institutional and regulatory variables.

< Insert Table 4>

< Insert Table 5>

< Insert Table 6>

< Insert Table 7>

The regression for Model 1 is well-fitted with an overall adjusted R-squared of 50, 62, 61 and 29 percent for MES, ES, VOL and Z-score respectively, while the regressions for Model 2 have an overall adjusted R-squared of 35, 50, 53 and 26 percent for MES, ES, LEV and Z-score, respectively.

As mentioned before, the Z-score is inversely related to the probability of bank insolvency and thus it is expected to have an opposite sign with respect to other measures of risk. More importantly, in order to interpret our results, we remind that the Z-score differs from the other measures of risk used in our analysis because it is based on accounting data at year-end and explicitly accounts for bank default. MES, ES and VOL are computed over a one-year horizon but on a daily basis. VOL and Z-score are the only two variables we have in common with previous studies.

With regards to bank board variables, we find that the coefficient on BS is statistically significant across all measures of bank risk (with a positive sign for MES, ES, VOL and a negative sign for Z-score). This illustrates that after controlling for bank characteristics, a small bank board is associated with less bank risk-taking during the crisis, both in terms of tail risk, systemic risk, stock return volatility, and notably in terms of distance to default. The evidence for the dependent variable VOL 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). The evidence for the Z-score is consistent with Beltratti and Stulz (2012) for a post-crisis period. Overall, this result is consistent with our first hypothesis where we argue that a smaller board should have a greater ability to coordinate and control the managers and in the decision-making process. The positive relationship

(negative for the Z-score) we find suggests that banks with larger boards have higher stock market volatility, but also that they suffer higher losses during a crisis at an individual level but also in terms of contribution to the market losses. This may be because large boards have more difficulties to supervise managers and their initiatives in opaque activities and to overcome conflict of interest within directors and between directors and managers. Moreover, managers could have an incentive to be more linked to the market poor performance, by increasing their systemic risk, to hide their true performance during the crisis. Finally, large boards of complex and interconnected bank could address shareholders willing to increase exposure to this risk because they believe in a government bailout to avoid systemic banking crises.

Our results show a significant inverted U-shaped relation between board size (BS) and our risk measures. This suggests that the addition of new directors is positively related to bank's risk-taking, although the increase in risk shows a diminishing marginal growth. Thus, the significant coefficient of BS_SQ shows that there is a point at which adding a new director reduces bank risk-taking. Following de Andres and Vallelado (2008), we conclude that the benefits deriving from the inclusion of more directors in terms of a better monitoring and advising function to the board is only effective when the number of directors became larger as to outweigh the cost in terms of coordination, control and decision problems.

Regarding the proportion of independent directors, we find an interesting result. When we add the control variables related to the institutional and regulatory setting, we find no support for our second hypothesis: board independence is not associated with bank risk, except for Z-score. This result is partially in line with Erkens et al. (2012) for VOL. For the Z-score, we find a positive and significant coefficient: banks with more independent directors had a lower probability of default during the crisis. Overall, this finding is in line with the idea that the role of independent directors is valuable during distressed market conditions (as argued by Hermalin and Weisbach, 2003) but with less effect on daily market perception.

In addition, we observe that the influence of the independent directors on the other market-based measures of bank risk (VOL and ES) weakens in economies with stricter restrictions on bank activities but weaker restrictions on bank capital. More in general, we find that the index on restrictions of bank activities is positively and significantly related to the bank systemic and tail risk-taking during the crisis. This is generally in line with Barth, Caprio, and Levine (1999) showing that the banking system is more fragile in countries where banking activities are more restricted. In addition, we find that weaker restriction on capital regulation is associated with more systemic bank risk (negative and significant coefficient). The interpretation supportive of this result is that European banks, in need of capital and liquidity, were involved in off-balance banking activities before and after the crisis, exposing them to systemic risks, also for capital arbitrage purposes as suggested by Acharya et al. (2013). Moreover, this finding is consistent with Leaven and Levine (2009). They argue that stricter capital regulation has an opposite effect in widely held bank (less risk) than in banks with concentrated ownership (more risk). They estimate an average CFR for an international sample of banks equals to 0.27, while Beltratti and Stulz (2012) estimate an average CFR equals 0.23 for the US. Our sample of large European banks has an average of CFR equals to 12.2. The coefficient of CFR is negative in all regressions, but weakly significant only for the MES. However, our country-level variable for bank ownership, LARGESHAREHOLDERS, is positive and significant for all bank risk measures. In other words, the banking system ownership structure more than individual bank ownership concentration is associated with more systemic risk.

We find a negative relation between the number of board meetings (BM) and bank risk-taking. The coefficient of BM is negative for all measures of risk and statistically significant, except for Z-score. This result supports our third hypothesis that a high frequency of bank board meetings means that the board plays a more proactive role than reactive, and thus is associated with less tail and systemic risk.

The coefficients on the other bank characteristics all have the expected sign and offer some significant insights. For instance, we observe that the LEV is positively associated with all bank risk measures. This is consistent with the tendency to consider the leverage, together with MES, as one of the main conditions used to identify systemically important risky banks (Acharya and Steffen, 2012) and as a major concern of the risk management at individual bank-level. Finally, we find coherent sign and significant coefficients for our proxy of bank capital (TIER1), credit risk and (funding) liquidity risk, IMP and LIQUID. As expected, we find that the bank exposures on these two risks were among the main drivers of bank risk during the financial crisis.

5. Robustness tests and endogeneity issues

When the unobserved effect is correlated with independent variables, pooled OLS estimations produces estimators that are biased and inconsistent (de Andres and Vallelado, 2008). Our secondary 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, BM and CFR 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 (40 financial firms over 5 years), 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. GLS RE, is proposed here.

Table 8 presents the results of GLS RE estimates of regression of Equation (1) when either MES, ES, VOL and Z-score is the dependent variable. Our results remain qualitatively unchanged.

< Insert Table 8>

Referring to the endogeneity concern, we underline that it is a common issue in governance studies that makes interpretation of the results 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. In our analysis, risk-taking might determine bank governance. Given that there is no empirical method that can eliminate endogeneity from the results, we take two steps to minimize the possibility that our results are biased. As to the reverse causality, we relate bank corporate governance variables in the earliest year of the sample (2006) to bank risk in the subsequent years, as in many governance studies (e.g. Erkens et al., 2012; Beltratti and Stulz, 2012; Chalermchatvichien et al. 2014).

In addition, the relation may be spurious because our corporate governance variables and the risk-taking measures are jointly determined by a third unobservable bank characteristic. Following Chalermchatvichien et al. (2014), we use the Altonji ratio (Altonji et al., 2005) to estimate the potential bias generated by unobservables. In particular, the ratio calculates how large selection on unobservables would need to be in order to attribute the entire effect (OLS estimates) to selection bias.

Table 9 presents our estimates of the Altonij ratio for MES. To compute the ratio we run a restricted model for each key independent variable where we add only the year dummies. Next, we use the coefficient from the restricted model and the full model to compute the ratio. Analytically, it is the ratio between the coefficient of the full model and the difference between the coefficients of the restricted and the full model.

< Insert Table 9>

We find that selection on unobservables would need to be 1.6, 2.3, 6.6 and 3 times stronger than selection on observables in the case of board independence (IND), board size (BS), number of board meetings (BM) and cash flow rights (CFR). For comparison, Altonij et al. (2005) report the ratios of 1.43 and 3.55 and argue that with those numbers the endogeneity bias due to possible omitted variables is unlikely. Therefore, we can also argue that the endogeneity bias is unlikely in our sample.

6. Conclusions

Our research on the relationship between corporate governance and tail and systemic risk measures, as the Expected Shortfall and the Marginal Expected Shortfall, yields a number of interesting findings. We provide empirical evidence on how corporate governance influences the risk taking of banks, as shown for a sample of European banks during the crisis. We find that banks with larger boards size and lower number of board meetings per year suffered more severe losses than other banks, but also that they contributed more to the losses of the banking system as a whole. Overall, our results confirm the crucial role of the board of directors in the banking business and its potential impact on one of the specialness of it, i.e. the potential to create disruptions able to spread across the entire financial system. We suggest that our results could contribute to the current debate on corporate governance standards in the banking industry and also banking regulation and supervisions when designing tools to prevent bank failure and contagion effects. We believe that our focus on the European banking system does not limit the generalization of our results to our financial and banking systems because of convergence of corporate governance, regulatory and supervisory standards at international level. In fact, we do find evidence of the effect of country-level characteristics on banks' systemic risk-taking as the effect of the regulation (on capital and bank activities) and of the banking systems' ownership concentration. Further research could

explore how recent changes in corporate governance standards and banking regulations may have affect this relationship and extend the analysis to an international sample of banks.

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Table 2. Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Panel A: key independent variables					
BS (No)	200	13.45	5.2522	4	31
BM (No)	200	10.425	6.2883	1	36
IND (No)	200	5.925	4.4405	0	20
CFR (%)	200	9.9714	20.2950	0	73.13
Panel B: control variables					
Bank characteristics					
M&A	200	0.095	0.2940	0	1
SIZE (ln)	200	12.0129	1.6886	7.1356	14.7659
LOANSTA (%)	193	52.7433	18.2000	0.0331	92.2778
LEV (%)	200	32.318	48.5512	1.7901	435.4532
IMP (%)	178	3.2998	2.6127	0.19	12.94
TIER 1 (%)	185	9.1171	2.1361	4.3	14.8
LIQUID (%)	196	47.0270	47.7212	6.78	441.82
Macroeconomic variables					
GDP (ln)	200	4.5547	0.1050	4.2802	4.7184
Bank regulation					
CAPITAL	200	5.675	1.9592	2	9
RESTRICT	200	8.275	2.7178	4	12
PRIVATE MONITORING	200	6.825	0.8649	4	8
LARGESHARHOLDER	200	0.7	0.4594	0	1
Panel C: dependent variables					
MES	200	0.0446	0.0282	0.00004	0.1763
ES	200	0.0633	0.0428	0.0150	0.2680
VOL	200	0.4413	0.2705	0.1179	1.7177
Z-score (ln)	200	2.8732	0.8205	-0.4309	4.6261

Notes: This table contains the descriptive statistics of the key independent variables, the board variables (IND, BS and BM) and ownership (CFR), (Panel A), the control variables (Panel B) and the dependent variables (Panel C); referring to Panel C, we specify that MES is the marginal expected shortfall of a stock given that the *market return* is below its 5^{th} percentile, ES is the expected shortfall of an individual firm below its 5th-percentile; VOL is the annualized daily individual stock return volatility and Z-score is computed as the natural logarithm of Z = {[mean (ROA) + (Equity/Total assets)] /volatility (ROA)}. Key independent variables, bank regulation variables and macroeconomic variables are computed using data at year end 2006. See Table 1 for variables definitions.

Table 3. Correlation matrix

	BS	BM	IND	CFR	CAPITAL	RESTRICT	PRIVATE MONITORING	LARGE SHAREHOLDER	M&A	SIZE	LOANSTA	LEV	TIER 1	IMP	LIQUID	GDP
BS	1															
BM	-0.07	1														
IND	0.46*	0.041	1													
CFR	-0.28*	0.13	-0.04	1												
CAPITAL	0.02	-0.09	0.03	-0.12	1											
RESTRICT	0.19	0.27*	0.15	0.23	-0.27*	1										
PRIVATE MONITORING	0.13	0.01	0.24	-0.30*	0.35*	-0.18	1									
LARGE SHAREHOLDER	-0.28*	0.10	-0.07	0.13	0.23	0.35*	-0.28*	1								
M&A	0.06	0.20	0.23	-0.03	-0.02	0.21	0.02	0.08	1							
SIZE	0.21	0.10	0.17	-0.23	0.21	-0.33*	0.14	0.04	0.16	1						
LOANSTA	0.08	0.06	0.07	0.13	-0.07	0.18	0.05	-0.05	-0.01	-0.28*	1					
LEV	0.04	0.00	-0.19	-0.07	-0.15	-0.12	0.08	-0.28*	0.02	0.23	-0.06	1				
TIER 1	-0.17	-0.15	-0.13	-0.04	-0.08	-0.20	-0.06	-0.09	-0.21	0.01	-0.34*	0.01	1			
IMP	0.02	0.14	0.20	0.04	-0.19	0.02	-0.05	-0.22	0.26	0.17	0.01	0.27*	0.21	1		
LIQUID	-0.14	-0.05	-0.15	-0.01	-0.01	0.10	0.01	0.02	0.00	-0.21	-0.53*	-0.10	0.11	-0.14	1	
GDP	-0.38*	0.08	-0.31*	-0.03	-0.52*	-0.37*	-0.14	-0.34*	-0.10	0.11	-0.18	0.23	0.25	-0.01	0.05	1

Notes: The table shows Pearson pairs-wise correlation matrix for all the independent variables. IND is the proportion of the independent board directors; BS is the number of boards of directors; BM is the number of the meetings held by the board during the fiscal year; CRF is a dummy variable which assumes a value equal to 1 if the cash-flow rights of the largest ultimate shareholder is greater than 10% and 0 otherwise (cut-offs at 10%); CAPITAL is an index of regulatory oversight of bank capital; RESTRICT is an index of regulatory restrictions on the activities of banks; PRIVATE MONITORING is an index of monitoring on the part of the private sector; LARGE SHAREHOLDER is the country average of a dummy variable equal to 1 if a bank has a large owner with direct and indirect voting rights greater than 10%, and 0 otherwise (at December 2006); M&A is a dummy variable accounting for merger and acquisitions activities for each bank in each country; SIZE is the natural logarithm of total assets; LOANSTA is loans to total assets at book value; LEV is measured as quasi-market value of assets divided by market value of equity, where quasi-market value of assets is book value of assets - book value of equity + market value of equity; IMP is the ratio of impaired loans to gross loans as a proxy of portfolio quality; TIER1 is the ratio of Tier 1 capital to risk-weighted assets; LIQUID is measured by the ratio of liquid assets to customer and short term funding; GDP is the natural logarithm of real domestic product per capita for 2006. * significant at 5%.

Table 4. Model 1 and Model 2: OLS estimates of MES

OLS regressions - Dependent variable MES	MODEL 1			MODEL 2		
	Coefficients	**Sig (p-value)**	**Robust standard errors**	**Coefficients**	**Sig (p-value)**	**Robust standard errors**
Key independent variables						
IND	-0.0334	0.671	0.0781	-0.0926	0.239	0.0773
BS	0.3826*	0.095	0.2233	0.3881**	0.026	0.1668
BS_SQ	-0.3676*	0.076	0.2014	-0.2411*	0.098	0.1586
BM	-0.1487***	0.007	0.0521	-0.1522***	0.002	0.0459
CFR	-0.0158	0.823	0.0699	-0.0058*	0.068	0.0031
Control variables						
M&A	-0.0068	0.955	0.1191	-0.0792	0.497	0.1154
SIZE	0.1806**	0.040	0.0847	0.0688	0.474	0.0951
LOANSTA	-0.1514	0.197	0.1150	-0.2288	0.214	0.1809
LEV	0.2549***	0.002	0.0780	0.4205***	0.000	0.0722
IMP	0.1503**	0.036	0.0688	0.1887	0.119	0.1180
TIER 1	-0.0074	0.923	0.0768	0.2047**	0.036	0.0938
LIQUID	-0.3147**	0.018	0.1266	-0.4317**	0.024	0.1828
GDP	0.1179*	0.060	0.0607	0.2334*	0.065	0.1227
CAPITAL				-0.4287**	0.021	0.1775
RESTRICT				0.3055**	0.015	0.1192
PRIVATE MONITORING				-0.1668*	0.066	0.0879
LARGE SHAREHOLDER				0.4546**	0.027	0.1971
COUNTRY DUMMIES		Included			Included	
YEAR DUMMIES		Included			Included	
CONS	-0.6315***	0.000	0.0825	-2.1707***	0.000	0.1984
Adj - R^2	0.4035			0.3531		
Number of obs.	178			178		

Dependent variable - Model 1 and Model 2: MES

Notes: The table reports OLS estimates of Model 1 and Model 2 with the standard error adjusted for clustering at the bank-level. MES is the marginal expected shortfall of a stock given that the *market return* is below its 5th percentile. Model 1 is the parsimonious model, in which the explanatory variables are IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID e GDP. IND is the proportion of the independent board directors; BS is the number of boards of directors; BM is the number of the meetings held by the board during the fiscal year; CRF is a dummy variable which assumes a value equal to 1 if the cash-flow rights of the largest ultimate shareholder is greater than 10% and 0 otherwise (cut-offs at 10%); M&A is a dummy variable accounting for merger and acquisitions activities for each bank in each country; SIZE is the natural logarithm of total assets; LOANSTA is loans to total assets at book value; LEV is measured as quasi-market value of assets divided by market value of equity, where quasi-market value of assets is book value of assets - book value of equity + market value of equity; IMP is the ratio of impaired loans to gross loans as a proxy of portfolio quality; TIER1 is the ratio of Tier 1 capital to risk-weighted assets; LIQUID is measured by the ratio of liquid assets to customer and short term funding; GDP is the natural logarithm of real

domestic product per capita for 2006. Model 2 is the full model, in which the explanatory variables are: IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID, GDP, CAPITAL, RESTRICT, PRIVATE MONITORING AND LARGE SHAREHOLDER. CAPITAL is an index of regulatory oversight of bank capital; RESTRICT is an index of regulatory restrictions on the activities of banks; PRIVATE MONITORING is an index of monitoring on the part of the private sector; LARGE SHAREHOLDER is the country average of a dummy variable equal to 1 if a bank has a large owner with direct and indirect voting rights greater than 10%, and 0 otherwise (at December 2006); all regressions include year and country dummies; all variables, except for the dummies, are winsorized at 1%.
* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Table 5 . Model 1 and Model 2: OLS estimates of ES

OLS regressions - Dependent variable ES	**MODEL 1**			**MODEL 2**		
	Coefficients	**Sig (p-value)**	**Robust standard errors**	**Coefficients**	**Sig (p-value)**	**Robust standard errors**
Key independent variables						
IND	-0.1120*	0.057	0.5689	-0.0732	0.232	0.0602
BS	0.4731**	0.016	0.1871	0.4065**	0.047	0.1979
BS_SQ	-0.3570**	0.025	0.1528	-0.2147*	0.098	0.1587
BM	-0.1164**	0.015	0.0453	-0.1413***	0.004	0.0453
CFR	0.0273	0.660	0.0616	-0.0408	0.513	0.0618
Control variables						
M&A	-0.1498	0.242	0.1259	-0.1320	0.177	0.0958
SIZE	-0.0074	0.933	0.0875	-0.0530	0.51	0.0797
LOANSTA	-0.0944	0.471	0.1295	0.0217	0.854	0.1167
LEV	0.4025***	0.000	0.0802	0.5607***	0.000	0.0709
IMP	0.2521***	0.000	0.0603	0.2751**	0.013	0.1052
TIER 1	0.0407	0.615	0.0802	0.2154**	0.021	0.0888
LIQUID	-0.2963**	0.046	0.1432	-0.3090**	0.033	0.1389
GDP	0.1320***	0.007	0.0462	0.2318*	0.066	0.1220
CAPITAL				-0.3051*	0.053	0.1522
RESTRICT				0.2132	0.371	0.2353
PRIVATE MONITORING				-0.1042	0.177	0.0757
LARGE SHAREHOLDER				0.3064***	0.002	0.0896
COUNTRY DUMMIES		Included			Included	
YEAR DUMMIES		Included			Included	
CONS	-0.4389***	0.000	0.0700	-1.7238***	0.000	0.1618
Adj - R^2	0.6162			0.5051		
Number of obs.	178			178		

Dependent variable - Model 1 and Model 2: ES

Notes: The table reports OLS estimates of Model 1 and Model 2 with the standard error adjusted for clustering at the bank-level. ES is the expected shortfall of an individual firm below its 5th-percentile. Model 1 is the parsimonious

model, in which the explanatory variables are IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID e GDP. IND is the proportion of the independent board directors; BS is the number of boards of directors; BM is the number of the meetings held by the board during the fiscal year; CRF is a dummy variable which assumes a value equal to 1 if the cash-flow rights of the largest ultimate shareholder is greater than 10% and 0 otherwise (cut-offs at 10%); M&A is a dummy variable accounting for merger and acquisitions activities for each bank in each country; SIZE is the natural logarithm of total assets; LOANSTA is loans to total assets at book value; LEV is measured as quasi-market value of assets divided by market value of equity, where quasi-market value of assets is book value of assets - book value of equity + market value of equity; IMP is the ratio of impaired loans to gross loans as a proxy of portfolio quality; TIER1 is the ratio of Tier 1 capital to risk-weighted assets; LIQUID is measured by the ratio of liquid assets to customer and short term funding; GDP is the natural logarithm of real domestic product per capita for 2006. Model 2 is the full model, in which the explanatory variables are: IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID, GDP, CAPITAL, RESTRICT, PRIVATE MONITORING AND LARGE SHAREHOLDER. CAPITAL is an index of regulatory oversight of bank capital; RESTRICT is an index of regulatory restrictions on the activities of banks; PRIVATE MONITORING is an index of monitoring on the part of the private sector; LARGE SHAREHOLDER is the country average of a dummy variable equal to 1 if a bank has a large owner with direct and indirect voting rights greater than 10%, and 0 otherwise (at December 2006); all regressions include year and country dummies; all variables, except for the dummies, are winsorized at 1%.
* Significant at 10%. ** Significant at 5%. *** Significant at 1%

Table 6 . Model 1 and Model 2: OLS estimates of VOL

OLS regressions - Dependent variable VOL	**MODEL 1**			**MODEL 2**		
	Coefficients	**Sig (p-value)**	**Robust standard errors**	**Coefficients**	**Sig (p-value)**	**Robust standard errors**
Key independent variables						
IND	-0.1285**	0.026	0.0553	-0.0614	0.271	0.0548
BS	0.5014**	0.013	0.1911	0.3267**	0.022	0.1362
BS_SQ	-0.3974**	0.014	0.1537	-0.2549**	0.056	0.1291
BM	-0.1160**	0.014	0.0450	-0.1516***	0.000	0.0376
CFR	- 0.0332	0.587	0.0607	-0.0204	0.684	0.0497
Control variables						
M&A	-0.1448	0.226	0.1174	-0.1279	0.186	0.0949
SIZE	-0.0082	0.928	0.0900	-0.0543	0.423	0.0670
LOANSTA	-0.1561	0.261	0.1368	-0.1405	0.244	0.1186
LEV	0.4032***	0.000	0.0832	0.5275***	0.000	0.0681
IMP	0.2477***	0.000	0.0525	0.3404***	0.000	0.0873
TIER 1	0.0503	0.534	0.0802	0.2598***	0.006	0.0896
LIQUID	-0.3930**	0.026	0.1688	-0.3090**	0.035	0.1405
GDP	0.1095**	0.034	0.0496	0.5611***	0.000	0.0999
CAPITAL				-0.7536***	0.000	0.1784
RESTRICT				1.4680***	0.000	0.3225
PRIVATE MONITORING				0.0733	0.225	0.0594
LARGE SHAREHOLDER				0.6633***	0.000	0.0966
COUNTRY DUMMIES		Included			Included	
YEAR DUMMIES		Included			Included	

CONS	-0.4599***	0.000	0.0792	-1.3983***	0.000	0.1540
Adj - R^2	0.6132			0.5395		
Number of obs.	178			178		

Dependent variable - Model 1 and Model 2: VOL

Notes: The table reports OLS estimates of Model 1 and Model 2 with the standard error adjusted for clustering at the bank-level. VOL is the annualized daily individual stock return volatility. Model 1 is the parsimonious model, in which the explanatory variables are IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID e GDP. IND is the proportion of the independent board directors; BS is the number of boards of directors; BM is the number of the meetings held by the board during the fiscal year; CRF is a dummy variable which assumes a value equal to 1 if the cash-flow rights of the largest ultimate shareholder is greater than 10% and 0 otherwise (cut-offs at 10%); M&A is a dummy variable accounting for merger and acquisitions activities for each bank in each country; SIZE is the natural logarithm of total assets; LOANSTA is loans to total assets at book value; LEV is measured as quasi-market value of assets divided by market value of equity, where quasi-market value of assets is book value of assets - book value of equity + market value of equity; IMP is the ratio of impaired loans to gross loans as a proxy of portfolio quality; TIER1 is the ratio of Tier 1 capital to risk-weighted assets; LIQUID is measured by the ratio of liquid assets to customer and short term funding; GDP is the natural logarithm of real domestic product per capita for 2006. Model 2 is the full model, in which the explanatory variables are: IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID, GDP, CAPITAL, RESTRICT, PRIVATE MONITORING AND LARGE SHAREHOLDER. CAPITAL is an index of regulatory oversight of bank capital; RESTRICT is an index of regulatory restrictions on the activities of banks; PRIVATE MONITORING is an index of monitoring on the part of the private sector; LARGE SHAREHOLDER is the country average of a dummy variable equal to 1 if a bank has a large owner with direct and indirect voting rights greater than 10%, and 0 otherwise (at December 2006); all regressions include year and country dummies; all variables, except for the dummies, are winsorized at 1%.
* Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Table 7. Model 1 and Model 2: OLS estimates of Z-score.

OLS regressions - Dependent variable Z-score	**MODEL 1**			**MODEL 2**		
	Coefficients	**Sig (p-value)**	**Robust standard errors**	**Coefficients**	**Sig (p-value)**	**Robust standard errors**
Key independent variables						
IND	0.3737***	0.004	0.1208	0.3434*	0.068	0.1826
BS	-0.8943***	0.007	0.3140	-0.9462***	0.002	0.2893
BS_SQ	0.09251***	0.002	0.2701	0.9086***	0.001	0.2584
BM	0.1070	0.241	0.0898	-0.0877	0.148	0.0594
CFR	0.0678	0.533	0.1077	0.1646	0.260	0.1439
Control variables						
M&A	-0.0530	0.770	0.1804	-0.0525	0.747	0.1617
SIZE	-0.0189	0.911	0.1676	0.1655	0.532	0.2619
LOANSTA	-0.1470	0.661	0.3327	-0.1873	0.604	0.3576
LEV	-0.4019***	0.001	0.1052	-0.2121**	0.038	0.0981
IMP	-0.1369	0.260	0.1197	0.0790	0.558	0.1335
TIER 1	0.0165	0.880	0.1083	0.0482	0.631	0.0995
LIQUID	0.0084	0.985	0.4546	-0.2440	0.585	0.4430

GDP	-0.1624*	0.100	0.1309	-0.0055*	0.096	0.2421
CAPITAL				-0.1657	0.746	0.5074
RESTRICT				1.0673	0.194	0.8056
PRIVATE MONITORING				-0.0280	0.864	0.1627
LARGE SHAREHOLDER				0.2913	0.180	0.2131
COUNTRY DUMMIES		Included			Included	
YEAR DUMMIES		Included			Included	
CONS	-0.2610*	0.094	0.1518	-0.5822*	0.100	0.3510
Adj - R^2	0.2871			0.2613		
Number of obs.	178			178		

Dependent variable - Model 1 and Model 2: Z-score

Notes: The table reports OLS estimates of Model 1 and Model 2 with the standard error adjusted for clustering at the bank-level. Z-score is computed as the natural logarithm of Z = {[mean (ROA) + (Equity/Total assets)] /volatility (ROA)}. Model 1 is the parsimonious model, in which the explanatory variables are IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID e GDP. IND is the proportion of the independent board directors; BS is the number of boards of directors; BM is the number of the meetings held by the board during the fiscal year; CRF is a dummy variable which assumes a value equal to 1 if the cash-flow rights of the largest ultimate shareholder is greater than 10% and 0 otherwise (cut-offs at 10%); M&A is a dummy variable accounting for merger and acquisitions activities for each bank in each country; SIZE is the natural logarithm of total assets; LOANSTA is loans to total assets at book value; LEV is measured as quasi-market value of assets divided by market value of equity, where quasi-market value of assets is book value of assets - book value of equity + market value of equity; IMP is the ratio of impaired loans to gross loans as a proxy of portfolio quality; TIER1 is the ratio of Tier 1 capital to risk-weighted assets; LIQUID is measured by the ratio of liquid assets to customer and short term funding; GDP is the natural logarithm of real domestic product per capita for 2006. Model 2 is the full model, in which the explanatory variables are: IND, BS, BS_SQ, BM, CFR, M&A, SIZE, LOANSTA, LEV, IMP, TIER 1, LIQUID, GDP, CAPITAL, RESTRICT, PRIVATE MONITORING AND LARGE SHAREHOLDER. CAPITAL is an index of regulatory oversight of bank capital; RESTRICT is an index of regulatory restrictions on the activities of banks; PRIVATE MONITORING is an index of monitoring on the part of the private sector; LARGE SHAREHOLDER is the country average of a dummy variable equal to 1 if a bank has a large owner with direct and indirect voting rights greater than 10%, and 0 otherwise (at December 2006); all regressions include year and country dummies; all variables, except for the dummies, are winsorized at 1%.

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

Table 8. Random effects (RE) - GLS estimates of MES, ES, VOL and Z-score

Measures of risk	MES	ES	VOL	Z-score
	(1)	(2)	(3)	(4)
Key independent variables				
IND	-0.0930	-0.0506	-0.0617	0.9134**
BS	0.4118**	0.3632**	0.3295*	-0.4138*
BS_SQ	-0.2530*	-0.2395*	-0.2562*	0.6182*
BM	-0.1539**	-0.1394***	-0.1518***	-0.0181
CFR	-0.1206*	-0.0445	-0.0203	0.0122
Control variables				
Bank characteristics				
M&A	-0.0850	-0.1237	-0.1286	0.0060
SIZE	0.0758	-0.0575	-0.0549	-0.1384
LOANSTA	-0.2018	-0.0298	-0.1398	0.2984***
LEV	0.4242***	0.5620***	0.5273***	-0.0498***
IMP	0.1866	0.2950**	0.3421***	0.0705***
TIER1	0.2089*	0.2269***	0.2603***	0.0645***
LIQUID	-0.4714**	-0.2724	-0.3137*	0.0427
Macroeconomic variables				
GDP	0.2581*	0.2878**	0.2608**	-0.1172***
Other control variables	Included	Included	Included	Included
COUNTRY DUMMIES	Included	Included	Included	Included
YEAR DUMMIES	Included	Included	Included	Included
CONSTANT	-2.1990***	-1.3984***	-1.3311***	-1.0259**

R- Square (overall)	0.6854	0.6935	0.7142	0.6422
Wald $\chi 2$ test	347.09	429.35	453.26	279.23
Number of Obs.	178	178	178	178

Notes: The table reports RE-GLS estimates of Model 2 with the standard error adjusted for clustering at the bank-level. The dependent variables are MES, ES, VOL and Z-score. MES (Column 1) is the marginal expected shortfall of a stock given that the *market return* is below its 5th percentile; ES (Column 2) is the expected shortfall of an individual bank below its 5th-percentile; VOL (Column 3) is the annualized daily individual stock return volatility; Z-score (Column 4) is computed as the natural logarithm of Z = {[mean (ROA) + (Equity/Total assets)] /volatility (ROA)}. Among independent variables, IND is the proportion of the independent board directors; BS is the number of boards of directors; BM is the number of the meetings held by the board during the fiscal year. As to control variables, the M&A variable is a dummy variable accounts for merger and acquisitions activities for each bank in each country. SIZE is the natural logarithm of total assets; LOANSTA is loans to total assets at book value; LEV is measured as quasi-market value of assets divided by market value of equity, where quasi-market value of assets is book value of assets - book value of equity + market value of equity; IMP is the ratio of impaired loans to gross loans as a proxy of portfolio quality; TIER1 is the ratio of Tier 1 capital to risk-weighted assets and LIQUID is measured by the ratio of liquid assets to customer and short term funding. GDP is the natural logarithm of real domestic product per capita for 2006 (as in Beltratti and Stulz (2012)). The bank regulation variables are from Caprio, Laeven, and Levine (2007) using data in the 2007 database (revised in June 2008) downloaded from the World Bank. CAPITAL is an index of regulatory oversight of bank capital; RESTRICT is an index of regulatory restrictions on the activities of banks and PRIVATE MONITORING is an index of monitoring on the part of the private sector. The LARGE SHAREHOLDER variable is from Erkens et al. (2012) and it is the country average of a dummy variable equal to 1 if a bank has a large owner with direct and indirect voting rights greater than 10%, and 0 otherwise (at December 2006). All regressions include year and country dummies. All variables, except for the dummies, are winsorized at 1%.

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

Table 9. Altonji ratio for MES

	RM_1 (1)	RM_2 (2)	RM_3 (3)	RM_4 (4)	FM (5)
Key independent variables					
IND	-0.0347				-0.0926
BS		0.5537**			0.3881
BS_SQ		-0.5678***			-0.2411
BM			-0.1292**		-0.1522
CFR				-0.0039*	-0.0058
Control variables					
Bank characteristics					
M&A					-0.0792
SIZE					0.0688
LOANSTA					-0.2288
LEV					0.4205***
IMP					0.1887
TIER1					0.2047**
LIQUID					-0.4317**

Other Control variables					Included
COUNTRY DUMMIES					Included
YEAR DUMMIES	Included	Included	Included	Included	Included
CONSTANT	-0.8189***	-0.8189***	-0.8189***	-0.8189***	-2.1707***
Adj - R^2	0.3745	0.3842	0.3923	0.3802	0.3531
Altonji ratio	-1.60014	2.34356 (BS)	-6.61452	-3.0333	
Number of obs.	178	178	178	178	178

Notes: The table reports the estimates of Altonji ratio for MES. RM1 is the restricted model for IND variable, RM2 is the restricted model for BS variable, RM3 is the restricted model for BM variable, RM4 is the restricted model for CFR variable and FM is the full model (Model 2 - Table 4). Following Chalermchatvichien et al. (2014), we estimate the Altonji ratio as βF- (βR - βF), where βF and βF are respectively the coefficients of the restricted and of the full models. IND is the proportion of the independent board directors; BS is the number of boards of directors; BM is the number of the meetings held by the board during the fiscal year; CRF is a dummy variable which assumes a value equal to 1 if the cash-flow rights of the largest ultimate shareholder are greater than 10% and 0 otherwise (cut-offs at 10%).
* Significant at 10%. ** Significant at 5%. *** Significant at 1%