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Corporate Governance and Banking Systemic Risk: A Test of the Bundling Hypothesis ☆

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ABSTRACT

We provide new evidence that the systemic risk of large banks is higher when external and internal corporate governance mechanisms complement each other. Using a sample of large European banks from 2000 to 2016, we examine the relationship between various internal and external corporate governance mechanisms and the level of systemic risk. Specifically, we analyze how monitoring by institutional investors complements or substitutes various board-level governance mechanisms in determining the systemic risk of a bank. Our empirical findings show that external (institutional ownership) and internal (board level) governance mechanisms complement each other to determine the level of systemic risk of a sample of domestic systemically important banks. Our results are robust to alternative systemic risk measures and additional controls. We conclude that banks have strategic flexibility in terms of configuring their corporate governance structures to attain similar levels of systemic risk.

1. Introduction

> *"Most studies of board effectiveness exclude financial firms from their samples. As a result, we know very little about the effectiveness of banking firm governance."*
> (Adams and Mehran, 2012, p. 243).

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This paper examines whether the systemic risk of financial institutions is associated with shareholder-friendliness of corporate governance mechanisms. The recent global financial crisis can be partially attributed to the weaknesses of the corporate governance mechanisms of financial institutions (Basel Committee on Banking Supervision, 2010). Stronger corporate governance mechanisms can change the willingness of managers to take more risk (John, Litov & Yeung, 2008) but in financial institutions stronger corporate governance mechanisms can also result in excessive risk-taking (Erkens et al., 2012). For financial institutions, this excessive risk-taking can lead to undercapitalization. Therefore, this study investigates whether strong corporate governance mechanisms are related to the systemic risk contribution of financial institutions.

In contrast to previous studies see e.g., Pathan (2009), Saunders, Strock, and Travolos (1990), Laeven and Levine (2009), John, Litov and Yeung (2008) that focus on idiosyncratic risks only, we pay attention to the systemic risk contribution of financial institutions.[1] Despite the acknowledgement of corporate governance (CG) as a tool to determine risk appetite and help a firm manage their risk portfolio (John et al., 2008), the role of CG in determining the systemic risk contribution of banks has received very little scholarly attention. This is surprising, as the board of directors ultimately determine the actions of the bank, which in-turn determine its risk outcomes (Forbes and Milliken, 1999). Instead, the literature primarily focuses on the estimation of systemic risk (Billio et al., 2012; Adrian and Brunnermeier, 2016; Acharya et al., 2017; Huang, De Haan and Scholtens, 2020). Consequently, the resulting metrics do not account for and/or investigate corporate governance as a driver of systemic risk contributions.

Furthermore, implicit and explicit government guarantees, highly leveraged capital structure, and too-big-to-fail (TBTF) policies encourage banks to take more risks (see e.g., Acharya, Anginer and Warburton, 2016; Abdelbadie and Salama, 2019). As a result, banks may not only increase their bank-specific risk but also create negative externalities for the financial system by increasing the aggregate level of systemic risk and undercapitalizing the system (De Haan and Vlahu, 2016; Brownlees and Engle, 2017). This warrants researchers to focus on the role of corporate governance in propagating or containing systemic risk contributions by banks. Yet, the literature in this direction remains insufficient and under-explored. The literature primarily explore the broad relations between overall strength of corporate governance structures and systemic risk (see e.g., Iqbal, Strobl & Vahamaa, 2015). However, there is limited evidence on the relationship between individual corporate governance mechanisms and banks' systemic risk contributions. This study aims to contribute to the debate about the determinants of systemic risk by examining how internal and external corporate governance mechanisms relate to the systemic risk of European banks.

Our study is motivated by two considerations. First, firms employ several governance mechanisms simultaneously, in the form of governance bundles, which jointly determine outcomes (Rediker & Seth, 1995) and protect the interests of shareholders. Hence, we maintain that the level of a particular mechanism is ideally dependent on the levels of other mechanisms which are simultaneously in place in a particular bank. Our point of departure from the extant literature is as follows: we consider multiple corporate governance mechanisms by examining both the individual and interactive effects of various corporate governance mechanisms (governance bundles) on a bank's systemic risk contribution. Since there is limited theory as to the most important board characteristics, the term 'strong boards' focuses on an ad hoc selection of board mechanisms which have been theoretically emphasized as effective in monitoring and aligning the interests of managers and shareholders; appropriate board size, board independence, female directorship and board meetings. Unlike Iqbal et al. (2015), the initial part of analysis investigates the individual rather than the effect of an indexed-measure of bank board mechanisms on systemic risk. We argue that using an index measure of board mechanisms undermines a deeper understanding of how a single bank board mechanism can influence the level of bank systemic risk.

Board size and its negative relation to bank risk is a common finding in the literature (Cheng, 2008; Pathan, 2009) due to potential free-riding problems, less cohesiveness, and high communication and coordination costs associated with larger boards (Jensen, 1993). Also, since an individual director's incentive to acquire information and monitor managers is low on large boards, CEOs may find it easier to pursue their risk-averse preferences on (Jensen, 1993). Independent directors are believed to be better monitors of managers as independent directors value maintaining their reputation in the directorship market (Fama and Jensen, 1983; Bhagat and Black, 2002). Existing studies have empirically shown that firms with female representation on their boards lead to better firm performance (Adams and Ferreira, 2009; Lückerath-Rovers, 2013). Adams and Ferreira (2009) explain that women contribute to discussions and exchange of ideas from a diverse perspective which enhances the monitoring potential of the board of directors. Vafeas (1999) shows that years preceding better firm performance exhibit increased frequency in board meetings, suggesting that board meetings are an effective mechanism for monitoring executive behavior.

Similar to Pathan (2009) and Iqbal et al. (2015), we expect a strong board to effectively monitor managers so that they work for the shareholders and curtail the bank's systemic risk contribution. In contrast, strong boards, especially in banks, can encourage managers to take excessive risk demanded by bank shareholders to maximize their wealth. This appetite for excessive risk-taking is further multiplied by the 'moral hazard' problem associated with the 'too-big-to-fail' phenomenon and deposit insurance schemes (Galai & Masulis, 1976; Saunders et al., 1990; Martinez Peria & Schmukler, 2001). Previous studies also argue that it is beneficial for banks to become large or achieve the status of too-big-to-fail to reap the benefits of implicit and explicit government funding subsidies (Brewer and Jagtiani, 2013). To achieve this status, banks may adopt risk-

[1] A firm is considered to be systemically risky if it is likely to face a capital shortage during periods of financial turmoil (Acharya et al., 2017). This capital shortage can be damaging to the real economy because the failure of a systemically risky firm will have effects throughout the financial industry (Acharya et al., 2017).

ier policies which can translate into greater systemic risk contributions. The recent global financial crisis demonstrated the negative side of systemic risk, where the interconnectedness of financial institutions resulted in the collapse of the financial system (Brunnermeier, Dong and Palia, 2020).

Second, existing literature advertises that the effect of governance mechanisms on bank risk is mainly dependent on the existing ownership structure (Choi & Hasan, 2005; Martín-Oliver et al., 2017). Empirically, Laeven and Levine (2009) show that the intended consequence of regulatory capital on risk-taking is attenuated when banks have large or concentrated ownership. In furtherance of this, the description of dispersed ownership with regard to the separation of ownership and control has been presumed to be universally applicable (Berle and Means, 1932). However, Fernández and Arrondo (2005) emphasize that managerial actions are mainly controlled by the board of directors and large shareholders in the European economy.[2] This suggests that direct control and monitoring by large (institutional) shareholders prevails as a fundamental and/or strong mechanism to increase managerial risk-taking. In this regard, Hoskisson et al. (2002) and Connelly et al. (2010) show that institutional investors strongly influence a firm's internal innovation and support risk-taking behavior. Ultimately, the key question which remains underexplored in the existing banking literature is whether the simultaneous existence of internal and external governance mechanisms limit or promote the systemic risk contribution of a bank. In our study we attempt to explore the role of institutional investors coupled with internal governance mechanisms on the systemic risk of banks.

To address this, we conduct our analysis using data from 38 European banks classified as Domestic Systemically Important Banks (D-SIBs) for the years 2000–2016. We use a market–based equity measure, absorption ratio (AR), proposed by Kritzman, Li, Page and Rigobon (2011) to proxy the systemic risk contribution by a bank. Our findings show that although strong boards have a varying effect on bank systemic risk, they synergistically promote prevailing bank systemic risk in the presence of external monitors (institutional shareholders). This evidence informs our conclusion that internal and external governance mechanisms mainly act as complements.

Our study makes several contributions to the literature. First, we extend the scope of bank risk by operationalizing a financial econometric estimation of systemic risk, namely the absorption ratio (AR). Second, most of the previous studies on corporate governance bundling have explored the interactive effects of multiple governance mechanisms without a single focus (see e.g., Rediker & Seth, 1995; Schepker & Oh, 2013; Zajac & Westphal, 1994). This arguably attenuates a deeper understanding of the role of a single mechanism conditioned on other mechanisms. In this sense, our study contributes by extending the theoretical boundary into how a single prevalent governance mechanism interacts with "strong board" mechanisms to determine the systemic risk contribution by banks. To the best of our knowledge, this is the first study to examine the bundling effect of bank governance mechanisms on systemic risk. Further, this study responds to the call of Schiehll et al. (2014) to further our understanding regarding the effect of corporate governance on organizational outcomes in the context of national/regional governance characteristics. By investigating the interactive effects of institutional control, which characterizes the ownership structure of European organizations, this study offers a relevant response to the call of Schiehll et al. (2014). Lastly, we acknowledge the recent agenda/calls towards a stakeholder approach to bank governance (BCBS, 2015; Schwarcz, 2017). Thus, although we build our arguments from the shareholder perspective, we appraise our findings and implications in light of the stakeholder perspective to inform how systemic risk could be managed/curtailed, especially from a practitioner and regulatory perspective.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and states the empirical hypotheses. Section 3 describes the data, variables, and the empirical methodology, while Section 4 presents the results and discussion of our empirical tests. Section 5 concludes by discussing various implications of the findings and offering directions for future research.

2. Related literature and hypothesis development

To complement earlier studies and build a convincing case for governance bundling, we first offer a theoretical background for our argument to aid our formulation of individual hypotheses for each of our strong board mechanisms as well as their interactive effects with institutional ownership.

2.1. Theoretical foundations of risk taking

Agency theory has been widely utilized to examine risk-return trade-off between principal and agent to determine the optimal levels of risk assumed by a business entity (Wiseman and Gomez-Mejia, 1998). Top executives may experience an agency conflict with shareholders regarding their risk preferences. Shareholders, who are entitled to the residual value of the firm, can diversify risk through their ownership portfolio and are therefore assumed to be risk neutral. Managers,

[2] Franks and Mayer (1994;1995) iterated a different system –insider system of governance– that existed in continental Europe by virtue of a remarkably high level of ownership concentration of the listed companies. Specifically, the authors reported the existence of a single shareholder owning more than 25% of shares in over 80% of the largest 170 companies listed on stock markets in France and Germany. Furthermore, in more than 50% of companies, there is a single majority shareholder. Standing in sharp contrast, the corresponding figures for the UK, 16% of largest 170 listed companies had single shareholders owning more than 25% of shares while 6% had single majority shareholders. Hence, concentration of ownership is staggeringly high on the European continent relative to the Anglo-American ownership control structure.

by contrast, cannot diversify their employment risk and are thus more risk-averse. If managers are assumed to bear significant residual risks, they will seek much higher monetary rewards or will make less risky decisions and thereby formulate unattractive corporate strategies (Hoskisson, Castleton, & Withers, 2009). To overcome the problem of risk aversion, agency theory proposes control mechanisms such as monitoring by the board of directors or powerful institutional investors.

However, for financial institutions, the optimal degree of risk taking is generally higher than for non-financial firms because the market expects government support for financial institutions if they become distressed. Therefore, implicit and explicit government guarantees can encourage financial institutions, especially the large banks, to take more risks (see Acharya, Anginer & Warburton, 2016)[3]. In addition, stronger corporate governance mechanisms may further encourage financial institutions to adopt risk-seeking corporate policies (Chava and Purnanandam, 2010) which may, in turn, lead to increased systemic risk contributions by financial institutions. In contrast to non-financial firms, the expectation of implicit and explicit government support in times of distress provides a unique environment to consider banks separately (Acharya et al., 2016; Zhao, 2018) because stronger corporate governance mechanisms in the large banks can lead to excessive risk taking (Erkens et al., 2012; Anginer et al., 2014a)[4]. On this background, Rose (1992) opines that the banking industry due to the opacity of its operations which exacerbate the inability for the principal to fully monitor agents represents one of the most unique 'laboratories' available to test the fundamental propositions of agency theory.

2.2. Board level governance mechanisms and bank risk taking

A bank's board of directors serves as an immediate defense against managerial inefficiency through monitoring and advisory roles (Hermalin and Weisbach, 2001). The effectiveness with which these roles are undertaken is partly dependent on its size (Jensen, 1993, p. 865). On the one hand, larger boards can offer a wider pool of expertise to execute the board's advisory role, while on the other hand, larger boards may suffer from problems of coordination, control, free-riding and flexibility in the decision-making process (Eisenberg et al., 1998; Fernández et al., 1997; Adams and Mehran, 2012). Further, a larger board size gives excessive control to the CEO, which could harm efficiency. As such, banks, should strategically take into account the trade-offs between the advantages (monitoring and advice) and disadvantages (coordination, control, and decision-making problems) associated with a large board size.

Given the growing opacity and complexity of banking operations, we argue that flexibility, timeliness of decision making, effective coordination, and control functions are valuable for effective monitoring and alignment of executive and shareholder risk interests (Fosu et al. 2017). Therefore, large boards may fail to encourage managers to pursue riskier policies for the benefit of shareholders and result in less overall firm risk. Thus, large boards will be associated with less systemic risk. Particularly, we expect this argument to be validated as decisions concerning a bank's contribution to the overall market fragility must be flexible, well-coordinated, and timely. Therefore, we formally state our first hypothesis as follows:

Hypothesis 1:. *Board size is negatively related to bank systemic risk.*

The risk-taking literature reports mixed findings regarding board independence. However, a considerable number of studies have argued that independent directors are better monitors since they relate their reputation in the directorship market to their performance (Fama and Jensen, 1983; Bhagat and Black, 2002). The presence of stringent external regulations renders banks distinct economic units. For this reason, we argue that the strict external regulations offer a unique opportunity for independent directors of banks to build and maintain a good reputation in the directorship market. Thus, an independent director's active role in monitoring is performed to not only avoid regulatory sanctions on the bank but also send a signal to the director labour market about the director's diligence (Pathan, 2009). In this sense, Deutsch et al. (2011) argue that independent directors are 'self-motivated agents' who act in their best interest to build their own reputation. Furthermore, Laeven and Levine (2009) and Barth et al., (2006) show that banking regulations limit bank risk-taking. Putting the pieces together, it follows that if independent directors are instruments through which regulations becomes enforced, then they will negatively impact bank systemic risk. Our argument is based on the evidence that inside directors relative to independent directors promote better performance as bank operations are technically sophisticated and require specialist knowledge (Darrat et al., 2016). Thus, the endogenous information asymmetry which characterizes these sophisticated operations will refrain independent directors from effectively monitoring actions which promote risk-taking. Thus, the formal specification of our second hypothesis is as follows:

Hypothesis 2:. *Board independence is negatively related to bank systemic risk.*

The idea that women are underrepresented on boards of directors in the banking industry is currently high on the agenda of most policy and academic discussions. The Glass Ceiling Phenomenon– a restrictive force against the inclusion of women on boards – has often been cited as a reason why women are relatively underrepresented as executives and directors (Eagly and Carli, 2003). A different perspective of this phenomenon offers a theoretical explanation as to why female directors have

[3] Implicit government guarantees refer to the expectation by market participants that the government may provide a bailout (Acharya et al., 2016). It is referred to as implicit because the government does not explicitly provide a commitment to intervene. Implicit government guarantees are extended to banks and other financial institutions (Zhao, 2018).

[4] For instance, Acharya et al. (2016) find that bondholders of financial institutions, especially large ones, expect that the government will protect them in case of failure of financial institution.

been documented as influential on organizational outcomes in the existing literature (Adams and Ferreira, 2009). Thus, consequently, women are left to demonstrate exceptional competencies to reach directorship positions and are likely to be highly proficient, diligent, and better monitors of managers than their male counterparts (Dunn, 2012). If this argument holds, we would expect female directors on bank boards to induce managers to increase risk-taking in accordance with bank shareholder interests. Our argument is accordant with the recent findings of Adams and Ragunathan (2017) who empirically show that women in finance, especially at the board level may be associated with relatively more risk-taking. Therefore, we hypothesize that:

Hypothesis 3:. *The proportion of women directors on the bank's board of directors is positively related to bank systemic risk.*

Board meetings are considered to be a signal of a proactive board. Frequent meetings help board members perform monitoring and advisory functions more diligently (Liang, Xu & Jiraporn, 2013). In large banks, the size of the board is usually large and the individual directors may be unable to express their opinions in the limited time available to them during board meetings (Lipton & Lorsch, 1992). In this regard, Vafeas (1999) empirically shows that board meetings are a mechanism to enhance board function, as they offer directors the platform to exercise their control over executives' actions to improve performance. Thus, meetings provide board members with the chance to come together, discuss and, exchange ideas on how they wish to monitor managers and bank strategy (de Andres & Vallelado, 2008). Hence, the more frequent the meetings, the closer the control over managers, and the more directors are able to offer their advisory services to the board. Furthermore, due to the complexity of the banking industry and the informational limitations faced by outsider/independent directors, there is an increased need for the board to meet to ensure bank shareholder interests are being pursued diligently by management (Macey and O'Hara, 2003). Hence, we would expect a greater number of board meetings to align managers' risk preferences to that of bank shareholders, which is associated with higher systemic risk. As such, we hypothesize:

Hypothesis 4:. *The frequency of board meetings is positively related to bank systemic risk.*

2.3. Institutional ownership and bank risk taking

The recent global financial crisis has given rise to one of the prominent notions in the banking literature, namely that institutional investors contributed to the crisis by pressuring the financial sector for short-term profits and increased risk-taking behavior (Manconi, Massa & Yasuda, 2012). On the other hand, some studies affirm the minimal agency cost associated with the intensive direct supervision performed by large (institutional) shareholders (Chung & Zhang, 2011). In this regard, Callen and Fang (2013) test the monitoring hypothesis and note that a higher proportional of institutional investors is positively associated with bank performance in China. Similarly, there is evidence that when firms are performing poorly, external monitoring by institutional investors can complement the role of the board of directors by increasing the disciplinary potential of the market for corporate control (Ward, Brown & Rodriguez, 2009; Shleifer & Vishny, 1986; Hirshleifer & Titman, 1990; Chowdhry & Jegadeesh, 1994). Similarly, institutional investors strongly influence a firm's internal innovation and support long-term competitive (risky) moves (Connelly et al., 2010; Hoskisson et al., 2002). Specifically, the bank risk-taking literature further substantiates the role of large shareholders in promoting managerial risk-taking. Laeven and Levine (2009) note that more powerful owners with substantial cash flows have the power and incentives to direct a bank's managers towards increased risk-taking policies. Collectively, this evidence suggests that institutional investors will promote systemic risk, and thus we hypothesize:

Hypothesis 5:. *There is a positive relationship between institutional ownership and bank systemic risk.*

2.4. Governance mechanisms as a bundle

Recent governance literature has acknowledged that various governance mechanisms work jointly to influence corporate policies (García-Castro, Aguilera & Ariño, 2013; Schiehll, Ahmadjian & Filatotchev, 2014). Governance mechanisms have unique characteristics, roles, and focus towards protecting shareholder interest. Regarding the monitoring role, Oh et al. (2018) explain that the strategic focus and implications of large shareholders and independent directors may differ as the former's investment value is directly tied to the firm's performance. The internal mechanisms of performance-related pay and strong board mechanisms (i.e., board size, women representation on the board, board meetings, and independence) help to align interests and monitor managerial actions, respectively. Given such fine-drawn differences, it is realistic to assume that banks will employ different configurations of mechanisms with similar and sometimes diverging effects. Beatty and Zajac (1994) posit that the decision to use multiple governance instruments involves resource allocation. Hence, governance mechanisms are bundled either as substitutes or complements under the rubric of a cost-benefit trade-off between the employed mechanisms. Governance mechanisms act as substitutes if there is a direct functional replacement of one mechanism by another to increase shareholders' wealth. Rediker and Seth (1995) and Randøya and Goel (2003) empirically demonstrate that when effective monitoring processes are in place, firms are less likely to use long-term incentive plans for CEOs as it becomes a redundant and costlier mechanism. On the other hand, two mechanisms interact as complements if the presence of one mechanism strengthens the other, resulting in a synergistic benefit in addressing agency problems. In this regard, Oh et al. (2018) report a mutually enhancing effect between an independent board and executives' incentive pay since the latter makes the agency problem less severe which enables the former to effectively commit to stakeholder management. Similarly, Chung and Zhang (2011) argue that the presence of institutional ownership improves board level governance effectiveness in aligning the principal-agent interests. Thus, in order to ascertain the effect of certain governance practices on the prevailing bank systemic risk, it is necessary to consider a set of other interrelated governance mechanisms.

2.4.1. Substitution effect hypothesis

Governance mechanisms substitute for each other if the marginal effect of one mechanism on an outcome increases (decreases) with the decrease (increase) in another mechanism (cf. Siggelkow, 2002). Many recent studies note that various monitoring mechanisms, if used simultaneously, may substitute each other (Hussain, Rigoni & Orij, 2018; Sihag & Rijsdijk, 2019). In line with this argument, we argue that institutional investors may substitute for the monitoring of the board while influencing the systemic risk of banks. Unlike diffused share ownership, institutional shareholders have increased incentives (well beyond the compensation associated with board membership) to monitor the actions of managers. This increased monitoring function is due to the fact that they will bear a greater proportion of the costs associated with the value-destroying decisions of firm managers (Demsetz & Lehn, 1985; Shleifer & Vishny, 1997; Holderness, 2003).

This monitoring may take the form of having some direct representation on boards (Holderness & Sheehan, 1988), exercising decisive voting rights (Tosi & Gomez-Mejia, 1989), increasing the disciplinary potential of the market for corporate control (Shleifer & Vishny, 1986; Hirshleifer & Titman, 1990; Chowdhry & Jegadeesh, 1994) or repealing managerial entrenchment provisions (Schepker & Oh, 2013). Rediker and Seth (1995) demonstrate that in the presence of such monitoring, independent directors on the board represent a less important monitoring mechanism due to a reduced need for their monitoring services. We extend the appeal behind this intuition and argue that, as major providers of capital coupled with their direct monitoring and participation on boards, institutional shareholders become privy to sensitive information that executives will not divulge to independent directors, thereby enabling them to monitor executives better (Li & Harrison, 2008). Therefore, we would expect a decreasing requirement for strong board mechanisms to monitor managerial actions. This argument offers some explanation why entities with higher institutional shareholding have a higher likelihood of director turnover in the event of poor performance (Kaplan & Minton, 1994; Denis & Serrano, 1996). Thus, if there exists effective direct monitoring by institutional investors, employing a smaller bank board, more independent directors, frequent board meetings, and female directors as additional mechanisms to further encourage top management to take excessive risk could be redundant and costly (and vice-versa). Thus, in line with the substitution logic, we hypothesize:

Hypothesis 6:. *The higher the monitoring effect of institutional owners, the lower the monitoring potential of strong board mechanisms to promote bank systemic risk-taking.*

2.4.2. Complementary effect hypothesis

The complementary effect view of CG suggests having "as many governance mechanisms as possible in the bundle in order to reduce agents' opportunism" (Schepker & Oh, 2013, p. 1733). Chung and Zhang (2011) empirically support this view in Chinese banks by finding a complementary effect between institutional investors and bank boards. Similarly, Baysinger and Butler (1985) document that due to the possibility of large pecuniary losses that could result from portfolio restructuring, institutional investors find it more efficient to pursue an "activist approach" through external monitoring that tends to have a synergistic effect with existing internal governance mechanisms on organizational outcomes.

Considerable empirical evidence suggests that external monitoring by institutional shareholders enhances the function of strong board mechanisms. This can result in increased diligence by the board of directors regarding internal monitoring (Wahal, 1996; Black, 1998) and prompt a realignment of incentives for managerial performance (Hartzell & Starks 2003; Ward et al., 2009). In extreme situations, large shareholders can even threaten to replace management to discipline the board of directors on their monitoring role (Grossman & Hart, 1982). Thus, this activism, even without a change in composition, may prompt passive boards to take action to improve their monitoring and facilitate more executive systemic risk-taking. Thus we hypothesize that:

Hypothesis 7:. *The higher the monitoring effect of institutional owners, the higher the monitoring potential of strong board mechanisms to increase a bank's systemic risk contribution.*

3. Data and econometric methods

3.1. Sample and data

To test our hypotheses, we use a panel dataset for European Union (EU) banks classified as Domestic Systemically Important Banks (D-SIBs) in 2011 by the Financial Stability Board (FSB hereafter) for the period 2000–2016. The ownership structure of EU entities is characterized by high institutional ownership as reported by Franks and Mayer (1994,1997) and

Fernández and Arrondo (2005). This entrenches monitoring by institutional shareholders as a potent monitoring mechanism. Hence, analyzing this purposive sample will offer convincing findings regarding the impact of governance on bank systemic risk. Essentially, we collect data on bank board variables and financial information, including monthly equity returns and institutional ownership from Bloomberg and the 13–F statements respectively. These data are then complemented by hand-collected data from the bank annual reports. Our initial sample begins with 42 large European banks classified as D–SIBs in 2011 by the FSB.[5] We then eliminate the banks with insufficient data.[6] This leaves us with a final sample of 38 D-SIBs and an unbalanced panel of 430 bank year observations.

3.2. Dependent variable: Measure of systemic risk.

Our dependent variable in our empirical analysis is the systemic risk of European D–SIB banks. Although it is hard to define systemic risk (Benoit, Colliard, Hurlin & Pérignon, 2017), it broadly measures of how much an individual bank or financial institution can contribute to the tail of the system's loss distribution (see e.g., Acharya, Engle & Richardson, 2012; Anginer Demirguc-Kunt & Zhu, 2014b; Acharya, Pedersen, Philippon & Richardson, 2017). Prominent market-data based systemic risk measures extensively used in previous literature include the systemic expected shortfall (SES) and marginal expected shortfall (MES) by Acharya et al. (2017); the SRISK by Acharya et al. (2012) and Brownlees and Engle (2015); and the ΔCoVaR by Adrian and Brunnermeier (2016).[7] In our study, we use a market–based equity measure, absorption ratio (AR), proposed by Kritzman, Li, Page and Rigobon (2011) in our main analyses.[8] This measure builds on the works of Ang and Chen (2002) and Billio et al. (2010, 2012) by utilizing principal components analysis (PCA) on periodic (monthly) equity returns to estimate on a rolling basis throughout history, the fraction of total market variance explained by a finite number of factors. One of the main sources of systemic risk is the interconnectedness of financial institutions (Benoit et al., 2017). Therefore, unlike non-financial firms, the financial industry is prone to contagion and problems at one financial institution can spread to the other financial institutions (Allen & Carletti, 2013). In this regard, the AR offers a direct estimate of the interconnectedness of financial institutions (Billio et al., 2012). Thus, the AR also accounts for the relative importance of each bank's (asset) contribution to the overall system-wide systemic risk. Kritzman et al. (2011) show that the absorption ratio systematically rose in advance of market turbulence and that most global financial crises coincided with positive shifts in the absorption ratio. Empirically, the absorption ratio is defined as the fraction of the total variance of a set of asset returns explained or "absorbed" by a fixed number of eigenvectors. Formally AR for bank i at time t is expressed as:

$$AR_{it} = \frac{\sum_{i=1}^{N} \sigma_{Ei}^2}{\sum_{j=1}^{N} \sigma_{Aj}^2}$$

where N is the number of assets (banks) whose equity returns are being considered; σ_{Ei}^2 is the variance of the i^{th} eigenvector, and σ_{Aj}^2 is the variance of the j^{th} asset returns. Intuitively, since we are focusing on endogenous risk (i.e., from a set of assets), the AR informs on the contribution and exposure of a focal bank to the overall risk of the system given a strong common component across the returns of all banks' equity. Thus, a higher AR corresponds to a higher level of systemic risk contribution by a bank's operations and vice versa.

Billio et al. (2012)'s econometric estimation for systemic risk, the *Cumulative Risk Fraction*, measured as the ratio of the risk associated with the first n principal components of a covariance matrix of a system of asset returns to total risk of the system, follows a similar intuition. In addition, several official reports and studies (BCBS, 2010; Lehar, 2005) converge on the fact that the 2007/2008 crisis was preceded by spikes in systemic risk. Fig. 1, which is a time series plot of our computed absorption ratio from our sample data is perfectly consistent with this fact. Together, these rest the reliability of our adopted measure on a bedrock.

To estimate the absorption ratio for a particular year, we use a window of monthly stock returns for our sample banks (assets) to estimate the periodic (yearly) covariance-variance matrix. We then apply the orthogonal rotation routine to decompose the covariance-variance matrix into eigenvectors and eigenvalues (weights). This is similar to running a Principal Component Analysis (PCA) on the covariance-variance matrix to observe how much of the total variations in the covariance-variance matrix is explained by each component (eigenvectors). In order to precisely capture each bank's contribution to the system's unification, we maintain all available number of eigenvectors. This equals the number of banks with returns data available. Since we applied an orthogonal rotation routine, the total variance of the entire system (set of eigenvectors) can be computed by simply summing across the variance of the individual eigenvectors. At this point, the $AR_{t=year}$ for a particular bank is computed simply as the ratio of the variance of the eigenvector of the bank to the total variance of the entire system.

[5] The Basel Committee for Banking Supervision (BCBS) methodology for identifying D-SIBs is based on several criteria, notably size, interconnectedness and substitutability (in practice, size appears to be the dominant criterion). The BCBS/FSB methodology for the identification of D-SIBs has been transposed in the EU regulatory framework (see Article 131 of the Capital Requirements Directive IV (CRDIV), which defines domestic systemically important institutions or G-SIIs).

[6] DLR, Nyekredit and Credit Mutuel banks were dropped due to the lack of annual report information. Banca Civica after 2011 was integrated into Caixa Bank, thereby limiting the availability of information to analyze its case. Nordea Bank as a group presented one corporate governance report for its subsidiaries, hence data on Nordea Bank are represented as one bank.

[7] For details on systemic risk sources and measures see Benoit et al. (2017).

[8] We also check the robustness of our results with alternative systemic risk measures such as LRMES and SRISK.

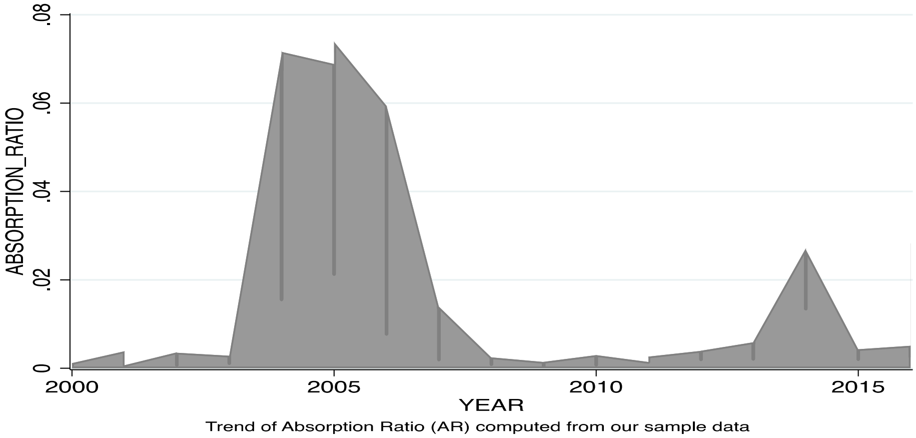

Fig. 1. Trend of Absorption Ratio (AR) computed from the sample data.

Monthly stock return data is collected from Bloomberg and is defined as the natural log of the stock price of the bank at the end of the month over the natural log of the price of the bank's stock at the beginning of the period. For the missing stock return data, we computed and augmented our data with Yahoo Finance information on the bank's stock price changes over a month.

3.3. Measures of independent variables

Our four proxies for board strength are board size, independent directors, women directorship and board activity. Yermack (1996) and Boone et al. (2007) have argued that board size varies according to firm size and thus we standardize board size from any bank size effects by operationalizing it as the logarithm of the number of directors on the board at the end of the year. Board independence (INDP) is operationalized as the proportion of board directors without any material or pecuniary relationship with the bank, except the board seat. Women on board (WOB) represents the proportion of board directors who are females. Our measure of board activity is the number of meetings (both ordinary and extraordinary) held by the board of directors annually (Vafeas, 1999). Finally, institutional ownership is operationalized as the proportion of outstanding shares controlled by banks, insurance companies, endowment, hedge funds, pension funds and mutual funds. A careful inspection of the 13-F documents indicates that these holdings commensurate voting rights and hence serve as a good proxy for institutional investors' control over the board.

3.4. Control variables

In order to limit omitted variable bias from our results, we control for several bank and country-level factors that may affect the level of systemic risk. Following prior bank risk-taking literature (Laeven & Levine, 2009; Pathan, 2009; Iqbal et al., 2015), we control for bank size, performance, growth, asset structure, loan loss provision and non-interest income.

At the country level, we control for the level of economic development, institutional development and bank regulations. The literature documents an association between bank size and systemic risk (Varotto and Zhao, 2018). Laeven et al. (2014) opine that the business model of large banks makes

them less risky on an individual basis but their contribution to systemic risk is disproportionately high. We measure bank size as the logarithm of total assets (TA).

Behavioural agency models document that the willingness of top executives to adopt risky strategies is partly dependent on the firm's performance (Kahneman & Tversky, 1979; Cyert & March, 1992). Sanders (2001) shows that the likelihood to pursue risky strategies (i.e., acquisitions, investment opportunities and geographical diversification) is performance contingent. We include banks' returns on asset (ROA) in our model to control for this effect of bank performance. We also include revenue growth, measured as the percentage change in the sequential total revenue of the bank, as an additional bank performance control variable. We control for the bank's asset structure with the ratio of total deposit to total assets (deposits to assets). The effect of liquidity on bank stability and its externalities associated with banking failures is captured using loan to asset ratio (Wagner, 2007; BCBS, 2015). Since our study covers the period of the credit crisis, we control for this effect on bank risk-taking using a dummy taking the value of 1 if the period under consideration is 2007, 2008 and 2009 and 0 otherwise. Loan loss provision is used to control for the banks' risk culture and appetite. Finally, to capture the effect of business

Table 1
Definitions of variables.

Variable	Definition/ Measure
Panel A: Dependent Variable	
Absorption Ratio (AR)	Ratio of the variance of the i^{th} bank's eigenvectors relating to its equity returns to the total variance of the set of banks' equities returns.
Long run Marginal Expected Shortfall (LRMES)[a]	The expected fractional loss of the firm equity when the Morgan Stanley Capital International (MSCI) World Index declines significantly in a six-month period.
Capital Shortfall Risk (SRISK)[b]	The expected capital shortfall of a bank in a systemic crisis where the broad market index falls by more than 40% in a six-month period.
Panel B: Strong Board Variables	
Board Size (BS).	The number of directors on the bank board at the end of the financial year.
Board Independence (INDP)	The proportion of board directors without any material or pecuniary relationship with the company, except the board seat.
Gender diversity (WOB)	The percentage of board directors who are women.
Board Meetings (BMEET)	The number of times the board of directors met (ordinary and extraordinary meetings) in a year as reported by the annual governance report. Written consent of the board and telephonic meetings are excluded since it is likely more difficult for directors to monitor effectively from a distance.
Institutional Ownership (INSTOWN)	The average proportion of outstanding shares of the bank held by institutional investors (i.e., banks, insurance companies, mutual funds, hedge funds etc.) at the end of the year.
Panel C: Control Variables	
Bank size (TA)	Log of total book value of assets as reported in the year-end financial reports
Bank Performance (ROA)	Net income divided by total assets expressed as a percentage.
Tier 1 Ratio (BIS_RATIO)	The ratio of tier 1 capital held by the bank to the average risk weighted asset reported by the financial statements.
Gross Domestic Product per Capita (GDP)	The log of gross domestic product per capita of the country where the bank is located.
Revenue Growth	The bank's average sequential growth in total revenues over the year.
Loan Loss Provision Ratio	The ratio of loan loss provisions to average total assets over the period.
Deposits to Asset	The ratio of total deposits to total assets.
Non-interest Income	The bank's revenue(standardized) from non-traditional activities.
Loan to Asset Ratio	Measure of bank liquidity holding computed as total loans dived by total assets.
Financial Crisis (FCRIS_DUMMY)	Dummy equaling 1 if year is 2007, 2008, and 2009 and 0 otherwise
Governance Effectiveness (WGI)	An index measuring the institutional strength/effectiveness of a country.

[a] LRMES is computed as $1 - \exp(\log(1 - d) \times \text{beta}$, where d is the six-month crisis threshold for decline in the equity market index. This takes a default value of 40%. **beta** is the firm's Dynamic Conditional Beta computed according to the Engle's Dynamic Conditional Beta model.

[b] $SRISK = k \times Debt - (1 - k) \times (1 - LRMES) \times MV$, where **LRMES**, the expected fractional loss of the equity when the MSCI All-Country World Index falls by the crisis threshold (default is 40%) in a six-month period. **k** is the prudential capital requirement and it is set to be 5.5% for banks in Europe for the purposes of this study. **MV** is the banks market value of equity**.**

models of the bank, we use the standardized measure of non-interest income to control for the level of income diversification and non-traditional banking activities (Köhler, 2015).

To account for country level effects, we control for the level of economic development on banking operations with the log of the gross domestic product of the country (GDP). Fang, Hasan and Marton (2014) show that efficient and developed institutions substantially increase financial stability and more value-enhancing bank risk-taking. We control for this effect with the governance effectiveness index (WGI).[9] Finally, Agoraki et al. (2011) show that regulations have an independent effect on bank risk-taking. Therefore, being an important channel for the risk-taking in banks (e.g., De Bruyckere et al., 2013; Minton, Taillard & Williamson, 2014; Dell'Ariccia, Laeven & Suarez, 2017), we consider controlling for the tier 1 capital ratio in our study. However, due to the homogeneity in the capital (Tier 1) requirement for our sample banks (8% for EEA banks), we are not able to control for this effect as Barth, Caprio, and Levine (2006) did. Rather, we capture a varying impact of bank regulations by focusing on the extent to which banks conform to the capital requirement regulations using the BIS_RATIO; the ratio of the tier 1 capital to average risk-weighted assets.[10] Detailed definitions of the variables are presented in Table 1.

3.5. Empirical method and Model

The generic model used to test our hypotheses is:

[9] The Government Effectiveness Index captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. These resultantly determine the soundness and uncertainty of the economic environment in which the entity operates. Percentile rank indicates the country's rank among all countries covered by the aggregate indicator, with 0 corresponding to the lowest rank, and 100 to the highest rank. Percentile ranks have been adjusted to correct for changes over time in the composition of the countries covered by the WGI.

[10] We acknowledge that by operationalising the tier 1 capital ratio, we may not have effectively controlled for the risk-taking effect of bank regulatory capital. Since some of our sample D-SIBs are concurrently GSIBs, national regulators may have different minimum capital holdings requirements for D-SIBs from the same country. Hence, an issue of within and between-country differences in capital requirement/compliance among our sample banks is inherent. As such, the results reported in our paper should be interpreted cautiously.

$$\boldsymbol{y}_{i,t} = \boldsymbol{\alpha} + \boldsymbol{\beta X}_{i,t} + \boldsymbol{\theta D}_{i,t} + \boldsymbol{\gamma Z}_{i,t} + \boldsymbol{\eta}_{i,t} + \boldsymbol{\varepsilon}_{i,t} \tag{2}$$

where the subscripts *i* identifies individual D-SIBs ($i = 1, 2, 3, \cdots, 38$) and *t* the time period (*t* = 2000,2001,. . ., 2016). $\boldsymbol{y}_{i,t}$ is the absorption ratio (AR) and represents our measure for bank systemic risk. $\boldsymbol{X}_{i,t}$ includes board size [Ln(BS)], board independence (INDP), female directorship (WOB), board meeting (BMEET) and institutional ownership (INSTOWN). $\boldsymbol{Z}_{i,t}$ includes bank size (Size), the log of annual per capita income (GDP), tier 1 ratio (BIS_RATIO), return on assets (ROA), deposits to assets ratio, loan loss provision ratio, revenue growth percentage, loan to asset ratio, financial crisis dummy, institutional strength, and non-interest income. At any point, $\boldsymbol{D}_{i,t}$ is an interaction term between institutional ownership and a strong board mechanism (i.e., board size, board independence, female directorship and board meetings). Finally, η_i and $\varepsilon_{i,t}$ represent the time-invariant unobserved bank-specific factor and the idiosyncratic error term, respectively. Our analysis begins with an assessment of the individual effect of governance of our strong board mechanisms on systemic risk using univariate and quantile regression analyses. Next, the focus of the analysis is shifted towards the examination of the bundling (interaction) effects. We examine closely the interaction effects using a common complements or substitutes assessment model in the field of economics (see Appendix B). The resulting simple slopes are plotted at 1 standard deviation below and above the mean of INSTOWN as Aiken et al. (1991) recommend.

Ownership structure has been found to be endogenously determined, among other factors, by firm risk (Demsetz & Villalonga, 2001). This implies that endogeneity must be taken into account when seeking to ascertain the relation between ownership and bank risk. Failing to do so is bound to yield biased estimates. Primarily, we address this problem by using a 2-Stage Least Squares (2SLS) regression model to estimate our regression, conditioning INSTOWN as endogenous. Following Laeven and Levine (2009), we use the average institutional ownership held by other banks in the country as an instrument for each bank's ownership structure. Economic intuition validates this instrument because it captures the industry and country factors explaining INSTOWN. Furthermore, the risk innovation of a single bank does not influence the INSTOWN of other banks especially when evidence suggests that bank ownership structure changes extremely little over time.

3.6. Descriptive statistics and correlation matrix

In Table 2, we present the descriptive statistics for our defined variables. As can be noted, there is sample heterogeneity, indicating that our sample contains banks with strong and weak boards. Panel B shows that board size varies from 6 to 32 with a mean of approximately 15 members. This is comparable to De Andres and Vallelado (2008), who report an average board size of 15 for the large international commercial banks they studied. Variably, the sample banks kept no to complete independent directors with a mean of 55%. The percentage of female directorship ranges from 0 to 65, with a mean of 21. The number of board meetings ranges between 1 and 54, with an average of 12 per year. Finally, institutional shareholding varies between 3.9% and 100%, with a mean of 71%, which substantially differs from the 27.69% reported by Elyasiani and Jia (2008) for a sample of US BHCs. This affirms the prevalence of institutional ownership in continental Europe as asserted by Franks and Mayer (1994;1995) and Fernández and Arrondo (2005). In addition to our board mechanism variables, the sample is also

Table 2
Descriptive statistics.

Variable	N	Mean	SD	Min.	Median	Max.	Skew.	Kurt.
Panel A: Dependent Variables								
AR	511	0.02	0.023	0.0003	0.004	0.074	1.76	4.50
LRMES	426	0.46	0.10	0.01	0.50	0.72	−0.70	4.34
SRISK	426	24369.83	35495.46	−56493.3	10840.65	164428.9	1.39	4.88
Panel B: Bank Board Variables								
BS	595	14.87	4.513	6	14	32	0.37	2.74
INDP (%)	595	55	25	0	58.3	100	−0.284	2.568
WOB (%)	595	21	13.1	0	18	65	0.68	3.19
BMEET	545	11.5	5.466	1	11	54	2.54	16.28
INSTOWN (%)	604	71	28.4	3.9	78	100	−0.73	2.35
Panel C: Control Variables								
Size (in € mil)	568	559.6011	536.6705	5.41903	369.528	2500	1.42	4.36
ROA (%)	572	0.39	0.56	−6.51	0.40	4.74	−3.02	50.33
BIS_RATIO	588	11.32	3.89	5.2	10.6	28.7	1.10	4.69
GDP	646	10.57	0.33	9.59	10.62	11.54	−0.12	3.75
Revenue Growth	557	4.39	26.55	−71.78	−0.30	207.09	2.93	19.12
Loan Loss Prov.	567	0.219	0.367	−0.484	0.16	5.816	9.22	125.9
Deposit to Assets	563	39.15	14.75	2.544	37.98	91.36	0.49	3.28
Loan to Asset	604	0.49	0.17	0.02	0.52	0.93	−0.44	2.65
Financial Crisis	646	0.18	0.39	0	0	1	1.70	3.88
Non-Interest Inc.	567	8573.531	8095.536	−2952	5698	45,209	1.20	4.28
WGI	608	91.41	7.201	60.194	92.78	100	−1.83	6.80

heterogeneous in terms of the contribution the sample banks make to the system-wide fragility. Panel A shows that the AR ranges from 0.0003 to 0.074 with a mean of 0.02, LRMES ranges from 0.01 to 0.72 with a mean of 0.46, and lastly SRISK ranges from –56493 Billion USD to 164428.9 Billion USD with a mean of 24369.83 Billion USD. Panel C indicates that the sample is also heterogeneous in terms of size, performance, risk culture, liquidity structure, business models and face varying economic and institutional environments. Although all of our sample banks are publicly traded banks, there is considerable variation in size, with the total assets value varying from 5.4 million to 2.5 billion EUROs. Also, the range of 5.2%–28.7% for the BIS ratio is satisfactorily above the regulatory requirement of 4.4% by the Bank for International Settlements; thereby reflecting varying regulatory compliance as well as the healthy state of the sample banks. On average our sample banks have almost half of their assets (0.49) loaned up. Finally, the statistics relating to the ratios of deposits to assets and non-interest income inform the engagement of our sample banks in commercial banking as well as other types of financial operations (investment banking and financial services).

Detailed mean statistics are provided in Appendix Aa-c for each bank, country, and year included in the study. While Dutch banks have the highest institutional ownership (94.5%) and independent directors (90.3%) over the period of study, Italian banks have the highest number of board membership on average. Unsurprisingly, women are more represented on the boards of Norwegian banks (39.6%), which is partly explained by the gender quota system introduced in 2008 (see Appendix Aa and b). Although bank boards from the Scandinavian region (Norway and Denmark) have the highest number of meetings, the frequency of board meetings since the onset of the crisis in 2007 has increased (from 10 to 13). This may be an indication of an increased intensity in internal oversight. Appendix Aa further shows that, with the exception of the Irish Bank, when the banks in our sample are clustered on the basis of country, the contribution towards system-wide systemic risk is similar (between 0.011 and 0.016). Norwegian banks are the most loaned banks with an average loan to assets of 0.56. Finally, Appendix Ac shows that the periods in which the AR was high (2004–2007) were matched with a substantial bank revenue growth. This affirms the importance of bank risk-taking to profitability as we argued earlier. Overall, it can be concluded from our descriptive statistics that our empirical analysis is based on a very heterogeneous sample of banks.

Table 3 presents the Pearson's pair-wise correlation matrix among the variables we use for our analysis. As expected, our systemic risk measure (AR) is significantly correlated with the higher levels of systemic risk (SRISK). As rightly anticipated, Table 3 also shows that the institutional ownership measure is negative and significantly correlated with INDP (−0.09) and BMEET (−0.09), which conjects a possible substitution effect between INSTOWN and strong board mechanisms. In addition to these, the significant correlations between INSTOWN and AR, WOB, INDP, and BMEET offer evidence consistent with Demsetz and Villalonga, (2001) that INSTOWN is endogenously determined by other governance mechanisms and risk.

Finally, it is worth noting that several of our control variables are strongly correlated with each other and their inferences appeal to economic intuition.[11] Most notably, size is positively correlated with non-interest income (0.57), indicating larger banks may be more involved in non-traditional banking activities. Furthermore, similar to Iqbal et al. (2015), the two variables which measure the asset and income structure (deposits to assets and non-interest income) of the banks are strongly and negatively correlated with each other. Finally, WGI exhibits a significant positive correlation with GDP and is positively correlated with ROA, emphasizing the importance of strong institutions for bank (entity) performance and economic development. These results indicate our control variables are able to curb biased estimates as expected.

4. Results

4.1. Univariate analysis

We begin the analysis by examining the univariate relationship between strong board variables and systemic risk. Table 4 presents the two-tailed t-tests of the difference in mean and Wilcoxon/Mann–Whitney median tests under the null hypothesis that there are no differences between the means and medians of the strong board mechanisms of banks with high and low systemic risk. We dichotomize our sample into two sub-samples using the median AR. Thus, sub-samples with their annual AR above and below the median are categorized as high and low systemic banks respectively.

As it can be noted from Table 4, the difference in board size, independence, and female directorship in terms of means and medians are negative and significant. Specifically, high systemic banks have, on average, approximately two board members less, 3% less independent directors, and 4% less female directors. Also, high systemic banks on average have approximately two meetings and 11% institutional shareholders more than banks with low systemic risk. Hence, our univariate analysis provides considerable support for Hypotheses 1, 2, 4, and 5. Thus, our argument that smaller board size, few independent directors, more board meetings, and monitoring by institutional investors increase bank systemic risk are largely supported.

Regarding the control variables, the univariate tests in Table 4 show that banks with higher systemic risk are smaller in size, informing the risk diversification effect of the activities of large banks. Also, high systemic banks have better national economic environments, greater deposits to total assets, a lower percentage of non-interest income and comply more with capital requirement regulations. Finally, banks with higher systemic risk contributions are less liquid relative to lower sys-

[11] Multicollinearity among the regressors should not be a concern as the maximum value of the correlation coefficient is 0.57. Furthermore, in a multivariate setting, the average variance inflation factor (VIF) for our models is between 1.46 and 4.31, which falls below the conventional threshold of 10 (Hair et al., 2006).

Table 3
Correlation matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. AR	1																		
2. LRMES	0.29***	1																	
3. SRISK	0.22***	0.57***	1																
4. BS	−0.030	−0.06	0.07	1															
5. INDP	−0.33	0.28***	0.12*	−0.35***	1														
6. WOB	−0.32***	0.21***	0.130**	−0.05***	0.20***	1													
7. BMEET	0.15**	−0.02	0.16**	−0.35***	0.10*	0.01	1												
8. INSTOWN	0.11*	−0.05	0.03	−0.01	−0.09*	−0.13**	−0.09***	1											
9. Size	−0.060	0.33***	0.77***	0.30***	0.10*	0.07	−0.16***	−0.01	1										
10. ROA	0.259***	−0.27**	−0.43***	0.001	−0.15***	0.02	−0.09*	−0.01	−0.16***	1									
11. GDP	0.024	0.15**	0.15**	−0.50***	0.21***	0.26***	0.21***	−0.01	−0.04	−0.07	1								
12. BIS_ RATIO	−0.28***	0.36***	0.20***	−0.32***	0.27***	0.22***	0.17***	0.19***	0.01	−0.18***	0.42***	1							
13. R_GROWTH	0.238***	−0.22***	−0.21***	0.10*	−0.05	−0.001	−0.09*	0.07	−0.05	0.27***	−0.07+	−0.27***	1						
14. Loan Loss P.	−0.147***	0.11*	0.12*	−0.01	0.07	−0.1*	0.19***	−0.09*	0.10*	−0.59***	−0.11**	−0.01	−0.14***	1					
15. Dep. to Asset	−0.080†	0.03	−0.30***	−0.15***	0.24***	−0.08†	0.10*	0.09*	−0.21***	0.09*	−0.14***	0.14***	0.05	−0.09*	1				
16. Loan to Asset	0.047	−0.27***	−0.52***	−0.36***	0.24***	0.09*	0.32***	−0.04	0.20***	−0.47***	0.04	0.13**	0.11**	−0.10*	0.59***	1			
17. Fin. Crisis	−0.191***	0.01	0.15**	0.03	0.03	0.01	−0.03	−0.06	−0.03	0.10*	0.25***	−0.19***	−0.01	0.06	−0.13**	−0.04	1		
18. Non-Int. Inc.	0.018	0.19***	0.23***	0.17***	0.01	0.27***	−0.06	0.05	0.57***	0.13**	0.10*	0.07†	0.04	−0.02	−0.27***	−0.30***	0.04	1	
19.WGI	0.043	−0.09 †	−0.07	−0.45***	0.03	0.13**	0.02	0.19***	−0.19***	0.13**	0.41***	0.24***	−0.02	−0.22***	−0.02	0.043	−0.08*	0.02	1

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. See Table 1 for variable definitions.

Table 4
T-test and Wilcoxon/Mann Whitney tests of differences in Means and Medians.

Strong Board Variable	Higher AR		Low AR		Difference in Means	Difference in Median
	Mean	Median	Mean	Median		
Independent Variables						
Board Size	14.2	14	15.8	15	−1.6***	−1**
Board Independence (%)	54.0	57.0	57.0	59.0	−3.0***	−2.0
Board Meetings	12.2	11	10.4	11	1.8***	0
Women on Board (%)	19.0	17.0	23.0	22.0	−4.0***	−5.0**
Institut. Ownership (%)	75.0	85.0	64.0	70.0	11.0***	15.0***
Control Variables						
Size (€)	529798.2	351744.5	598056.5	386846.5	−68258.26†	−35102
Return on Assets (%)	0.386	0.39	0.389	0.42	−0.003	−0.003
GDP	10.58	10.64	10.53	10.57	0.05*	0.07*
BIS RATIO	11.86	11.5	10.56	10	1.30***	1.5**
Loan loss Provision	0.19	0.11	0.26	0.19	−0.07**	−0.08***
Revenue Growth (%)	5.75	0.19	2.69	−0.79	3.05†	0.98*
Loan to Assets	0.50	0.53	0.48	0.51	0.02	−0.02
Deposit to Asset	40.06	37.9	37.95	38.1	2.11*	−0.2
Non-Interest Income (€)	8198.5	4845	9055.9	6258.5	−857.4	−1413.5*
Govern. Effectiveness	91.56	92.78	91.2	92.42	0.36	0.37

temic risk banks, which is in line with Wagner's (2007) conclusion that illiquidity exacerbates system-wide financial fragility. We proceed to test if these relations hold in a multivariate setting.

4.2. Quantile regression

Our goal to further analyze the effect of our strong board mechanisms using a quantile regression is to (1) reinforce the relations reported by the univariate tests; and (2) assess if the mixed results in the literature (see Section 2) are accounted for by the distribution of the data used in these studies (see e.g., Hao & Naiman, 2007; Armstrong et al., 2015).

Table 5 shows that the direction of our coefficient for our four proxies for strong boards are consistent (as per the results with our univariate tests) throughout the ten quantiles. Specifically, WOB is significantly negative across most of the quantile distribution. Also, board meetings positively and significantly promote bank systemic risk even at the lower quantiles of the distribution, indicating that board meetings enable executives to take more risk (Vafeas, 1999) Finally, INST and BINDP are mostly significant at the upper quantile of the distribution (mainly from q60-q90) and are associated with an increase in the pseudo-R-squared (from 6.0% to 50.8%). Subtly these results inform that, while a substantial increase in institutional shareholdings propagates more systemic risk, the opposite may result when independent directorship makes up more than 50% of the board.

Overall, we ascertain evidence for the consistent effect strong board mechanisms have on bank risk as predicted by the univariate analysis. In turn, the magnitudes of these effects increase on the continuum with the strong board mechanisms.

4.3. Two stage least squares (2SLS)

Using the absorption ratio (AR) as a dependent variable, Table 6 presents the two-stage least squares (2SLS) regression results of the complement versus substitute tests. The average institutional ownership held by other D-SIB banks in the country is used as a valid instrument for institutional ownership (Laeven & Levine, 2009). The regression models (1–5) are well-fitted with statistically significant test statistics for the tests of endogeneity and of over-identification restrictions, confirming the validity of the instrument and no model misspecification. Model 1 includes our control variables and governance mechanisms variables as the main effects. We describe Models 2 to 5 in more detail as they report the interaction effects of institutional ownership (INSTOWN) and the strong board mechanisms of interest on systemic risk.

In each model, the main effects of the governance variables, bank, and country-specific variables are controlled for. Model 1 reaffirms the findings from the univariate and quantile analyses that strong board mechanisms (with the exception of board size) individually significantly affect bank systemic risk-taking. This result is largely consistent with the findings of Pathan (2009) and demonstrates the validity of Hypotheses 2, 3, 4 and 5.

In Model 2, the interaction term between an external monitoring mechanism (INSTOWN) and an internal monitoring mechanism (BS) is negative and marginally significant ($\beta = -1.271$) at the 10% level. However, an additional simple-slope test indicates that the relationship between board size and systemic risk is not significant when INSTOWN is low ($\text{simpleslope} = 2.970, \text{n.s.}$) but is significant when INSTOWN is high ($\text{simpleslope} = 7.954, p < 0.014$), lending support for the complementary hypothesis. Thus, although a smaller board individually promotes systemic risk, a larger bank board can equally achieve high systemic risk if there is considerable monitoring and control by institutional owners. This evidence indicates that the risk attenuating consequences associated with the less efficient, delayed, and uncoordinated decisions of

Table 5

Quantile Regression Estimates: Corporate Governance Drivers of Bank Systemic Risk: AR. This table reports of results the following panel regression specification.$AR_{i,t} = \alpha + \beta_1 ln(BS)_{i,t} + \beta_2(WOB)_{i,t} + \beta_3(INDP)_{i,t} + \beta_4(BMEET)_{i,t} + \psi_5(INSTOWN)_{i,t} + \delta_1 ln(TA)_{i,t} + \delta_2(ROA)_{i,t} + \delta_3(GDP)_{i,t} + \delta_4(BIS_{RATIO})_{i,t} + \delta_5(DeposittoAssets)_{i,t} + \delta_6(LoanLossProvision)_{i,t} + \delta_7(RevenueGrowth)_{i,t} + \delta_8(LoantoAssets)_{i,t} + \delta_9(CrisisDummy)_{i,t} + \delta_{10}(NonInterestIncome)_{i,t} + \delta_{11}(WGI)_{i,t} + \eta_i + \varepsilon_{i,t}$. *The table reports the estimates of the individual effect of strong board mechanisms on bank risk taking using a quantile regression for 10 quantiles on the data's distribution. The results are based on a sample of 38 domestic systemically important banks (D-SIBs) and 430 bank years from the period (t = 2000,2001,2002…,2016).* ln *is the natural logarithm.* β, ψ, δ *are our parameters to be estimated for the strong board mechanisms, institutional shareholdings, interaction mechanisms, and control variables, respectively. Finally,* η_i *and* $\varepsilon_{i,t}$ *represent the time-invariant unobserved firm-specific factor and the idiosyncratic error term, respectively. Robust standard errors are in parentheses. Superscripts †, *, **, *** indicate statistical significance at 10%, 5%, 1% and 0.1% levels, respectively.*

Dependent Variable: Absorption Ration (AR)									
	q10	q20	q30	q40	q50	q60	q70	q80	q90
β_1Ln (BS)	−0.010	−0.018	−0.037	−0.034	−0.016	0.038	−0.152	−0.116	0.033
	(0.016)	(0.027)	(0.023)	(0.064)	(0.145)	(0.334)	(0.271)	(0.259)	(0.315)
β_2WOB	**−0.129*****	**−0.126****	−0.097	−0.241	**−0.646**†	**−1.954*****	**−2.571*****	**−2.531*****	**−1.836*****
	(0.034)	**(0.048)**	(0.075)	(0.263)	**(0.358)**	**(0.467)**	**(0.541)**	**(0.697)**	**(0.485)**
β_3INDP	−0.016	−0.039	−0.08**	−0.103	−0.273	−0.734	**−1.290*****	**−1.498*****	**−1.308*****
	(0.019)	(0.028)	(0.028)	(0.160)	(0.225)	(0.536)	**(0.320)**	**(0.418)**	**(0.300)**
β_4BMEET	**0.003*****	**0.004*****	**0.004***	0.005	**0.013****	**0.031***	**0.035****	**0.051****	**0.037***
	(0.001)	**(0.001)**	**(0.002)**	(0.006)	**(0.005)**	**(0.014)**	**(0.012)**	**(0.017)**	**(0.015)**
ψ_5INSTOWN	0.004	0.010	0.025	0.048	0.170	**0.577*****	**0.524***	0.228	0.214
	(0.019)	(0.019)	(0.024)	(0.065)	(0.212)	**(0.166)**	**(0.216)**	(0.218)	(0.213)
δ_1Size	0.001	−0.002	0.009	0.006	0.010	0.014	0.065	0.061	0.013
	(0.007)	(0.006)	(0.007)	(0.014)	(0.034)	(0.085)	(0.054)	(0.078)	(0.067)
δ_2ROA	−0.003	0.003	0.018	0.038	0.091	0.269*	0.200	0.0632	0.201
	(0.008)	(0.018)	(0.020)	(0.044)	(0.088)	(0.107)	(0.226)	(0.159)	(0.149)
δ_3GDP	0.024	0.036	0.053†	0.112	0.337†	0.865**	0.716***	0.594	0.165
	(0.026)	(0.023)	(0.027)	(0.159)	(0.173)	(0.334)	(0.196)	(0.525)	(0.501)
δ_4BIS RATIO	0.001	0.001	0.0001	−0.003	−0.019	−0.090**	−0.122***	−0.116***	−0.121***
	(0.002)	(0.002)	(0.003)	(0.012)	(0.018)	(0.028)	(0.021)	(0.015)	(0.015)
δ_5DEPOSITS TO ASSET	−0.0001	−0.0003	0.001	0.001	0.00004	−0.003	0.0005	−0.003	−0.006
	(0.0003)	(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.006)	(0.006)	(0.004)
δ_6LOAN LOSS PROV. RATIO	−0.025	−0.052	−0.036	−0.046	−0.041	−0.167	−0.244	−0.267	−0.138
	(0.030)	(0.038)	(0.039)	(0.063)	(0.154)	(0.173)	(0.283)	(0.258)	(0.241)
δ_7REVENUE_GROWTH	0.006†	0.003	0.002	0.024	0.114	0.131	0.133†	0.183**	0.070
	(0.003)	(0.007)	(0.016)	(0.044)	(0.076)	(0.092)	(0.073)	(0.056)	(0.055)
δ_8LOAN TO ASSETS	0.020	−0.005	−0.018	−0.027	0.139	0.741	1.000*	1.389**	1.647*
	(0.034)	(0.045)	(0.047)	(0.096)	(0.352)	(0.617)	(0.476)	(0.468)	(0.671)
δ_9FCRIS_DUMMY	−0.63***	−0.050***	−0.065***	−0.096†	−0.171	−0.752***	−1.019***	−1.096***	−1.302***
	(0.008)	(0.010)	(0.014)	(0.056)	(0.132)	(0.197)		(0.149)	(0.159)
							(0.118)		
δ_{10}NON-INTEREST INCOME	0.006	0.005	−0.002	0.007	0.029	0.065	0.127†	0.154**	0.077
	(0.005)	(0.006)	(0.008)	(0.015)	(0.023)	(0.065)	(0.074)	(0.059)	(0.062)
δ_{11}WGI	−0.001	−0.001	−0.002*	−0.003	−0.005	−0.006	−0.002	0.004	0.007
	(0.001)	(0.0001)	(0.001)	(0.002)	(0.008)	(0.007)	(0.006)	(0.010)	(0.006)
Constant	−0.750***	−0.797*	−0.925**	−1.363	−3.537*	−7.895†	−5.851*	−4.836	−0.088
	(0.290)	(0.255)	(0.310)	(1.402)	(1.721)	(4.053)	(2.720)	(5.254)	(5.590)
Pseudo R-Square	0.060	0.037	0.034	0.035	0.052	0.124	0.297	0.439	0.508
No. of Observations	430	430	430	430	430	430	430	430	430

Standard errors in parentheses.
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

large boards may be alleviated by the monitoring and oversight exerted by institutional shareholders to induce higher bank systemic risk. Furthermore, a larger board sizeoffers institutional owners the possibility of ample board representation to pursue their preference for high risk more closely by prompting executive and director diligence and discipline (Grossman & Hart, 1982; Ward et al., 2009). We also include in Models 1 and 2 of all of the regression estimates a squared term of board size, $[\text{Ln}(\text{BS})]^2$. We do so to further explore the possible non-linear relationship of board size with systemic risk. We observe that the direction of the coefficient for $[\text{Ln}(\text{BS})]^2$ is opposed to that of Ln(BS). Notably, this is significant for the main result, which suggests that a non-linear relationship between board size and systemic risk exists.

In Model 3, the interaction term between two monitoring mechanisms, board independence and institutional ownership (INSTOWN × INDP), is positive and statistically significant ($\beta = 1.464$). Since a simple slope test reports significance at low INSTOWN ($\text{simpleslope} = -1.937, p < 0.000$), we conclude a substitution effect for this bundle. That is, when independent board directors exist, the monitoring and control exerted by institutional investors does not marginally increase bank systemic risk. In Model 4, we find a positive and significant interaction between BMEET and INSTOWN ($\beta = 0.0491$). The simple-slope test confirms a complementary effect between these two monitoring mechanisms; at a low level of INSTOWN, the relationship between BMEET and bank systemic risk is not significant ($\text{simpleslope} = 0.012, \text{n.s.}$) but becomes significant when

Table 6

. 2SLS Estimates: Corporate Governance Drivers of Bank Systemic Risk: AR. This table reports results of the following general panel regression specification. $AR_{i,t} = \alpha + \beta_1 \ln(BS)_{i,t} + \beta_2[\ln(BS)]^2_{i,t} + \beta_3(WOB)_{i,t} + \beta_4(INDP)_{i,t} + \beta_5(BMEET)_{i,t} + \psi_6(INSTOWN)_{i,t} + \theta D_{i,t} + \delta_1 \ln(TA)_{i,t} + \delta_2(ROA)_{i,t} + \delta_3(GDP)_{i,t} + \delta_4(BIS_{RATIO})_{i,t} + \delta_5(DeposittoAssets)_{i,t} + \delta_6(LoanLossProvision)_{i,t} + \delta_7(RevenueGrowth)_{i,t} + \delta_8(LoantoAssets)_{i,t} + \delta_9(CrisisDummy)_{i,t} + \delta_{10}(NonInterestIncome)_{i,t} + \delta_{11}(WGI)_{i,t} + \eta_i + \varepsilon_{i,t}$. The model employs a two stage least squares regression (2SLS) which instruments institutional ownership with the average institutional ownership held by other DSIBs in the country of a focal bank. The results are based on a sample of 38 domestic systemically important banks (D-SIBs) and 434 bank years from the period (t = 2000,2001,2002…,2016). ln is the natural logarithm. At any point, $D_{i,t}$ denotes the interactions between our measure of institutional shareholding and our variables of interest. $\beta, \psi, \theta, \delta$ are our parameters to be estimated for the strong board mechanisms, institutional shareholdings, interaction mechanisms, and control variables, respectively. Finally, η_i and $\varepsilon_{i,t}$ represent the time-invariant unobserved firm-specific factor and the idiosyncratic error term respectively. Robust standard errors are in parentheses. Superscripts †, *, **, *** indicate statistical significance at 10%, 5%, 1% and 0.1% levels, respectively. The F-test for excluded instruments (exogeneity test) as well as the test statistics for the test of over identification restrictions indicate the validity of our chosen instrument throughout Models 1–5. The associated significance supports the validity of the instruments and no model misspecification. The reported estimates are for the second stage.

Dependent Variable: Absorption Ratio					
	Model 1	Model 2	Model 3	Model 4	Model 5
β_1Ln (BS)	0.125	6.365**			
	(1.713)	(2.467)			
β_2[Ln (BS)]^2	−0.0653	−1.015*			
	(0.323)	(0.419)			
β_3WOB	−2.126***				−0.605
	(0.299)				(0.686)
β_4INDP	−1.087***		−2.156***		
	(0.210)		(0.546)		
β_5BMEET	0.0314***			0.00509	
	(0.00821)			(0.0132)	
ψ_6INSTOWN	0.380**	3.908*	−0.529	−0.0445	1.064***
	(0.133)	(1.787)	(0.484)	(0.248)	(0.267)
θ_1INSTOWN × Ln(BS)		**−1.271†**			
		(0.675)			
θ_2INSTOWN × INDP			**1.464***		
			(0.707)		
θ_3INSTOWN × BMEET				**0.0491***	
				(0.0198)	
θ_4INSTOWN × WOB					**−2.837****
					(1.032)
δ_1Size	0.0636	−0.0433	0.0338	−0.000181	−0.0166
	(0.0410)	(0.0540)	(0.0491)	(0.0471)	(0.0449)
δ_2ROA	0.236*	0.451***	0.352**	0.368**	0.314**
	(0.102)	(0.118)	(0.114)	(0.112)	(0.106)
δ_3GDP	0.842***	1.026***	1.081***	0.714***	0.869***
	(0.185)	(0.208)	(0.215)	(0.209)	(0.178)
δ_4BIS RATIO	−0.0914***	−0.114***	−0.101***	−0.116***	−0.0955***
	(0.0137)	(0.0150)	(0.0144)	(0.0152)	(0.0147)
δ_5DEPOSITS TO ASSET	−0.00239	−0.00399	−0.00113	−0.00395	−0.00909**
	(0.00337)	(0.00360)	(0.00352)	(0.00352)	(0.00351)
δ_6LOAN LOSS PROV. RATIO	−0.118	0.297	0.220	0.00243	0.0564
	(0.189)	(0.196)	(0.185)	(0.210)	(0.189)
δ_7REVENUE_GROWTH	0.127*	0.132*	0.121*	0.133*	0.111*
	(0.0537)	(0.0607)	(0.0570)	(0.0576)	(0.0544)
δ_8LOAN TO ASSETS	0.555	0.289	0.774*	0.0226	0.860**
	(0.365)	(0.410)	(0.358)	(0.378)	(0.325)
δ_9FCRIS_DUMMY	−0.817***	−0.991***	−0.927***	−0.912***	−0.930***
	(0.0920)	(0.0944)	(0.0927)	(0.0942)	(0.0929)
δ_{10}NON-INTEREST INCOME	0.0540	−0.0454	−0.0201	−0.0341	0.0676
	(0.0421)	(0.0459)	(0.0448)	(0.0434)	(0.0447
δ_{11}WGI	−0.00688	−0.00543	−0.0111†	−0.00406	−0.00290
	(0.00636)	(0.00665)	(0.00614)	(0.00625)	(0.00606)
Constant	−7.560*	−18.54***	−9.031***	−6.060**	−7.820***
	(3.187)	(4.293)	(2.391)	(2.239)	(1.939)
Adjusted R^2	0.486	0.340	0.379	0.377	0.412
Over-identification	0.00	0.00	3.855e-13	2.804e-13	9.637e-14
Test-stat (critical value)	(3.84)	(3.84)	(3.84)	(3.84)	(3.84)
F-test of	20.06***	12.98**	28.16***	20.00***	15.96***
Excluded Instrument					
Observations	421	434	434	421	434

Standard errors in parentheses.
† p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

institutional investor monitoring is high ($simpleslope = 0.067, p < 0.000$). Thus, banks' systemic risk increases when managerial actions are concurrently monitored through meetings and institutional investors. Consistent with theory, this finding illuminates the instrumental role of board meetings in the pursuit of shareholder goals. Through board meetings, the activist roles of influential owners are effectively undertaken to promote systemic risk. Board meetings bring institutional owners in direct contact with executives and directors to ask questions, seek explanations about issues, review meeting materials, and most importantly exercise decisive voting rights to influence critical decisions (Tosi & Gomez-Mejia, 1989). This allows institutional owners to supervise managers and independent directors, collect information, and engage in strategic decisions for the bank (Adams & Ferreira, 2008; Chou, Chung &Yin, 2013). Thus, it appeals to conventional wisdom that the synergistic effect of frequent board meetings and institutional ownership monitoring yields high systemic risk.

Finally, Model 5 examines the interaction between WOB and INSTOWN, reporting a negative significant coefficient ($\beta = -2.837$). A simple-slope test confirms a complementary effect between these mechanisms; the effect of WOB on bank systemic risk-taking is not significant when monitoring by institutional investors is low ($simpleslope = -0.237, n.s.$), but is significant when INSTOWN is high ($simpleslope = -5.003, p < 0.000$). Hence, when there exists considerable monitoring by institutional investors, the appointment of women to bank board synergistically promote systemic risk. Institutional shareholders have been documented to possess disciplinary potency. The presence of an outside (institutional) blockholder increases the sensitivity of top executive turnover to firm performance (Kaplan & Minton, 1994; Franks & Mayer, 1994; Denis & Serrano, 1996). For example, takeovers are a viable strategy used by institutional shareholders to replace previously ineffective monitors of management (Shleifer & Vishny, 1986). Furthermore, in line with our results so far, women tend to be less overconfident than their male counterparts and hence take minimal risk (Barber & Odean, 2001; Niederle & Vesterlund, 2007). Consequently, it follows that female directors are more likely to be sanctioned by institutional shareholders. This possible threat of being sanctioned offers an explanation to our finding that when institutional investor monitoring exists, female directors on bank boards encourage and endorse decisions that promote more systemic risk.[12]

In addition to being statistically significant, the economic significance of our results is compelling. Given that the reported mean and median for AR are 0.02 and 0.004 respectively, the coefficients of the interaction variables indicate that a one standard deviation change in board size, board independence, board meetings, and female directorship will on average change a bank's contribution to system fragility (AR) by approximately 7.43, 19.03, 11.8, and 15.6 percentage points, respectively, when there is considerable institutional ownership.[13] Overall, our results show that external monitoring by institutional owners complements various internal monitoring governance mechanisms to promote bank systemic risk-taking.

4.4. Robustness tests

We perform a number of additional tests to examine the sensitivity of our empirical results. First Adams et al. (2010) argue that corporate governance mechanisms are largely endogenous. To ensure the results presented above are to a greater extent rid of endogeneity and reverse causality concerns emanating from the governance variables (other than institutional ownership), we re-estimate our model using the Hausman-Taylor estimation (Hausman & Taylor, 1981). This estimation technique, unlike the fixed and random-effect models, addresses the endogeneity problem by estimating time-invariant regressors while using the between and within-variations of a subset of variables that are specified to be endogenous as instruments. Accordingly, we specify all our governance mechanism variables as endogenous variables. The results, slope test analysis, and conclusions of this alternative estimation are similar to our main findings.

Second, since there is no consensus on the appropriate proxy for systemic risk, we examine the sensitivity of our result using alternative measures for systemic risk. For alternative dependent variables, we use other market-based systemic risk measures, LRMES and SRISK, proposed by Acharya et al. (2012). Simply, SRISK is defined as the amount of "capital that a firm is expected to need if we have another financial crisis". The data for LRMES and SRISK were obtained from NYU Stern's V-Lab website. The methodology behind the computation of LRMES and SRISK is based on the approach of Brownlees and Engle (2015) and utilizes publicly available stock market data in its attempt to capture the capital shortfall of an institution amidst a financial crisis based on its stock return volatility and correlation with the market. The results for these analyses are reported in Tables 7 (LRMES as dependent variable) and 8 (SRISK as dependent variable). For the case of SRISK, two bundles are consistent with the main results. Overall, we report consistency for our bundles across at least two alternative measures of systemic risk. Overall, the estimates with LRMES and SRISK as dependent variables are qualitatively similar to our main findings reported in Table 6.

Interestingly, unlike Tables 6 and 7, the interaction between WOB and INST is insignificant in Table 8. These discrepancies we maintain can be attributed to the different perspectives AR and SRISK offer on systemic risk. Kritzman et al. (2011) simply define the AR as the contribution and exposure of a focal bank to the overall risk of the system given a strong common component across the returns of all the banks' equity while Acharya et al. (2012) define systemic risk (SRISK) as the amount of "capital that a firm is expected to need if we have another financial crisis". That is, while the AR basically looks at a bank's role in the entire system fragility, the SRISK takes a view on the potential pecuniary losses which a bank may face in times of

[12] We follow Vives (1990) for explaining the complementary and substitution matching between variables. A detailed explanation of this preamble is provided now in the appendix B of the manuscript.

[13] For instance, the standard deviation of $INSTOWN \times INDP$ interaction is 0.256 (unreported). The economic significance of this is computed as $0.256 \times 1.464/0.02 = 19.032$. Similar computations are repeated for the other interactions.

Table 7

2SLS Estimates: Corporate Governance Drivers of Bank Systemic Risk: LRMES. This table reports results of the following general panel regression specification. $LRMES_{i,t} = \alpha + \beta_1 \ln(BS)_{i,t} + \beta_2[\ln(BS)]^2_{i,t} + \beta_3(WOB)_{i,t} + \beta_4(INDP)_{i,t} + \beta_5(BMEET)_{i,t} + \psi_6(INSTOWN)_{i,t} + \theta D_{i,t} + \delta_1 \ln(TA)_{i,t} + \delta_2(ROA)_{i,t} + \delta_3(GDP)_{i,t} + \delta_4(BIS_{RATIO})_{i,t} + \delta_5(DeposittoAssets)_{i,t} + \delta_6(LoanLossProvision)_{i,t} + \delta_7(RevenueGrowth)_{i,t} + \delta_8(LoantoAssets)_{i,t} + \delta_9(CrisisDummy)_{i,t} + \delta_{10}(NonInterestIncome)_{i,t} + \delta_{11}(WGI)_{i,t} + \eta_i + \varepsilon_{i,t}$. The model employs a two stage least squares regression (2SLS) which instruments institutional ownership with the average institutional ownership held by other DSIBs in the country of a focal bank. The results are based on a sample of 38 domestic systemically important banks (D-SIBs) and 366 bank years from the period (t = 2000,2001,2002. . .,2016). ln is the natural logarithm. At any point, $D_{i,t}$ denotes the interactions between our measure of institutional shareholding and our variables of interest. $\beta, \psi, \theta, \delta$ are our parameters to be estimated for the, strong board mechanisms, institutional shareholdings, interaction mechanisms, and control variables, respectively. Finally, η_i and $\varepsilon_{i,t}$ represent the time-invariant unobserved firm-specific factor and the idiosyncratic error term respectively. Robust standard errors are in parentheses. Superscripts †, *, **, *** indicate statistical significance at 10%, 5%, 1% and 0.1% levels, respectively. The F-test for excluded instruments (exogeneity test) as well as the test statistics for the test of over identification restrictions indicate the validity of our chosen instrument throughout Models 1–5. The associated significance supports the validity of the instruments and no model misspecification. The reported estimates are for the second stage.

Dependent Variable: LRMES					
	Model 1	Model 2	Model 3	Model 4	Model 5
β_1Ln (BS)	−7.601**	−5.187			
	(2.871)	(3.279)			
β_2[Ln (BS)]^2	1.536**	1.113†			
	(0.548)	(0.590)			
β_3WOB	−1.382***				−0.851
	(0.383)				(0.988)
β_4INDP	−0.462*		−1.416*		
	(0.220)		(0.631)		
β_5BMEET	−0.00337			−0.0200	
	(0.00621)			(0.0143)	
ψ_6INSTOWN	0.196	0.357*	−0.519	−0.0387	0.324*
	(0.165)	(1.932)	(0.536)	(0.345)	(0.341)
θ_1INSTOWN × Ln(BS)		**−0.0484**†			
		(0.723)			
θ_2INSTOWN × INDP			**1.268**†		
			(0.863)		
θ_3INSTOWN × BMEET				0.0287	
				(0.0238)	
θ_4INSTOWN × WOB					**−0.194***
					(1.342)
δ_1Size	−0.196***	−0.211***	−0.192***	−0.191***	−0.199***
	(0.0515)	(0.0544)	(0.0510)	(0.0512)	(0.0498)
δ_2ROA	0.177	0.312*	0.263*	0.287*	0.225
	(0.136)	(0.139)	(0.133)	(0.141)	(0.140)
δ_3GDP	0.00452	0.0297	−0.0392	−0.103	−0.114
	(0.215)	(0.242)	(0.166)	(0.188)	(0.168)
δ_4BIS RATIO	−0.0493***	−0.0680***	−0.0676***	−0.0703***	−0.0675***
	(0.0129)	(0.0127)	(0.0130)	(0.0125)	(0.0131)
δ_5DEPOSITS TO ASSET	−0.00850	−0.00815†	−0.00620	−0.00696	−0.00989*
	(0.00519)	(0.00460)	(0.00502)	(0.00529)	(0.00497)
δ_6LOAN LOSS PROV. RATIO	0.125	0.265	0.180	0.207	0.0648
	(0.247)	(0.270)	(0.256)	(0.254)	(0.272)
δ_7REVENUE_GROWTH	0.0602	0.0658	0.0896†	0.106*	0.0877†
	(0.0461)	(0.0510)	(0.0519)	(0.0540)	(0.0530)
δ_8LOAN TO ASSETS	1.744***	1.552***	1.177***	1.009**	1.199***
	(0.345)	(0.329)	(0.282)	(0.307)	(0.299)
δ_9FCRIS_DUMMY	0.00421	−0.0707	−0.0413	−0.0369	−0.0488
	(0.104)	(0.112)	(0.113)	(0.115)	(0.117)
δ_{10}NON-INTEREST INCOME	0.0591	−0.00616	−0.00611	−0.0239	0.0113
	(0.0608)	(0.0590)	(0.0648)	(0.0664)	(0.0673)
δ_{11}WGI	0.0205**	0.0239**	0.0118†	0.0140*	0.0168*
	(0.00768)	(0.00747)	(0.00620)	(0.00688)	(0.00688)
Constant	10.15*	5.977	2.709	2.670	2.641
	(5.076)	(6.008)	(2.199)	(2.204)	(2.050)
Adjusted R^2	0.389	0.361	0.345	0.314	0.339
Over-identification	1.176e-13	1.219e-13	0.00	1.960e-13	0.00
Test-stat (criticalvalue)	(3.84)	(3.84)	(3.84)	(3.84)	(3.84)
F-test of Excluded Instrument	11.91***	8.32*	7.84*	10.98**	4.13
Observations	353	366	366	353	366

Standard errors in parentheses.
† p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

Table 8

2SLS Estimates: Corporate Governance Drivers of Bank Systemic Risk: SRISK. This table reports results of the following general panel regression specification. $SRISK_{i,t} = \alpha + \beta_1 \ln(BS)_{i,t} + \beta_2[\ln(BS)]^2_{i,t} + \beta_3(WOB)_{i,t} + \beta_4(INDP)_{i,t} + \beta_5(BMEET)_{i,t} + \psi_6(INSTOWN)_{i,t} + \theta D_{i,t} + \delta_1 \ln(TA)_{i,t} + \delta_2(ROA)_{i,t} + \delta_3(GDP)_{i,t} + \delta_4(BIS_{RATIO})_{i,t} + \delta_5(DeposittoAssets)_{i,t} + \delta_6(LoanLossProvision)_{i,t} + \delta_7(RevenueGrowth)_{i,t} + \delta_8(LoantoAssets)_{i,t} + \delta_9(CrisisDummy)_{i,t} + \delta_{10}(NonInterestIncome)_{i,t} + \delta_{11}(WGI)_{i,t} + \eta_i + \varepsilon_{i,t}$. The model employs a two stage least squares regression (2SLS) which instruments institutional ownership with the average institutional ownership held by other DSIBs in the country of a focal bank. The results are based on a sample of 38 domestic systemically important banks (D-SIBs) and 366 bank years from the period (t = 2000,2001,2002. . .,2016). ln is the natural logarithm. At any point, $D_{i,t}$ denotes the interactions between our measure of institutional shareholding and our variables of interest. $\beta, \psi, \theta, \delta$ are our parameters to be estimated for the strong board mechanisms, institutional shareholdings, interaction mechanisms, and control variables, respectively. Finally, η_i and $\varepsilon_{i,t}$ represent the time-invariant unobserved firm-specific factor and the idiosyncratic error term, respectively. Robust standard errors are in parentheses. Superscripts †, *, **, *** indicate statistical significance at 10%, 5%, 1% and 0.1% levels, respectively. The F-test for excluded instruments (exogeneity test) as well as the test statistics for test of over identification restrictions indicate the validity of our chosen instrument throughout Models 1–5. The associated significance supports the validity of the instruments and no model misspecification. The reported estimates are for the second stage.

Dependent Variable: SRISK					
	Model 1	Model 2	Model 3	Model 4	Model 5
β_1Ln (BS)	−3.163†	−0.842			
	(1.725)	(1.992)			
β_2[Ln (BS)]^2	0.773*	0.503			
	(0.322)	(0.327)			
β_3WOB	−0.352				−0.267
	(0.319)				(0.641)
β_4INDP	0.0876		0.391		
	(0.180)		(0.476)		
β_5BMEET	0.00430			−0.0207*	
	(0.00626)			(0.0100)	
ψ_6INSTOWN	−0.101	3.364†	0.432	−0.497†	−0.0875
	(0.136)	(1.810)	(0.424)	(0.290)	(0.282)
θ_1INSTOWN × Ln(BS)		**−1.289**†			
		(0.687)			
θ_2INSTOWN × INDP			−0.840		
			(0.644)		
θ_3INSTOWN × BMEET				**0.0354**†	
				(0.0195)	
θ_4INSTOWN × WOB					0.303
					(1.024)
δ_1Size	−0.451***	−0.486***	−0.394***	−0.414***	−0.412***
	(0.0438)	(0.0462)	(0.0416)	(0.0419)	(0.0409)
δ_2ROA	0.553***	0.601***	0.519***	0.563***	0.543***
	(0.144)	(0.140)	(0.153)	(0.153)	(0.151)
δ_3GDP	0.103	0.155	−0.133	−0.0770	−0.135
	(0.161)	(0.164)	(0.132)	(0.139)	(0.132)
δ_4BIS RATIO	−0.0353**	−0.0377***	−0.0390***	−0.0421***	−0.0433***
	(0.0112)	(0.0101)	(0.0106)	(0.0109)	(0.0112)
δ_5DEPOSITS TO ASSET	0.00799*	0.00896*	0.00852*	0.00973*	0.00719†
	(0.00391)	(0.00369)	(0.00407)	(0.00418)	(0.00399)
δ_6LOAN LOSS PROV. RATIO	0.508*	0.637*	0.408	0.468†	0.429†
	(0.253)	(0.249)	(0.259)	(0.264)	(0.258)
δ_7REVENUE_GROWTH	0.0681†	0.0695†	0.0911*	0.112**	0.0876*
	(0.0377)	(0.0365)	(0.0414)	(0.0423)	(0.0403
δ_8LOAN TO ASSETS	2.413***	2.200***	1.850***	1.797***	1.785***
	(0.332)	(0.315)	(0.281)	(0.294)	(0.285)
δ_9FCRIS_DUMMY	−0.352***	−0.371***	−0.323**	−0.332**	−0.344**
	(0.107)	(0.105)	(0.114)	(0.114)	(0.118)
δ_{10}NON-INTEREST INCOME	0.110*	0.0982*	0.0776	0.0828	0.0804
	(0.0486)	(0.0451)	(0.0505)	(0.0511)	(0.0524)
δ_{11}WGI	0.0155**	0.0155**	0.00626	0.00492	0.00516
	(0.00560)	(0.00529)	(0.00514)	(0.00518)	(0.00517)
Constant	4.820	0.530	4.670**	4.929**	5.421***
	(3.388)	(4.020)	(1.658)	(1.637)	(1.599)
Adjusted R^2	0.637	0.631	0.597	0.606	0.594
Over-identification	3.527e-13	0.00	0.00	0.00	8.127e-14
Test-stat (critical value)	(3.84)	(3.84)	(3.84)	(3.84)	(3.84)
F-test of Excluded Instrument	11.48***	18.21***	13.49**	10.30**	13.59**
Observations	353	366	366	353	366

Standard errors in parentheses.
† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 9

2SLS Estimates: Corporate Governance Drivers of Bank Systemic Risk: SRISK. This table reports results of the following general panel regression specification. $SRISK_{i,t} = \alpha + \beta_1 \ln(BS)_{i,t} + \beta_2[\ln(BS)]^2_{i,t} + \beta_3(WOB)_{i,t} + \beta_4(INDP)_{i,t} + \beta_5(BMEET)_{i,t} + \psi_6(INSTOWN)_{i,t} + \theta D_{i,t} + \delta_1 \ln(TA)_{i,t} + \delta_2(ROA)_{i,t} + \delta_3(GDP)_{i,t} + \delta_4(BIS_{RATIO})_{i,t} + \delta_5(DeposittoAssets)_{i,t} + \delta_6(LoanLossProvision)_{i,t} + \delta_7(RevenueGrowth)_{i,t} + \delta_8(LoantoAssets)_{i,t} + \delta_9(CrisisDummy)_{i,t} + \delta_{10}(NonInterestIncome)_{i,t} + \delta_{11}(WGI)_{i,t} + \eta_i + \varepsilon_{i,t}$. The model employs a two stage least squares regression (2SLS) which instruments institutional ownership with the average institutional ownership held by other DSIBs in the country of a focal bank. The results are based on a sample of 111 smaller EEA banks and 380 bank years from the period (t = 2005,2001,2002. . .,2019) to externally validate our findings for non-DSIBs. ln is the natural logarithm. At any point, $D_{i,t}$ denotes the interactions between our measure of institutional shareholding and our variables of interest. $\beta, \psi, \theta, \delta$ are our parameters to be estimated for the strong board mechanisms, institutional shareholdings, interaction mechanisms, and control variables, respectively. Finally, η_i and $\varepsilon_{i,t}$ represent the time-invariant unobserved firm-specific factor and the idiosyncratic error term, respectively. Robust standard errors are in parentheses. Superscripts †, *, **, *** indicate statistical significance at 10%, 5%, 1% and 0.1% levels, respectively. The F-test for excluded instruments (exogeneity test) as well as the test statistics for the test of over identification restrictions indicate the validity of our chosen instrument throughout Models 1–5. The associated significance supports the validity of the instruments and no model misspecification. The reported estimates are for the second stage. Dependent Variable: Absorption Ratio

	Model 1	Model 2	Model 3	Model 4	Model 5
β_1Ln (BS)	−3.151 (2.436)	1.671 (1.365)			
β_2[Ln (BS)]^2	0.633 (0.444)	−0.259 (0.230)			
β_3WOB	−0.405 (0.583)				0.612† (0.366)
β_4INDP	2.320*** (0.494)		−0.504 (0.372)		
β_5BMEET	−0.01937* (0.00647)			−0.0236* (0.00936)	
ψ_6INSTOWN	−0.0143 (0.285)	1.447 (1.000)	−2.610*** (0.530)	−0.628 (0.447)	−0.0363 (0.170)
θ_1INSTOWN × Ln(BS)		**−0.723**† **(0.424)**			
θ_2INSTOWN × INDP			**3.092***** **(0.665)**		
θ_3INSTOWN × BMEET				**0.0254**† **(0.0143)**	
θ_4INSTOWN × WOB					**−2.345**† **(1.253)**
δ_1Size	−0.342* (0.159)	−0.225*** (0.0608)	−0.211*** (0.0627)	−0.206 (0.176)	−0.228*** (0.0596)
δ_2ROA	0.101* (0.0507)	0.0897* (0.0447)	0.0863† (0.0457)	0.0912† (0.0510)	0.0734 (0.0464)
δ_3GDP	−0.0570 (0.109)	−0.0693** (0.0245)	−0.118*** (0.0316)	0.0386 (0.107)	−0.0642** (0.0226)
δ_4BIS RATIO	0.0283 (0.0192)	0.00367 (0.0063)	−0.001 (0.00478)	0.0466† (0.0239)	0.00871 (0.00880)
δ_5DEPOSITS TO ASSET	2.197*** (0.535)	1.443*** (0.293)	1.367*** (0.278)	2.658*** (0.588)	1.501*** (0.300)
δ_6LOAN LOSS PROV. RATIO	0.284 (0.181)	−0.0305 (0.151)	−0.0152 (0.160)	0.211 (0.183)	−0.0222 (0.164)
δ_7REVENUE_GROWTH	0.212* (0.0846)	0.0645 (0.0501)	0.0397 (0.0485)	0.270*** (0.0811)	0.0690 (0.0496)
δ_8LOAN TO ASSETS	0.0189** (0.00648)	0.0902** (0.00312)	0.00302† (0.00172)	0.0284** (0.0110)	0.00882** (0.00316)
δ_9FCRIS_DUMMY	1.073** (0.289)	0.265* (0.106)	0.216* (0.0902)	0.650** (0.213)	0.296** (0.114)
δ_{10}NON-INTEREST INCOME	−0.0736 (0.118)	0.0902 (0.0994)	0.112 (0.0967)	−0.144 (0.103)	0.0813 (0.0994)
δ_{11}WGI	−0.0263** (0.00978)	−0.00623* (0.00299)	−0.00559† (0.00310)	−0.0243** (0.00926)	−0.00653* (0.00293)
Constant	5.839 (4.675)	−0.253 (2.026)	3.414*** (0.802)	0.101 (2.857)	2.113** (0.780)
Adjusted R^2	0.628	0.356	0.503	0.512	0.354
Over-identification Test-stat (critical value)	8.438e-14 (3.84)	8.438e-14 (3.84)	0.00 (3.84)	5.063e-14 (3.84)	0.00 (3.84)
F-test of Excluded Instrument	0.059†	0.301†	13.20**	0.547†	1.93†
Observations	152	380	380	152	380

Standard errors in parentheses., † p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

Table 10
Summary of results.

BUNDLE	AR	LRMES	SRISK	SUPPORT	HYPOTHESIS
INSTOWN × Ln(BS)	–	–	–	Consistent	Complements (H7)
INSTOWN × INDP	+	+	X	Partial	Substitutes (H6)
INSTOWN × BMEET	+	X	+	Partial	Complements (H7)
INSTOWN × WOB	–	–	X	Partial	Complements (H7)

–: significant negative bundling effect; **+**: significant positive bundling effect; **X**: No significant bundling effect.

financial turmoil. Therefore, independent and female directors, in the presence of institutional control, seemingly influence a bank's contribution to system-wide fragility only with no implication for pecuniary losses statistically.

Third, we confirm our findings by employing an additional instrument operationalized and validated by the work of Laeven and Levine (2009). As a different instrument for institutional ownership control (INSTOWN), we identify the year in which the bank was founded using the Bankscope databases and compute the age (AGE) of the bank. To rationalise this choice of instrument, we argue that older banks have had more time to diversify ownership. Furthermore, AGE is unlikely to affect bank risk directly. Instead, by reducing the ownership of the large (institutional) owner over time, there are incentives for the owner to influence risk. The results of this analysis are in line with our main results.

Fourth, we acknowledge that our sample consists of only large and systemically important banks. Because of this, the market may expect government support for the systemically important and largest banks, also known as too-big-to-fail (TBTF). The presence of implicit and explicit government guarantees differentiates these banks from smaller banks, and consequently large banks can also have higher levels of systemic risk (see e.g., Acharya, Anginer & Warburton, 2016). Moreover, apart from regulations, the governance of large banks is complicated because of the large number of stakeholders (Adams & Mehran, 2012). In order to examine whether our results are also relevant to the small banks, we perform additional analyses for small and non-DSIB banks.[14] We re-estimate the main two-stage regression models with this new sample. The additional analysis (reported in Table 9) shows that these results are qualitatively similar to our main findings reported in Table 6 (i.e., systemic risk is higher when internal and external governance mechanisms complement each other). For the individual effects, women directorships and board independence are negatively related to systemic risk, similar to our main analyses. Thus, from these findings, we conclude that our results are also applicable to small banks.

Finally, we undertake analysis with more control variables, including capital ratio, net loans to total assets and an additional measure of regulation (the relative number of years the bank's country have had deposit insurance schemes in place). The results are very similar to our main findings. We also control for the possibility that our results are influenced by outliers.

Specifically, we in turn exclude each country from the analysis to check whether our results change significantly; all of the results remain similar. An overview of our findings is presented in Table 10.

5. Conclusion

By studying the case of D-SIBs, we hope to have extended knowledge on an important external corporate governance mechanism (i.e., monitoring by institutional owners) and its interactive implications with strong bank boards in terms of systemic risk contribution. A novelty of our study lies in the operationalization of a financial econometric measure of systemic risk, whose aptness is substantiated by the consistency of its trend with that postulated by the literature. As theory suggests and earlier empirical evidence has confirmed, this study further affirms the relevance of ownership structure on firms' corporate governance choices and outcomes. This study concludes that in order to properly align the interests of bank executives and owners, banks should find an "optimal" balance between external monitoring by institutional owners and various internal monitoring mechanisms to achieve a desired level of risk-taking.

The findings of this paper have some important theoretical, practical, and policy implications. Theoretically, our study demonstrates that outside the setting of diffuse ownership, countervailing outcomes to the propositions of agency theory are imminent. In this regard, our findings provide some insights to reconcile the inconsistent findings documented for governance mechanisms and bank risk-taking. For instance, previous studies that report no relationship between strong boards and risk-taking might have been conducted under conditions of minimal or no institutional shareholdings, while those reporting a significant relationship might have been conducted in jurisdictions with significant institutional shareholdings. Also, our findings reinforce the agenda for researchers to pursue and reshape generalizable understanding on how bundles of governance mechanisms affect organizational outcomes within the framework of the agency theory.

Practically, the findings of this study iterate that, given the structural and resource constraints faced by banks, managers should be informed of how different combinations of governance practices can yield similar levels of systemic risk desired by

[14] We collected new/additional data for other (smaller) banks not included in our purposive sample across Europe based on their availability from diverse sources (Bloomberg, Reuters, Compustat, Eikon, and hand collection from annual reports). Our final sample comprises an unbalanced panel data set for 111 EEA non-DSIBs from 2005 to 2019. The dependent variable for this analysis was the SRISK because we required periodic stock returns data to compute the absorption ratio (AR). For various reasons (e.g., delisted over the period or not listed/ private), the stock returns data was mostly unavailable for most of these small banks.

shareholders (Rediker & Seth, 1995; Gresov & Drazin, 1997). As such, banks should strategically consider the trade-offs associated with the concurrent implementation of diverse governance mechanisms. In so doing, banks have the strategic flexibility in designing a bundle of governance practices to achieve the desired level of systemic risk. For example, banks with higher levels of systemic risk have more active monitoring by institutional investorsand generally have a larger board size or greater proportion of female directors.

Finally, heightened unification of markets is a sign to regulators of imminent crisis. On the verge of such indications, our study can offer regulators 'unconventional' remedies to curtail systemic risk to optimal levels. For instance, since monitoring by institutional investors is an entrenched mechanism within European banks, the Basel Commission for Banking Supervision (BCBS) could mandate banks to maintain smaller boards (relative to size and operations) and a minimal proportion of female directors to return systemic risk to appropriate levels.

Our findings are limited in several ways that open up new avenues for future research. Our study considers European banks, which are often characterized by having large institutional owners who are not highly diversified and presumably risk seeking. However, American or Asian banks face different institutional environments that define different ownership structures, stakeholder risk attitudes and subsequently corporate governance practices (La Porta et al., 2000). As such, our study approach would benefit from replication with sample banks from Asia and America. This particularly will be important in view of the recent findings that variations in firm characteristics such as ownership interact with national institutions and lead to variation in governance choices (Filatotchev, Jackson & Nakajima, 2013; Schiehll et al., 2014).

Furthermore, Hoskisson et al. (2002) and Neubaum and Zahra (2006) argue that different types of institutional investors, based on their interest and motivations, are likely to affect firms' behavior differently. However, due to the lack of sufficiently fine-grained data on the different types of institutional investor ownership, we resorted to the aggregate institutional ownership data for our analysis. For this reason, we entreat future research to make a more finely grained distinction between institutional investors. This, when done, will advance understanding on the dynamics behind the monitoring potential of different institutional investors. Lastly, this study is limited by an issue of within and between-country differences in capital requirement/compliance among our sample banks. A common equity tier 1 (CET1) deviation measure (i.e., excess or deficit from the minimum CET1 requirement) in this instance will appropriately capture the risk-taking effects of a bank's conformance to this heterogeneous regulatory capital requirement. Because of inconsistent and unavailable data (unreported in annual bank reports) on periodic minimum regulatory capital holdings, we are unable to explore this issue in more depth. Therefore, future research should examine this issue of periodic minimum regulatory capital holdings and systemic risk contributions in a comparative international study. Nevertheless, Jokipii and Milne (2008, pg. 1441) suggests that banks' motives for maintaining capital above the regulatory minimum inform of their propensity to assume more risk.[15] Based on this and coupled with the fact that this paper does not primarily focus on regulatory interventions but merely aims to control for the regulatory-induced risk-taking behaviour of banks, our adopted measure of CET1 suffices as an ad-hoc proxy.

[15] According to Jokpii and Milne (2008), a bank's capital may be over the regulatory minimum for the following reasons: (1) the bank's internal economic models estimate higher subjective buffers to signal soundness to the market in order to warrant more risk assumption; (2) banks would want to take advantage of future profitable/growth investment opportunities which come with some level of risk (e.g., an unexpected increase in loan demand); and (3) protection against the costs of violating the minimum regulatory requirement restrictions on the future scope of operations. Thematically, it is suggestive that maintaining excess capital aims to avoid outcomes that may jeopardise banks' ability to assume risk on which their profitability is dependent.

Appendix A. – Table Aa: Mean statistics for each of the sample bank for the years 2000–2016.

Bank	AR	BS	INDP (%)	WOB (%)	BMEET	INSTOWN (%)	ROA (%)	Size (in € mil)	BIS_RATIO	Revenue Growth (%)	Loan Loss Prov.	Deposit to Assets	Loan to Assets	Non-Interest Inc.
1. Deutsche Bank	0.005	20.12	51.2	34.5	5.13	79.2	0.199	1,478,907	11.54	1.95	0.111	32.037	0.20	18,593
2. Commerzbank	0.016	20.47	47.1	21.7	9	68.8	0.038	558,643	9.78	−2.03	0.278	31.020	0.40	4323.353
3. Landesbank BW	0.021	22.5	38.4	16.3	5.7	70.7	0.019	345420.1	11.86	1.94	0.206	21.371	0.37	1315.88
4. DZ Bank	0.007	19.93	38.6	15.1	5.57	100	0.195	414399.6	12	0.88	0.145	21.641	0.29	16974.33
5. Bayerische Landesbank	0.008	10.36	68.3	2.4	11.46	33	−0.019	309726.8	9.84	−3.00	0.395	26.938	0.48	939.634
6. Danske Bank	0.017	16.12	43.5	29.7	12.92	68.4	0.343	373260.6	12.10	6.32	0.148	24.418	0.47	12710.65
7. Jyske Bank	0.017	9.24	63.6	15	20.12	48.5	0.668	34264.22	13.1	7.97	0.196	41.837	0.59	2721.756
8. Sydbank	0.017	11.07	59.4	20.1	10.88	33.78	0.728	16215.6	11.84	3.93	0.208	47.422	0.56	47.422
9. BNP	0.016	16.59	50.6	25.4	11	70.75	0.389	1559524	9.68	4.26	0.198	26.316	0.30	20858.76
10. Crédit Agricole	0.019	21.19	24.2	18.8	10.13	41.13	0.182	1249402	10.18	1.10	0.218	32.252	0.25	9543
11. Société Générale	0.017	14.75	54.3	24.7	9.88	18.72	0.326	964835.2	9.97	4.11	0.244	29.334	0.31	14756.76
12. Banque Populaire CE Group	0.008	17	8.5	10.6	10.38	100	0.509	45730.03	14.16	−7.08	0.106	34.519	0.31	1447.034
13. HSBC France	0.008	17.83	41.5	16.7	4.83	99.99	0.677	202333.8	12.8	7.16	0.018	20.497	0.36	2210.5
14. Unicredit	0.018	20.69	82.9	26.1	13.62	60.49	0.179	696487.4	8.42	8.76	0.374	40.481	0.56	9395.984
15. Intesa SanPaolo	0.017	20.88	49.4	21.2	11.06	39.16	0.347	517126.5	9.33	9.70	0.281	34.910	0.55	6732.612
16. ING Bank NV	0.018	10.41	83.2	13.6	10.27	99.93	0.346	906506.8	13.86	−5.15	0.133	50.878	0.56	4609.8
17. Rabobank	0.017	11.53	95.0	14.1	10.82	100	0.354	567281	13.44	1.78	0.138	45.056	0.64	3665.588
18. ABN AMRO Bank NV	0.011	9.65	92.9	23.3	11.07	82.94	0.269	390373.8	12.92	−1.88	0.202	56.028	0.58	3181.5
19. DNB ASA	0.017	9.18	64.1	34.8	16.57	61.37	0.825	189446.8	9.89	8.13	0.080	39.048	0.64	14556.53
20. Kommunalbanken	0.012	7.88	78.5	44.6	N/A	22.71	0.278	34771.24	12.89	21.71	−0.025	N/A	0.66	719.4761
21. Banco Santander	0.017	18.59	44.1	20.5	11.88	59	0.659	911962.2	9.63	8.53	0.292	42.644	0.56	14231.64
22. BBVA	0.017	16.35	74.4	11.9	12.35	38.72	0.737	491584.4	9.53	6.26	0.252	45.074	0.56	7787.058
23. Bankia	0.008	11.83	67.7	10.7	20.33	65.65	−1.029	251385.6	10.16	−13.84	1.252	45.709	0.46	1329.803
24. Banco de Sabadell	0.017	13	46.2	7.6	12.67	42.89	0.672	95338.21	9.35	13.61	0.293	53.373	0.73	1082.784
25. La Caixa	0.007	19.41	33.0	22.5	12.9	87.76	0.213	323273	12.43	−0.17	0.586	50.293	0.56	3766.321
26. Nordea Bank	0.017	13.11	58.1	27.3	14.41	56.75	0.620	460501.8	11.12	7.45	0.085	31.905	0.53	4116.353
27. Swedbank	0.017	12.29	55.1	40	17.59	89.55	0.652	166303.2	13.54	2.25	0.135	29.589	0.68	15920.88
28. Svenska Handelsbanken	0.002	11.88	34.3	25.1	11.12	79.20	0.660	208963	13.73	0.37	0.039	27.567	0.60	10767.76
29. Skandinaviska	0.017	12.41	58.8	27.5	10.24	85.74	0.50	218908.7	12.77	5.46	0.105	33.354	0.43	24531.06

– **Table Aa: Mean statistics for each of the sample bank for the years 2000–2016.** (*continued*)

Bank	AR	BS	INDP (%)	WOB (%)	BMEET	INSTOWN (%)	ROA (%)	Size (in € mil)	BIS_RATIO	Revenue Growth (%)	Loan Loss Prov.	Deposit to Assets	Loan to Assets	Non-Interest Inc.
Enskilda Bank														
30. Merrill Lynch International	0.008	11.46	35.1	0.6.6	11	100	−0.088	290695.1	10.84	−31.29	0.822	4.9812	0.18	955.890
31. HSBC	0.018	19.65	61.3	21	9	68.70	0.688	1534645	10.74	5.47	0.254	53.663	0.45	27904.36
32. Barclays	0.017	14.41	62.1	0.15.3	11.12	84.67	0.369	1346652	10.41	5.19	0.269	32.037	0.36	12300.94
33. Royal Bank of Scotland	0.017	13.94	62.7	0.15.8	9.82	88.23	0.172	1309056	10.8	11.82	0.294	39.647	0.43	9738.412
34. Santander	0.004	12.76	51.9	0.16.3	12.18	91.95	0.252	320929.4	11.08	−0.47	0.132	45.126	0.58	1392.412
35. Standard Chartered	0.017	16.18	59.2	0.15.5	10.41	56.84	0.728	313504.1	10.72	12.37	0.186	58.094	0.46	5111.444
36. Nationwide Building Society	0.006	12.57	58.1	0.16.5	12	100	0.291	200583.2	14.51	4.33	0.120	71.723	0.78	419.506
37. Lloyds Banking Group	0.017	14.47	54.0	0.18.1	11.53	76.39	0.499	743130.4	11.03	6.66	0.295	45.176	0.56	7804.882
38. Cooperative Bank	0.008	14.57	53.2	0.13.3	14.29	100	−0.417	37195.48	13.19	10.18	0.074	76.247	0.68	196.508

Refer to Table 1 for the definitions of the variables.

Table Ab: Country level (mean) statistics.

Variable	Country Germany [N = 5]	Denmark [N = 3]	France [N = 5]	Italy [N = 2]	Netherlands [N = 3]	Norway [N = 2]	Spain [N = 5]	Sweden [N = 4]	Ireland [N = 1]	United Kingdom [N = 8]
AR	0.011	0.016	0.0155	0.016	0.016	0.0147	0.0144	0.016	0.007	0.0153
BS	18.956	12.183	17.435	20.8	10.529	8.529	16.479	12.426	11.461	14.876
INDP (%)	48.5	55.3	35.3	63.9	90.3	71.2	50.9	51.5	35.0	57.9
WOB (%)	19.6	21.6	19.3	23.3	17.0	39.6	15.3	29.9	6.5	16.5
BMEET	7.163	14.826	9.452	12.166	10.734	16.571	13.1238	13.338	11.000	11.207
INSTOWN (%)	70.7	51.6	66.4	48.4	94.5	42.0	55.7	77.8	100	84.1
ROA (%)	0.080	0.579	0.394	0.263	0.336	0.610	0.480	0.607	-0.087	0.351
Size (in € mil)	641766.6	141246.8	973296.7	606806.9	623766.7	125443.1	453902.3	263669.2	290695.1	746576.2
bs_tier1_c ~ o	10.878	12.348	10.634	8.873	13.407	10.847	9.890	12.7916	10.843	11.514

(*continued on next page*)

Table Ab: Country level (mean) statistics. *(continued)*

Variable	Country Germany [N = 5]	Denmark [N = 3]	France [N = 5]	Italy [N = 2]	Netherlands [N = 3]	Norway [N = 2]	Spain [N = 5]	Sweden [N = 4]	Ireland [N = 1]	United Kingdom [N = 8]
Revenue Growth	−0.2035855	6.073	2.339	9.230	-0.888	13.465	6.327	3.882	−31.286	6.819
Loan Loss Prov.	0.232	0.183	0.182	0.327	0.151	0.036	0.417	0.091	0.822	0.206
Deposits to Assets	27.053	37.892	29.190	37.695	49.433	39.047	47.239	30.604	4.981	51.988
Loans to Assets	0.34	0.54	0.30	0.56	0.60	0.65	0.60	0.56	0.18	0.53
Non-Interest Inc.	8063.872	5732.801	11894.850	8064.298	3824.714	8830.852	6590.74	13834.01	955.889	8348.317

Refer to Table 1 for definitions of the variables.

Table Ac: Year-by-Year (mean) statistics.

Year	AR	BS	INDP (%)	WOB (%)	BMEET	INSTOWN (%)	ROA (%)	Size (in € mil)	BIS_RATIO	Revenue Growth (%)	Loan Loss Prov.	Deposit to Assets	Loans to Assets	Non-Interest Inc
2000	0.001	17.185	54.4	30.4	4.909	70.2	0.799	309635.6	7.883	40.544	0.118	41.644	0.51	6692.886
2001	0.003	16.703	51.3	17.2	10.315	69.0	0.551	332407.1	8.137	5.331	0.170	42.407	0.52	6325.34
2002	0.003	16.100	52.1	16.6	10.375	72.7	0.418	318960.3	8.344	11.305	0.220	41.284	0.49	5692.449
2003	0.002	15.468	51.7	18.3	9.115	73.1	0.677	337433.1	8.858	−2.138	0.175	40.692	0.50	6306.807
2004	0.068	14.969	31.2	13.2	12.000	76.6	0.655	377362.9	8.992	4.004	0.104	40.013	0.53	7208.962
2005	0.071	15.194	33.1	12.4	12.500	84.0	0.693	476645.4	8.827	23.589	0.080	36.145	0.50	8591.738
2006	0.057	14.600	57.0	12.5	12.181	71.3	0.673	555852.9	8.482	29.060	0.086	34.844	0.49	10430.51
2007	0.013	15.694	56.2	17.3	10.794	68.7	0.591	670701.2	8.287	21.729	0.105	35.038	0.47	10697.38
2008	0.002	14.810	57.4	20.5	11.314	67.6	0.236	703596.8	9.439	5.4861	0.278	33.534	0.47	8112.492
2009	0.001	14.891	56.7	24.0	11.222	64.4	0.227	637130.5	11.407	−13.871	0.405	36.511	0.50	9254.67
2010	0.002	14.783	56.8	20.5	10.638	64.1	0.317	642801.1	12.320	−0.447	0.255	38.933	0.50	9257.327
2011	0.002	14.526	63.6	22.3	11.081	67.8	0.153	687438.5	12.730	5.582	0.292	37.220	0.49	8918.971
2012	0.003	14.263	62.5	21.8	13.000	65.4	0.013	667236.1	13.871	−1.150	0.536	37.897	0.48	8881.987
2013	0.005	14.131	62.7	23.8	12.513	69.7	0.134	601253.7	14.365	−8.748	0.330	41.478	0.49	8999.53
2014	0.026	13.657	62.0	17.1	12.837	73.4	0.271	645544.5	14.526	−2.155	0.173	40.784	0.48	9164.842
2015	0.004	13.684	64.6	27.8	12.378	73.0	0.272	628751.7	15.893	−5.427	0.131	42.876	0.50	9346.444
2016	0.005	13.710	61.3	31.8	13.750	70.7	0.246	640321.8	16.673	−0.8853	0.129	44.415	0.50	9679.702

Refer to Table 1 for definitions of the variables.

Appendix B

According to Vives (1990), below are the conditions under which complementary and substitution matching between variables are assessed.

- Substitutive effect: $f(X_{\_H}, Y_{\_H}) - f(X_{\_L}, Y_{\_H}) < f(X_{\_H}, Y_{\_L}) - f(X_{\_L}, Y_{\_L})$
- Complementary effect: $f(X_{\_H}, Y_{\_H}) - f(X_{\_L}, Y_{\_H}) > f(X_{\_H}, Y_{\_L}) - f(X_{\_L}, Y_{\_L})$

where X and Y represent our two bank corporate governance mechanisms of interest, whereas H and L denote the high and low levels of our governance mechanisms respectively. The gains from any match (governance bundles) are represented by an increasing function, positive valued function f, which gives the match output $f(X, Y)$ for any pair of governance mechanisms. For instance, suppose from the function, $f(X, Y)$, BINDP is X and INSTOWN is Y, then $X_{\_H}$(vs. $X_{\_L}$) indicate a high (vs. low) level of BINDP. In a similar manner, $Y_{\_H}$(vs. $Y_{\_L}$) indicates a high (vs. low) level of INSTOWN. If BINDP and INSTOWN interact as substitutes, the marginal gains between the high level of BINDP and low level of INSTOWN [i.e., $f(X_{\_H}, Y_{\_L}) - f(X_{\_L}, Y_{\_L})$] should be greater when they work under a lower INSTOWN rather than under a high INSTOWN [i.e. $f(X_{\_H}, Y_{\_H}) - f(X_{\_L}, Y_{\_H})$]. On the contrary, if BINDP and INSTOWN interact as complements, the marginal gain between a high level of BINDP and a low level of BINDP should be greater when they work under higher INSTOWN. That is,$f(X_{\_H}, Y_{\_H}) - f(X_{\_L}, Y_{\_H})$ will be greater than $f(X_{\_H}, Y_{\_L}) - f(X_{\_L}, Y_{\_L})$. This assessment can be graphically represented or carried out using regression coefficients and regression covariance-variance information.

References

Abdelbadie, R.A., Salama, A., 2019. Corporate governance and financial stability in US banks: do indirect interlocks matter?. J. Bus. Res. 104, 85–105.
Acharya, V., Anginer, D., Warburton, A.J., 2016. The end of market discipline? Investor expectations of implicit government guarantees, Working paper. Available at: http://pages.stern.nyu.edu/~sternfin/vacharya/.
Acharya, V., Engle, R., Richardson, M., 2012. Capital shortfall: a new approach to ranking and regulating systemic risks. Am. Econ. Rev. 102 (3), 59–64.
Acharya, V., Pedersen, L.H., Philippon, T., Richardson, M., 2017. Measuring systemic risk. Rev. Financ. Stud. 30 (1), 2–47.
Adams, R., Ferreira, D., 2009. Women in the boardroom and their impact on governance and performance. Journal of Financial Economics 94 (2).
Adams, R.B., Ragunathan, V., 2017. Lehman sisters. Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3046451.
Adams, R.B., Hermalin, B.E., Weisbach, M.S., 2010. The role of boards of directors in corporate governance: a conceptual framework and survey. J. Econ. Lit. 48 (1), 58–107.
Adams, R., Ferreira, D., 2008. One share-one vote: the empirical evidence. Rev. Financ. 12 (1), 51–91.
Adams, R., Mehran, H., 2012. Bank board structure and performance: evidence for large bank holding companies. J. Financ. Intermediat. 21, 243–267.
Adrian, T., Brunnermeier, M., 2016. CoVaR. Am. Econ. Rev. 106, 1705–1741.
Agoraki, M.E.K., Delis, M.D., Pasiouras, F., 2011. Regulations, competition and bank risk-taking in transition countries. J. Financ. Stabil. 7 (1), 38–48.
Aiken, L.S., West, S.G., Reno, R.R., 1991. Multiple regression: Testing and interpreting interactions. Sage.
Allen, F., Carletti, E., 2013. What is systemic risk? J. Money Credit Bank. 45 (1), 121–127.
Ang, A., Chen, J., 2002. Asymmetric correlations of equity portfolios. J. Financ. Econ. 63 (3), 443–494.
Anginer, D., Demirguc-Kunt, A., Huizinga, H., Zhu, M., 2014. Corporate Governance and Bank Insolvency Risk International Evidence, Policy Research Working Paper 7017. Available at: World Bank e-library.
Anginer, D., Demirguc-Kunt, A., Zhu, M., 2014b. How does competition affect bank systemic risk?. J. Financ. Intermediat. 23 (1), 1–26.
Armstrong, C.S., Blouin, J.L., Jagolinzer, A.D., Larcker, D.F., 2015. Corporate governance, incentives, and tax avoidance. J. Account. Econ. 60 (1), 1–17.
Barber, B.M., Odean, T., 2001. Boys will be boys: gender, overconfidence, and common stock investment. Q. J. Econ. 116 (1), 261–292.
Barth, J.R., Caprio, G., Levine, R., 2006. Rethinking bank regulation: Till angels govern. Cambridge University Press.
Basel Committee on Banking Supervision (2015). Making supervisory stress tests more macroprudential: Considering liquidity and solvency interactions and systemic risk. BCBS Working Paper 29.
Basel Committee on Banking Supervision, 2010. Principles for enhancing corporate governance. Basel Committee. Basel, Switzerland: Bank for International Settlements.
Baysinger, B.D., Butler, H.N., 1985. Corporate governance and the board of directors: performance effects of changes in board composition. J. Law Econ. Organ. 1 (1), 101–124.
Beatty, R.P., Zajac, E.J., 1990. Top management incentives, monitoring, and risk-bearing: a study of executive compensation, ownership, and board structure in initial public offerings. In Academy of Management Proceedings (Vol. 1990, No. 1, pp. 7–11).
Berle, A., Means, G., 1932. The modern corporate and private property. McMillian, New York, NY.
Bhagat, S., Black, B., 2002. The non-correlation between board independence and long-term firm performance. J. Corporat. Law 27, 231–273.
Billio, M., Getmansky, M., Lo, A. W., & Pelizzon, L., 2010. Econometric measures of systemic risk in the finance and insurance sectors (No. w16223). National Bureau of Economic Research. Available at https://www.nber.org/papers/w16223.
Billio, M., Getmansky, M., Lo, A.W., Pelizzon, L., 2012. Econometric measures of connectedness and systemic risk in the finance and insurance sectors. J. Financ. Econ. 104 (3), 535–559.
Black, B.S., 1998. Shareholder activism and corporate governance in the United States. In: Newman, P. (Ed.), The New Palgrave dictionary of Economics and the Law. Palgrave Macmillan, Basingstoke.
Boone, A.L., Field, L.C., Karpoff, J.M., Raheja, C.G., 2007. The determinants of corporate board size and composition: an empirical analysis. J. Financ. Econ. 85 (1), 66–101.
Brewer III, E., Jagtiani, J., 2013. How much did banks pay to become too-big-to-fail and to become systemically important? J. Financ. Serv. Res. 43 (1), 1–35.
Brownlees, T.C., Engle, R.F., 2015. SRISK: a conditional capital shortfall index for systemic risk measurement. Rev. Financ. Stud. 30 (1), 48–79.
Brownlees, C., Engle, R., 2017. SRISK: a conditional capital shortfall measure of systemic risk. Rev. Financial Stud. 30 (1), 48–79.
Callen, J.L., Fang, X., 2013. Institutional investor stability and crash risk: monitoring versus short-termism? J. Bank. Finance 37 (8), 3047–3063.
Chava, S., Purnanandam, A., 2010. CEOs versus CFOs: incentives and corporate policies. J. Financ. Econ. 97, 263–278.
Cheng, S., 2008. Board size and the variability of corporate performance. Journal of Financial Economics 87 (1).
Choi, S., Hasan, I., 2005. Ownership, governance, and bank performance: Korean experience. Financ. Market. Instit. Instrum. 14 (4), 215–242.
Chou, H.I., Chung, H., Yin, X., 2013. Attendance of board meetings and company performance: Evidence from Taiwan. J. Bank. Finance 37 (11), 4157–4171.
Chowdhry, B., Jegadeesh, N., 1994. Pre-tender offer share acquisition strategy in takeovers. J. Financ. Quantit. Anal. 29 (1), 117–129.
Chung, K.H., Zhang, H., 2011. Corporate governance and institutional ownership. J. Financ. Quantit. Anal. 46 (1), 247–273.

Connelly, B.L., Tihanyi, L., Certo, S.T., Hitt, M.A., 2010. Marching to the beat of different drummers: the influence of institutional owners on competitive actions. Acad. Manage. J. 53, 723–742.
Cyert, R.M., March, J.G., 1992. A behavioral theory of the firm. Blackwell, Cambridge, MA.
Darrat, A.F., Gray, S., Park, J.C., Wu, Y., 2016. Corporate governance and bankruptcy risk. J. Account. Audit. Financ. 31 (2), 163–202.
De Andres, P., Vallelado, E., 2008. Corporate governance in banking: the role of the board of directors. J. Bank. Finance 32 (12), 2570–2580.
De Bruyckere, V., Gerhardt, M., Schepens, G., Vander Vennet, R., 2013. Bank/sovereign risk spillovers in the European debt crisis. J. Bank. Finance 37, 4793–4809.
Dell'Ariccia, G., Laeven, L., Suarez, G.A., 2017. Bank leverage and monetary policy's risk-taking channel: evidence from the United States. J. Finance 72, 613–654.
Demsetz, H., Lehn, K., 1985. The structure of corporate ownership: causes and consequences. J. Polit. Econ. 93 (6), 1155–1177.
Demsetz, H., Villalonga, B., 2001. Ownership structure and corporate performance. J. Corp. Finance 7 (3), 209–233.
Denis, D.J., Serrano, J.M., 1996. Active investors and management turnover following unsuccessful control contests. J. Financ. Econ. 40 (2), 239–266.
Deutsch, Y., Keil, T., Laamanen, T., 2011. A dual agency view of board compensation: the joint effects of outside director and CEO stock options on firm risk. Strateg. Manage. J. 32 (2), 212–227.
Dunn, P., 2012. Breaking the boardroom gender barrier: the human capital of female corporate directors. J. Manage. Governance 16 (4), 557–570.
Eagly, A.H., Carli, L.L., 2003. The female leadership advantage: an evaluation of the evidence. Leadership Quart. 14 (6), 807–834.
Eisenberg, T.S., Sundgren, S., Wells, M., 1998. Larger board size and decreasing firm value in small firms. J. Financ. Econ. 48, 35–54.
Elyasiani, E., Jia, J.J., 2008. Institutional ownership stability and BHC performance. J. Bank. Finance 32 (9), 1767–1781.
Erkens, D., Hung, M., Matos, P., 2012. Corporate governance in the 2007–2008 financial crisis: evidence from financial institutions worldwide. J. Corp. Finance 18 (2), 389–411.
Fama, E.F., Jensen, M.C., 1983. Separation of ownership and control. The Journal of Law and Economics 26 (2), 301–325.
Fang, Y., Hasan, I., Marton, K., 2014. Institutional development and bank stability: evidence from transition countries. J. Bank. Finance 39, 160–176.
Fernández, A.I., Gomez, S., Fernandez, C., 1997. The effect of board size and composition on corporate performance. In: Ballin, M. (Ed.), Corporate Governance, Financial Markets and Global Convergence. Kluwer Academic Publishers, Boston.
Fernández, C., Arrondo, R., 2005. Alternative internal controls as substitutes of the board of directors. Corp. Govern.: Int. Rev. 13 (6), 856–866.
Filatotchev, I., Jackson, G., Nakajima, C., 2013. Corporate governance and national institutions: a review and emerging research agenda. Asia Pacific J. Manage. 30 (4), 965–986.
Forbes, D.P., Milliken, F.J., 1999. Cognition and corporate governance: understanding boards of directors as strategic decision-making groups. Acad. Manage. Rev. 24 (3), 489–505.
Fosu, S., Ntim, C.G., Coffie, W., Murinde, V., 2017. Bank opacity and risk-taking: Evidence from analysts' forecasts. J. Financ. Stabil. 33, 81–95.
Franks, J., Mayer, C., 1994. Corporate Control: A Comparison of insider and outsider systems. Working Paper of London Business School.
Franks, J., Mayer, C., 1997. Corporate ownership and control in the UK, Germany, and France. J. Appl. Corp. Financ. 9 (4), 30–45.
Galai, D., Masulis, R.W., 1976. The option pricing model and the risk factor of stock. J. Financ. Econ. 3 (1–2), 53–81.
García-Castro, R., Aguilera, R.V., Ariño, M.A., 2013. Bundles of firm corporate governance practices: a fuzzy set analysis. Corporate Govern.: Int. Rev. 21 (4), 390–407.
Gresov, C., Drazin, R., 1997. Equifinality: functional equivalence in organization design. Acad. Manage. Rev. 22 (2), 403–428.
Grossman, S.J., Hart, O.D., 1982. Corporate financial structure and managerial incentives. In: the Economics of Information and Uncertainty (pp. 107-140). University of Chicago Press.
Haan, J., Vlahu, R., 2016. Corporate governance of banks: a survey. J. Econ. Surveys 30 (2), 228–277.
Hair, J.F., Black, W.C., Babin, B.J., Anderson, R. E., Tatham, R.L., 2006. Multivariate Data Analysis (Vol. 6): Pearson Prentice Hall Upper Saddle River. NJ.
Hao, L., Naiman, D.Q., 2007. Quantile regression, No. 149. Sage.
Hartzell, J.C., Starks, L.T., 2003. Institutional investors and executive compensation. J. Financ. 58 (6), 2351–2374.
Hausman, J.A., Taylor, W.E., 1981. Panel data and unobservable individual effects. Econometrica: J. Econom. Soc., 1377–1398.
Hermalin, B.E., Weisbach, M.S., 2001. Boards of directors as an endogenously determined institution: a survey of the economic literature. FRBNY Econ. Pol. Rev. 9, 7–26.
Hirshleifer, D., Titman, S., 1990. Share tendering strategies and the success of hostile takeover bids. J. Polit. Econ. 98 (2), 295–324.
Holderness, C., 2003. A survey of blockholders and corporate control. FRBNY Econ. Pol. Rev. 9, 51–64.
Holderness, C.G., Sheehan, D.P., 1988. The role of majority shareholders in publicly held corporations: an exploratory analysis. J. Financ. Econ. 20, 317–346.
Hoskisson, R.E., Castleton, M.W., Withers, M.C., 2009. Complementarity in monitoring and bonding: more intense monitoring leads to higher executive compensation. Acad. Manage. Perspect. 23 (2), 57–74.
Hoskisson, R.E., Hitt, M.A., Johnson, R.A., Grossman, W., 2002. Conflicting voices: the effects of institutional ownership heterogeneity and internal governance on corporate innovation strategies. Acad. Manage. J. 45, 697–716.
Huang, Q., Haan, J., Scholtens, B., 2020. Does bank capitalization matter for bank stock returns?. The North American Journal of Economics and Finance 52.
Hussain, N., Rigoni, U., Orij, R.P., 2018. Corporate governance and sustainability performance: analysis of triple bottom line performance. J. Bus. Ethics 149 (2), 411–432.
Iqbal, J., Strobl, S., Vähämaa, S., 2015. Corporate governance and the systemic risk of financial institutions. J. Econ. Business 82, 42–61.
Jensen, M.C., 1993. The modern industrial revolution, exit, and the failure of internal control systems. J. Finance 48 (3), 831–880.
John, K., Litov, L., Yeung, B., 2008. Corporate governance and risk-taking. J. Financ. 63 (4), 1679–1728.
Jokipii, T., Milne, A., 2008. The cyclical behaviour of European bank capital buffers. J. Bank. Finance 32 (8), 1440–1451.
Kahneman, D., Tversky, A., 1979. Prospect theory: an analysis of decision under risk. Econometrica: J. Econ. Soc., 263–291
Kaplan, S., Minton, B., 1994. Appointments of outsiders to Japanese boards: determinants and implications for managers. J. Financ. Econ. 36, 225–258.
Köhler, M., 2015. Which banks are more risky? The impact of business models on bank stability. J. Financ. Stab. 16, 195–212.
Kritzman, M., Li, Y., Page, S., Rigobon, R., 2011. Principal components as a measure of systemic risk. J. Portfolio Manage. 37 (4), 112–126.
La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 2000. Investor protection and corporate governance. J. Financ. Econ. 58 (1), 3–27.
Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. J. Financ. Econ. 93 (2), 259–275.
Laeven, M.L., Ratnovski, L., Tong, H., 2014. Bank size and systemic risk (No. 14). International Monetary Fund. Available here.
Lehar, A., 2005. Measuring systemic risk: a risk management approach. J. Bank. Finance 29 (10), 2577–2603.
Li, J., Harrison, J.R., 2008. Corporate governance and national culture: a multi-country study. Corp. Governance: Int. J. Bus. Soc. 8 (5), 607–621.
Liang, Q., Xu, P., Jiraporn, P., 2013. Board characteristics and Chinese bank performance. J. Bank. Finance 37 (8), 2953–2968.
Lipton, M., Lorsch, J.W., 1992. A modest proposal for improved corporate governance. Business Lawyer, 59–77.
Lückerath-Rovers, M., 2013. Women on boards and firm performance. J. Manage. Governance 17 (2), 491–509.
Macey, J.R., O'hara, M., 2003. The corporate governance of banks. Econ. Pol. Rev. 9(1).
Manconi, A., Massa, M., Yasuda, A., 2012. The role of institutional investors in propagating the crisis of 2007–2008. J. Financ. Econ. 104 (3), 491–518.
Brunnermeier, M.K., Dong, G.N., Palia, D., 2020. Banks' noninterest income and systemic risk. Rev. Corp. Financ. Stud. 9 (2), 229–255.
Martinez Peria, M.S., Schmukler, S.L., 2001. Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises. J. Financ. 56 (3), 1029–1051.
Martín-Oliver, A., Ruano, S., Salas-Fumás, V., 2017. The fall of Spanish cajas: lessons of ownership and governance for banks. J. Financ. Stabil. 33, 244–260.
Minton, B., Taillard, J., Williamson, R., 2014. Financial expertise of the board, risk taking, and performance: evidence from bank holding companies. J. Financ. Quantit. Anal. 49 (2), 351–380.

Neubaum, D.O., Zahra, S.A., 2006. Institutional ownership and corporate social performance: the moderating effects of investment horizon, activism, and coordination. J. Manage. 32 (1), 108–131.
Niederle, M., Vesterlund, L., 2007. Do women shy away from competition? Do men compete too much?. Q. J. Econ. 122 (3), 1067–1101.
Oh, W.Y., Chang, Y.K., Kim, T.Y., 2018. Complementary or substitutive effects? Corporate governance mechanisms and corporate social responsibility. J. Manage. 44 (7), 2716–2739.
Pathan, S., 2009. Strong boards, CEO power and bank risk-taking. J. Bank. Finance 33 (7), 1340–1350.
Randøya, T., Goel, S., 2003. Ownership structure, founder leadership, and performance in Norwegian SMEs: implications for financing entrepreneurial opportunities. J. Bus. Ventur. 18, 619–637.
Rediker, K.J., Seth, A., 1995. Boards of directors and substitution effects of alternative governance mechanisms. Strateg. Manage. J. 16 (2), 85–99.
Rose, P., 1992. Agency theory and entry barriers in banking. Financ. Rev. 27 (3), 323–354.
Sanders, W.G., 2001. Behavioral responses of CEOs to stock ownership and stock option pay. Acad. Manage. J. 44 (3), 477–492.
Saunders, A., Strock, E., Travlos, N.G., 1990. Ownership structure, deregulation, and bank risk taking. J. Financ. 45 (2), 643–654.
Schepker, D.J., Oh, W.Y., 2013. Complementary or substitutive effects? Corporate governance mechanisms and poison pill repeal. J. Manage. 39 (7), 1729–1759.
Schiehll, E., Ahmadjian, C., Filatotchev, I., 2014. National governance bundles perspective: understanding the diversity of corporate governance practices at the firm and country levels. Corp Governance: Int. Rev. 22 (3), 179–184.
Schwarcz, S.L., 2017. Controlling Systemic Risk through Corporate Governance. CIGI Policy Brief No. 2017 Feb14. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2933045.
Shleifer, A., Vishny, R.W., 1986. Large shareholder and corporate control. J. Polit. Econ. 94, 461–488.
Shleifer, A., Vishny, R.W., 1997. A survey of corporate governance. J. Financ. 52 (2), 737–783.
Siggelkow, N., 2002. Misperceiving interactions among complements and substitutes: organizational consequences. Manage. Sci. 48 (7), 900–916.
Sihag, V., Rijsdijk, S.A., 2019. Organizational controls and performance outcomes: A meta-analytic assessment and extension. J. Manage. Stud. 56 (1), 91–133.
Benoit, S., Colliard, J.E., Hurlin, C., Pérignon, C., 2017. Where the risks lie: a survey on systemic risk. Rev. Financ. 21 (1), 109–152.
Tosi Jr, H.L., Gomez-Mejia, L.R., 1989. The decoupling of CEO pay and performance: an agency theory perspective. Adm. Sci. Q., 169–189
Vafeas, N., 1999. Board meeting frequency and firm performance. J. Financ. Econ. 53 (1), 113–142.
Varotto, S., Zhao, L., 2018. Systemic risk and bank size. J. Int. Money Finance 82, 45–70.
Vives, X., 1990. Nash equilibrium with strategic complementarities. J. Math. Econ. 19 (3), 305–321.
Wagner, W., 2007. The liquidity of bank assets and banking stability. J. Bank. Finance 31 (1), 121–139.
Wahal, S., 1996. Pension fund activism and firm performance. J. Financ. Quantit. Anal. 31 (1), 1–23.
Ward, A.J., Brown, J.A., Rodriguez, D., 2009. Governance bundles, firm performance, and the substitutability and complementarity of governance mechanisms. Corp. Govern.: Int. Rev. 17 (5), 646–660.
Wiseman, R.M., Gomez-Mejia, L.R., 1998. A behavioral agency model of managerial risk taking. Academy of Management Review 23 (1).
Yermack, D., 1996. Higher market valuation of companies with a small board of directors. J. Financ. Econ. 40 (2), 185–211.
Zajac, E.J., Westphal, J.D., 1994. The costs and benefits of managerial incentives and monitoring in large US corporations: when is more not better?. Strateg. Manage. J. 15 (S1), 121–142.
Zhao, L., 2018. Market-based estimates of implicit government guarantees in European financial institutions. Europ. Financ. Manage. 24, 79–112.