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Strong boards, CEO power and bank risk-taking

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A B S T R A C T

This study examines the relevance of bank board structure on bank risk-taking. Using a sample of 212 large US bank holding companies over 1997–2004 (1534 observations), this study finds that strong bank boards (boards reflecting more of bank shareholders interest) particularly small and less restrictive boards positively affect bank risk-taking. In contrast, CEO power (CEO's ability to control board decision) negatively affects bank risk-taking. These results are consistent with the bank contracting environment and robust to several proxies for bank risk-takings and different estimation techniques.

1. Introduction

The board of directors is the 'apex body' of an organization's internal governance system (Fama and Jensen, 1983, p. 311) and judged to be as the first-line of defense (Weisbach, 1988, p. 431) or at least as the second-best efficient solution (Hermalin and Weisbach, 2003, p. 9) to the shareholders against incumbent management. To that end, this paper examines the relevance of boards to bank risk-taking. Particularly, it investigates whether strong bank boards and CEO power affect bank risk-taking. The term 'strong boards' is to explain boards' effectiveness in monitoring bank managers for their shareholders. Similarly, the term 'CEO power' refers to bank CEO's ability to influence board decisions.

The policy makers constantly try to revise legislation to facilitate better monitoring of bank activities including their risk-taking. As unfolding, the 'financial shock' in the US and elsewhere initiated with the sub-prime mortgage crisis in August 2007 is considered to be the largest since the Great Depression 1929–1932. This indicates how vulnerable the economy is to the irresponsible risk-taking by the financial institutions. The consequences of such risk-taking by financial institutions via imprudent lending activities are far reaching. Therefore, studying bank risk-taking behavior is far more important today than ever before.

Likewise, the problems with poor bank governance are more severe than that of non-bank firms and their failures have even more significant costs. This is because banks are 'special' economic units due to their distinctive roles in financial intermediation, in the payment system, liquidity, information, and maturity and denomination transformation. Banks are also important as they provide critical monitoring role in the governance of their borrowers such as by reducing borrowers' earnings management behavior (Ahn and Choi, 2009). In addition, banks are more intensely regulated to avoid negative externalities from any 'systemic risk' (Flannery, 1998) as well as to protect the interest of 'dispersed' and 'unsophisticated' bank depositors. The bank board plays a vital role in the sound governance of complex banks. In the presence of opacity in bank lending activities, the role of bank board is more important as other stakeholders such as shareholders or debtholders are not able to impose effective governance in banks (Levine, 2004). In this regard, Adams and Mehran (2008) and Andres and Vallelado (2008) show some evidence that bank board structure is relevant to bank performance. Perhaps, the bank board is even more important as a governance mechanism than its non-bank counterparts because of directors fiduciary responsibilities extends beyond shareholders to depositors and to regulators as well (Macey and O'Hara, 2003). The Basel Committee on Banking Supervision

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(2006) in its consultative document, "Enhancing Corporate Governance of Banking Industry", places the board as an essential part of bank regulatory reforms. In addition, the second pillar (supervisory review process) of Basel II identifies the role of board of directors as an integral part of risk management (Basel Committee on Banking Supervision, 2005, pp. 163–164) but their effectiveness in doing so has not been tested.

Given the significance of studying bank risk-taking, and the renewed focus on the board as internal governance mechanism, it is important to examine how bank boards relate to bank risk-taking. Although Akhigbe and Martin (2008) show some cross-sectional evidence of the relevance of governance structure to bank risk, the bank risk-taking literature is mainly limited to capital regulation, charter value, market discipline and ownership structure as risk controlling mechanisms. Thus, there is no evidence to date on whether the bank board relates to bank risk-taking. This study examines the nature of relation between bank board structure and bank risk-taking from an agency theory perspective.

Using a sample of 212 large US bank holding companies (BHCs) over 1997–2004 period, the study finds that bank risk-taking is positively related to strong bank boards (i.e. small boards and less restrictive boards) while it is negatively related to CEO power. These results are consistent with the bank contracting environment. Particularly, the results for strong boards indicate that if a bank board better represents the bank shareholder's interests, then there will be greater bank risk-taking because shareholders' have reasons to prefer more risk (e.g., Galai and Masulis, 1976; Jensen and Meckling, 1976; Merton, 1977). Similarly, the CEO power results show that if bank CEOs have more power or ability to compel board decisions, then their banks would exhibit less risk since bank managers (including CEOs) have reason to be risk-averse (Smith and Stulz, 1985).

This study contributes to the existing literature in several important ways. As far as it could be ascertained, this is the first study to show that bank board structure is relevant to bank risk-taking in a way consistent with the bank contracting environment. It also contributes to the existing bank risk-taking literature by covering a sample period (1997–2004) considered to be one of less regulation for US banks. Thus, along with board structure variables, the findings provide evidence as to the effectiveness of regulatory discipline and capital market discipline (as already examined in existing literature) in less regulated periods. In terms of methodology, as far as it could be ascertained, this is the first study to use market (total risk, idiosyncratic risk and systematic risk), and hybrid (assets return risk, insolvency risk) measures of bank risk-taking in a single study.

The remainder of the paper is structured as follows. Section 2 presents a critical review of academic literature on shareholders and managers risk-taking incentives and board governance leading to the hypotheses development. Section 3 describes the data and econometric methods. Section 4 provides the empirical results while Section 5 shows the robustness of the results. Finally, Section 6 concludes the paper.

2. Related literature and hypotheses development

2.1. Shareholders incentives, strong boards and bank risk-taking

As in any corporate firm, due to the 'moral hazard' problem with the limited liability and the associated 'convex pay-off', bank shareholders have preference for 'excessive risk' (Galai and Masulis, 1976; Jensen and Meckling, 1976; John et al., 1991). As Galai and Masulis (1976) explain, the shareholders effectively hold a 'call option' on the firm's value with an exercise price of the total amount of debt outstanding. If the interest (deposit) rate is not properly priced to reflect this risk which is more likely to be the case for banks (due to deposit insurance and regulatory rescue), then the bank shareholders have an incentive to gain from this call option by increasing the bank's asset risk. The 'dispersed' and 'unsophisticated' debt-holders including depositors cannot refrain bank shareholders from undertaking more risk by initiating 'complete' debt contracts on an *ex-ante* basis because of the high information asymmetry (Dewatripont and Tirole, 1994).

The presence of deposit insurance scheme similar to that of Federal Deposit Insurance Corporation and the perceived 'too-big-to-fail' policy also contributes to bank shareholders 'moral hazard problem' by encouraging more bank risk-taking (Galai and Masulis, 1976; Jensen and Meckling, 1976; Merton, 1977). Using Black and Scholes (1973) option pricing formulae, Merton (1977) demonstrates that bank shareholders' claim on the insurer or guarantor can be thought of as holding a 'put option' on the value of bank's assets with an exercise price of depositors' claim. With a risk-insensitive deposit insurance premium, bank shareholders enjoy a 'subsidy' which increases in value with leverage and bank risk. Thus, bank shareholders have even stronger incentives for 'excessively' risky investments that potentially benefit themselves at the expense of the deposit insurance fund and the tax-payers who back it. Even the risk-adjusted capital with Financial Institutions Reform Recovery and Enforcement Act of 1989 and the risk-adjusted deposit insurance premium with Federal Deposit Insurance Corporation Improvement Act of 1991, can not reduce the 'moral hazard' problem fully and hence cannot fully control banks' risk-taking incentives (John et al., 1991).

Now that the effectiveness with which a bank board monitors bank managers and limits their opportunistic behavior depends upon its constructs (such as board size and composition). Since there is limited theory as to the most important board characteristics, an ad hoc selection of variables is made based on those emphasized most in the literature as a proxy of a 'strong bank boards': board size, independent directors, and less restrictive shareholders rights (such as non-staggered boards). Board size and its negative relation to firm performance is a common finding in the literature (Hermalin and Weisbach, 2003, p. 8) due to nimbleness, cohesiveness, less communication and coordination costs as well as less 'free-riding' director problems with smaller boards (Jensen, 1993). Since an individual director's incentive to acquire information and monitor managers is low in large boards, CEOs may find larger boards easier to control (Jensen, 1993, p. 865). In this regard, Yermack (1996) presents an inverse relationship between board size and firm performance. Independent directors are believed to be better monitors of managers as independent directors value maintaining reputation in directorship market is important but the findings in this instance are mixed (Fama and Jensen, 1983; Bhagat and Black, 2002). In the presence of restrictive shareholders rights, such as staggered board and poison pills, the boards are insulated from the market for corporate control and so may become entrenched in serving managers distorted interests (Bebchuk et al., 2009).

Thus a strong bank board (measured by board size, independence, and non-staggered and no poison pills) is expected to better monitor bank managers for shareholders. In the presence of 'moral hazard problem', since bank shareholders have incentives for more risk, strong bank boards (measured by board size, independence, and non-staggered and no poison pills) can be expected to associated with bank risk-taking positively. Thus, the formal representation of the first hypothesis of this study is as follows:

Hypothesis 1. ($\mathbf{H_1}$): Bank risk-taking is positively related to strong bank boards (i.e. small board size, more independent directors, and non restrictive shareholders rights).

2.2. Managerial incentives, CEO power and bank risk-taking

The separation of ownership from control in corporate firms creates 'agency problem' between shareholders and managers (Berle and Means, 1932). This separation bestows the bank's critical portfolio decisions on managers and the later may not always act in the best interests of shareholders. Thus, it is also crucial to understand bank managers' incentives regarding risk-taking. As argued previously in Section 2.1, while bank shareholders have preferences for excessive risk, bank managers have reasons to prefer less risk.

Like any investor, bank managers' wealth consists of a portfolio of tangible and financial assets as well as human capital (talent, job related experience). In contrast to other investors, the managers' wealth is mostly concentrated in the firms that managers manage. To the extent that bank managers have concentrated wealth including their non-diversifiable human capital, managers are expected to protect this internally by selecting 'excessively safe assets' or by diversification (e.g., Smith and Stulz, 1985; May, 1995). While shareholders can diversify their portfolio risk in the capital market, managers can effectively do so only at the firm level (May, 1995, p. 1292). In addition, the expected value of debt tax shield and bankruptcy costs contribute further toward managerial incentives at levered firms like banks to select overly safe projects, rather than excessively risky projects (Parrino et al., 2005). Furthermore, bank managers could have different risk-taking incentives if managers are compensated through wage and salary contracts rather than through shares and share option programs. When receive fixed-wages, managers behave in a risk-averse manner and so are unlikely to exploit the same 'moral hazard' incentives as stock owner-controlled banks. This is because managers have little to gain if their banks do exceptionally well (when their salaries are fixed) but will probably lose their jobs and human capital investments if their bank fails (Saunders and Cornett, 2006, p. 532). Thus, bank shareholders want managers to invest in all positive net-present-value projects, irrespective of their associated risks (Guay, 1999) but the risk-averse bank managers may accept some safe, value-reducing projects, and reject some risky but value-increasing projects (May, 1995).

Since CEO power could also influence the board's monitoring ability, similar to strong board, *a priori* CEO power considered to originate from two sources: CEO duality (Hermalin and Weisbach, 1998), and internally-hired CEO (May, 1995; Adams et al., 2005). CEO duality (when CEO chairs the board) restricts the information flow to other board directors and hence reduces board's independent oversight of manager (Fama and Jensen, 1983, p. 314; Jensen, 1993, p. 862). An 'internally-hired'[1] CEO may indicate CEO's long-term involvement with the firm and hence add to 'CEO power' to influence board decisions (May, 1995; Adams et al., 2005).

The discussion so far suggests that as risk-averse entrenched managers, bank CEOs have incentives to take less risk. Thus, it can be ascertained that 'CEO power' (measured by CEO duality and internally-hire) may negatively affect bank risk-taking. Hence, the second formal hypothesis to address in this study is as follows:

Hypothesis 2. (**H_2**): Bank risk-taking is inversely related to 'CEO power' (i.e. CEO duality and if internally-hired).

3. Data and econometric methods

3.1. Sample and data

The initial sample examined in this paper consists of the largest BHCs headquartered in the US with standard industrial classification of 6021 and 6022 for respective national and state commercial banks over the period 1997–2004. The data is sourced from DEF 14A proxy statements, BANKSCOPE, FR Y-9C, DATASTREAM, Federal Reserve Bank of St. Louis and SDC Platinum.

The detailed information on bank board structures are hand collected from DEF 14A proxy statements of annual meetings found in the SEC's EDGAR filings. Following Adams and Mehran (2008), the governance data is measured on the date of the proxy statement, i.e. at the beginning of the respective fiscal year. The data collection procedure is then adjusted to account for when the proxies disclose some governance information for the previous fiscal year (e.g., the percentage of CEO shareholding) and others for the following fiscal year (e.g., the number of directors). The financial information on BHCs is mostly obtained from BANKSCOPE database and complemented by fourth quarter Consolidated Financial Statements for BHCs, i.e. Form FR Y-9C, from Federal Reserve Board. The market information on BHCs is collected from DATASTREAM database. Similarly, the US three-month Treasury-bill rate in the two-index market model for bank risk computations, is obtained from the Federal Reserve Bank of St. Louis. The information on M&A activities of the sample BHCs over the sample period are obtained from Thomson Financial's SDC Platinum database. The initial sample begins with the 300 largest BHCs as ranked by 2004 year-end book value of total assets. The final sample, an intersection of the data on BHCs with SIC 6021 and 6022 in DEF 14A proxy statements, BANKSCOPE, DATASTREAM, and with minimum two consecutive years' data over 1997–2004, consists of 1534 observations.

3.2. Measures of bank risk

Multiple proxies of bank risk are selected to show whether strong boards and CEO's position have any impact on the bank risk-taking. The three primary measures of bank risk-taking include total risk (TR), idiosyncratic risk (IDIOR), and systematic risk (SYSR). Following Anderson and Fraser (2000), TR of a bank is calculated as the standard deviation of its daily stock returns (R_{it}) for each fiscal year. The daily stock return is calculated as the natural logarithmic of the ratio of equity return series, i.e. $R_{it} = \ln(P_{it}/P_{it-1})$, where P_{it} stock price which is also adjusted for any capital adjustment including dividend and stock splits. TR captures the overall variability in bank stock returns and reflects the market's perceptions about the risks inherent in the bank's assets, liabilities, and off-balance-sheet positions. Both regulators and bank managers frequently monitor this total risk.

SYSR and IDIOR are calculated using the following two-index market model as suggested by Chen et al. (2006) and Anderson and Fraser (2000). This model is estimated for each year for each bank:

$$R_{it} = \alpha_i + \beta_{1i} R_{mt} + \beta_{2i} INTEREST_t + \varepsilon_{it}, \quad (1)$$

where, i and t denote bank i and time t respectively; R is the bank's equity return; R_m is the return on S&P 500 market index; *INTEREST* is the yield on the three-month Treasury-bill rate[2]; α is the intercept term; ε is the residuals. β_{1i} is the SYSR of bank i. while IDIOR is calculated as the standard deviation of residuals of Eq. (1) for each year.

[1] A CEO is considered to be 'internally-hired' when the CEO is either founder or was an executive before being promoted to the CEO position. Alternatively, when the CEO is not externally-hired, it is termed as 'internally-hired' CEO.

[2] This study also uses the return on 5-year Treasury bond rate as an alternative interest rate index. The qualitative results, however, remain the same as using three-month T-bill yield and so only the latter one (i.e. three-month T-bill rate) is reported.

The coefficient estimate using the above two-index market model, i.e. Eq. (2), may be biased if there is any relationship between the interest rate changes and the market returns (Akhigbe and Whyte, 2003). However, orthogonalization (i.e. $E(Y_{it}, X_{it}) = 0$) could address this problem (Chance and Lane, 1980) which may also provide some bias *t*-statistics (Kane and Unal, 1988). Therefore, following Kane and Unal (1988), Anderson and Fraser (2000), and Akhigbe and Whyte (2003), this study use the un-orthogonalized two-index market model.

Two additional measures of bank risk, i.e. assets return risk (ARR) and insolvency risk (*Z*-score), are also used to check the robustness of the results. Following Flannery and Rangan, (2008), ARR is computed as the standard deviation of the daily stock returns *times* the ratio of market value of equity to market value of total assets *times* square-root of 250. The market value of total assets is the sum of book value of liabilities and the market value of equity. Following Boyd et al. (1993), *Z*-score for each fiscal period is computed as *Z* = {[Average(Returns) + Average(Equity/Total assets)]/TR}. The *Z*-score has an inverse form, i.e. 1/*Z*, so as to make the interpretation of the signs of coefficients comparable. Otherwise a high *Z*-score means less insolvency risk whereas a high TR, SYSR, IDIOR, or ARR indicates more risk.

3.3. Measures of explanatory variables

Three proxies of strong bank boards are board size, independent directors and less restrictive shareholders right index. I define board size (BS) as the number of directors on the board. Independent directors (INDIR) is measured as the percentage of total directors who are independent. An independent director has only business relationship with the bank is his or her directorship, i.e. an independent director is not an existing or former employee of the banks or its immediate family members and does not have any significant business ties with the bank. When evaluating independence, the borrowing and depositing by directors with their BHCs or its subsidiaries are also considered.[3] A shareholders' restrictive rights index (GINDEX), an approximation of Bebchuk et al. (2009) entrenchment index[4], is computed as the sum of two dummy variables: staggered board (STAGG) and poison pill (POISON). The dummy variable, STAGG, equals one if the board is staggered, otherwise zero. The dummy variable, POISON, equals one if the bank board has the provision for poison pill, otherwise zero. Given the expectation that strong board positively affects bank risk-taking due to bank shareholders' 'moral hazard problem', we may expect bank risk-taking to be negatively related to BS, positively related to INDIR and negatively related to GINDEX. A dummy variable (CEOPOWER) is used to capture CEO influence over bank board decisions. CEOPOWER equals one if CEO is also the board chair and if internally-hired (i.e. either founder or not externally-hired), otherwise zero. CEO shareholding can also add to CEO power but also likely to align both CEO and shareholders' incentives. Hence the affect of CEO shareholdings on bank risk-taking is an empirical issue.

Following prior studies (e.g., Saunders et al., 1990; Demsetz et al., 1997; Anderson and Fraser, 2000) five other variables are included to control for bank size (TA), charter value (CV)[5], financial leverage (CAPITAL), frequency of trading (FREQ), and any previous M&A activity (MERGER). For the sake of brevity, further details on the control variables are omitted as they are shown in Panel C of Table 1.

3.4. Empirical models and estimation methods

3.4.1. Empirical models

The following regression equation is formulated to test empirically the two main hypotheses, $\mathbf{H_1}$, and $\mathbf{H_2}$, given the literature discussion in Section 2.

$$\begin{aligned}\ln(RISK)_{i,t} &= \alpha + \beta_1 \ln(\underset{-}{BS})_{i,t} + \beta_2(\underset{+}{INDIR})_{i,t} + \beta_3(\underset{-}{GINDEX})_{i,t} \\ &\quad + \delta_1(\underset{-}{CEOPOWER})_{i,t} + \delta_2(\underset{+/-}{CEOWN})_{i,t}, + \zeta_1 \ln(\underset{-}{TA})_{i,t} \\ &\quad + \zeta_2(\underset{-}{CV})_{i,t} + \zeta_3(\underset{-}{CAPITAL})_{i,t} + \zeta_4(\underset{+}{FREQ})_{i,t} \\ &\quad + \zeta_5(\underset{+}{MERGER})_{i,t}, + \sum_{t=1}^{1998-2004} \psi_t(YEAR)_t + \varepsilon_{i,t}, \qquad (2)\end{aligned}$$

where subscripts *i* denotes individual BHC (*i* = 1,2, ... ,212), *t* time period (*t* = 1998, 1999, ... ,2004) and ln is the natural logarithmic. β, δ, γ, ζ, and Ψ are the parameters to be estimated. ε is the idiosyncratic error term. The definition of the variables in the regression Eq. (2) is as mentioned in Sections 3.2 and 3.3 and also as summarized in Table 1. The sign beneath each variable indicates the expected nature of relation between the dependent and relevant explanatory variables.

3.4.2. Estimation method

The primary estimation method for Eq. (2) is generalized least square (GLS) random effect (RE) technique following Baltagi and Wu (1999) procedure. This technique is robust to first-order autoregressive (AR(1)) disturbances (if any) within unbalanced-panels and cross-sectional correlation and/or heteroskedasticity across panels. In the presence of unobserved bank fixed-effect, panel 'Fixed-Effect' (FE) estimation is commonly suggested (see Wooldridge, 2002, pp. 265–291, for details on FE estimation). However, such FE estimation is not suitable for this study for several reasons. First, time-invariant variable like GINDEX cannot be estimated with FE regression as it would be absorbed or wiped out in 'within transformation' or 'time-demeaning' process of the variables in FE. Second, FE estimation requires significant within panel (bank) variation of the variable values to produce consistent and efficient estimates. When the important variables on the right-hand side do not vary much over time, like the board structure variables in this paper, the FE estimates would be imprecise (Wooldridge, 2002, p. 286).[6] Third, FE estimates may aggravate the problem of multicollinearity if solved with least squares dummy variables (Baltagi, 2005). Finally, for large '*N*' (i.e. 212) and fixed small 'T' (i.e. 8), which is the case with this study's panel data set (observations on 212 BHCs over 8 years) FE estimation is inconsistent (Baltagi, 2005, p. 13). Furthermore, in case of a large N, FE estimation would lead to an enormous loss of degrees of freedom (Baltagi, 2005, p. 14). Thus, an alternative to FE, i.e. GLS RE is proposed here.

3.5. Descriptive statistics and correlation matrix

The descriptive statistics for the various board structure, CEO characteristics, and bank characteristics variables are presented in Table 2. The board structure variables in Panel A of Table 2 show that the mean (median) BS is 12.92 (12.00) with a minimum of 5

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[3] Any loans should comply with the applicable law, including Regulation O of Board of Governors of Federal Reserve and Section 13(k) of the Securities Exchange Act of 1934.

[4] Bebchuk et al. (2009) entrenchment index is the composite of six dummy variables: staggered boards, limits to shareholder by-law amendments, supermajority requirements for mergers, super-majority requirements for charter amendments, poison pills and golden parachutes. Definitions of these variables are in Bebchuk et al. (2009, pp. 8–9). In an unreported correlation between a Bebchuk's entrenchment index and GINDEX is 0.67 (*p*-value <0.01) for a sample of 49 banks.

[5] The 'charter value' of a bank is the present value of a bank's future economic profits when considered as a going concern (Demsetz et al., 1997, p. 6).

[6] In an unreported table of year-to-year changes in board structure variables shows statistically insignificant both t-statistics and Mann-Whitney z-statistics of changes of board structure variables.

Table 1
Definitions of variables.

Variables	Measures
Panel A: Dependent variables (RISK)	
1. Total risk (TR)	The standard deviation of the daily bank stock returns in each year
2. Idiosyncratic risk (IDIOR)	The standard deviation of the error terms in Eq. (1)
3. Systematic risk (SYSR)	Coefficient of *Rmt* (i.e. β_1) in Eq. (1)
4. Assets return risk (ARR)	The standard deviation of the daily stock returns *times* the ratio of market value of equity to market value of total assets *times* square-root of 250
5. Insolvency risk (*Z*-score)	*Z* = [Average(Returns) + Average(Equity/Total assets)]/Std(Equity/Total assets)
Panel B: Strong board and CEO variables	
Board size (BS)	The number of directors in the BHC's board
Independent directors (INDIR)	The percentage of total directors who are independent
Share-holders' restrictive right index (GINDEX)	The sum of two dummy variables: staggered board, and poison pills. The dummy for staggered boards equals 1 if the BHC's board is classified, otherwise zero. The dummy for poison pills equals one if the board has poison pill provision, otherwise zero
CEO power (CEOPOWER)	A dummy variable which equals one if CEO chairs the board and also internally-hired, otherwise zero
CEO ownership (CEOWN)	The percentage of the BHC CEO's shareholdings
Panel C: Other control variables	
Bank size (TA)	Total assets as at the end of each fiscal year.
Charter value (CV)	Keeley's Q (Keeley, 1990) which is calculated as the sum of the market value of equity *plus* the book value of liabilities *divided* by the book value of total assets
Bank capital (CAPITAL)	The BHC's total equity as percentage of total assets
Frequency of trading (FREQ)	The average daily trading volume of shares in a year divided by the number of bank's total outstanding shares at the beginning of each year
Previous M&A (MERGER)	A dummy for any previous period M&A, i.e. a dummy variable which equals one for BHC that made an acquisition in a year, otherwise zero
Year dummies (YEAR)	Seven individual dummy variables which equals either one or zero for each year from 1998 to 2004 with 1997 being the excluded year

Table 2
Descriptive statistics.

Variables	Mean	SD	Min.	1st Quartile	Median	2nd Quartile	Max.	Skew.	Kurt.
Panel A: Strong board and CEO variables:									
BS (No.)	12.92	4.54	5	10	12	15	31	0.96	3.83
OUTDIR (%)	84.62	8.73	37.5	80	86.96	90.91	100	−1.49	5.94
INDIR (%)	64.52	15.72	10	55.56	66.67	75	96.55	−0.58	3.1
STAGG	0.74	0.44	0	0	1	1	1	−1.11	2.22
POISON	0.34	0.47	0	0	0	1	1	0.7	1.49
GINDEX	1.08	0.72	0	1	1	2	2	−0.12	1.91
CEOPOWER	0.48	0.50	0	0	0	1	1	0.08	1.00
CEOWN (%)	4.41	8.8	0	0.55	1.3	3.46	65.19	3.72	18.72
Panel B: Bank-specific variables:									
TA (in bil.)	23.66	105.78	.16	1.02	2.07	7.66	1484.1	8.23	81.31
CV	1.1	0.07	0.94	1.05	1.09	1.13	1.64	1.82	10.54
CAPITAL (%)	9.26	1.9	3	7.99	9.09	10.16	21.59	1.34	7.93
FREQ (%)	0.32	0.45	0.01	0.11	0.2	0.35	9.85	8.84	148.9
MERGER	0.11	0.32	0	0	0	0	1	2.45	6.99
Panel C: Bank risk measures:									
TR (%)	2.26	1.2	0.65	1.65	2.02	2.53	17.32	4.81	42.75
IDIOR (%)	1.98	0.82	0.58	1.44	1.85	2.35	10.23	1.87	12.07
SYSR	0.52	0.42	−0.54	0.17	0.47	0.81	2.38	0.58	2.98
ARR (%)	5.06	2.49	1.21	3.45	4.6	6.05	28.15	2.41	14.94
Z-score	19.74	14.43	2.24	11.23	16.69	23.74	211.31	4.06	35.57

This table presents the distribution of variables by showing mean, standard deviation (SD), minimum (Min.), first quartile (1st Quartile), median (Median), second quartile (2nd Quartile), skewness (Skew.), and kurtosis (Kurt.). See Table 1 for variable definitions.

and a maximum of 31. The mean (median) percentage of non-executive directors, OUTDIR, is 84.62% (86.96%) and the mean (median) percentage of independent directors, INDIR, is 64.52% (66.67%). Seventy-four percent of the sample banks have staggered boards and thirty-four percent have a poison pill provision. The mean value of shareholders' restrictive right index (GINDEX) is 1.08. Forty-eight percent of the BHCs' CEOs were board chairs and also internally promoted, i.e. either a founder or not externally-hired. The mean (median) CEOWN of 4.41% (1.30%) is greater than that reported by Adams and Mehran (2008) of 2.27%.

For brevity, the descriptive statistics of other bank-specific variables (in Panels B of Table 2) are omitted. Turning to the descriptive statistics of bank risk measures in Panel C of Table 2, the mean (median) TR of 2.26% (2.02%) is comparable to that mean TR (2.13%) reported by Anderson and Fraser (2000). The mean (median) IDIOR is 1.98% (1.85%) which resembles the mean value (2.08%) shown by Anderson and Fraser (2000). The mean (median) SYSR is 0.52 (0.47) and the mean (median) ARR is 5.06% (4.60%). Finally, the mean (median) *Z*-score for the sample BHCs is 19.74 (16.69).

Table 3 presents the Pearson's pair-wise correlation matrix between variables. The correlation coefficients between strong boards, CEO power measures and bank risk measures are largely in consistent with the expectation except for INDIR. For example, the correlation coefficient between BS and all bank risk measures are negative and statistically significant for TR and IDIOR. Multicol-

Table 3
Correlation matrix.

	Variables	1	2	3	4	5	6	7	8	9	10
1	BS	1.00	**0.16**	0.01	**0.08**	**−0.15**	**0.38**	0.02	−0.02	−0.05	0.05
2	INDIR		1.00	0.05	**0.14**	**−0.12**	**0.33**	0.05	0.01	0.03	0.00
3	GINDEX			1.00	−0.04	**−0.14**	−0.01	0.03	−0.07	0.03	−0.02
4	CEOPOWER				1.00	**0.11**	**0.24**	**0.09**	−0.07	0.03	−0.07
5	CEOWN					1.00	**−0.15**	**−0.13**	0.02	0.04	−0.07
6	LNTA						1.00	**0.31**	−0.07	**0.23**	**0.12**
7	CV							1.00	**0.17**	**0.15**	−0.02
8	CAPITAL								1.00	**−0.09**	**0.08**
9	FREQ									1.00	0.02
10	MERGER										1.00
11	TR	**−0.10**	**−0.18**	**−0.12**	−0.04	**0.09**	**−0.24**	**−0.13**	0.01	0.00	−0.03
12	IDIOR	**−0.12**	**−0.23**	**−0.11**	**−0.10**	**0.19**	**−0.39**	**−0.24**	−0.02	−0.03	−0.03
13	SYSR	−0.03	−0.03	−0.06	0.04	−0.07	0.04	0.04	0.04	0.03	−0.01
14	ARR	−0.04	**−0.08**	−0.06	−0.03	−0.05	0.04	**0.58**	**0.34**	0.06	−0.02
15	*Z*-score	−0.05	−0.05	−0.02	0.03	−0.06	−0.06	0.00	−0.06	0.06	**−0.12**

The table shows Pearson pairs-wise correlation matrix. Bold texts indicate statistically significant at 1% level or better. See Table 1 for variable definitions.

linearity among the regressors should not be a concern as the maximum value of correlation coefficient is 0.38 which is between board size (BS) and bank size (LNTA). In addition, in a multivariate setting, the average variance inflation factor (a post-estimation measure) of 1.65 also suggests that multicollinearity among the regressors should not bias the coefficient estimates in the regression model.

4. Empirical results

Table 4 presents the results of GLS RE estimates of regression Eq. (2) when either TR, IDIOR, SYSR, ARR or $1/Z$ is the dependent variable. The regression Eq. (2) is well-fitted with an overall R-squared of 32.5%, 52.9%, 43.6%, 54% and 7.52% for TR, IDIOR, SYSR, ARR and $1/Z$ respectively with statistically significant Wald Chi-square (χ^2) statistics.

With regards to strong board measures, as anticipated the coefficient on BS is negative across all five measures of bank risk and statistically significant. This illustrates that, after controlling for other governance mechanisms and bank characteristics, a small bank board is associated with more bank risk-taking. This result is also consistent with corporate firm evidence by Cheng (2008). The economic significance of this result is also important. For instance, an increase in the BS by one (sample) standard deviation (i.e. using Table 2, an increase in BS of 4.54 points) would increase bank TR (in logarithmic) by approximately 12.45 percentage points $[\ln(4.54) \times 0.0671/\ln(2.26) = 0.1245]$. Contrary to expectation, the coefficient on INDIR is negative and statistically significant for all bank risk measures except insolvency risk ($1/Z$). This result is still robust when the percentage of non-executive directors (OUTDIR) is used in place of INDIR. This illustrates that more independent boards are also independent from bank shareholders which resulted in less risk-taking. This may be because independent directors are more sensitive to the regulatory compliance. That is, in the presence of continuous and close monitoring by regulators, bank managers including directors act more conservatively to avoid any lawsuits in case of any default. Consistent with expectation the coefficient on GINDEX is also negative across all measures of bank risk and statistically significant for TR, IDIOR, and ARR. This suggests that banks with more restrictive boards take less risk. The economic significance of this result is also important. For instance, an increase in the GINDEX by one (sample) standard deviation (i.e. using Table 2, an increase in GINDEX of 0.72 points) would increase bank TR (in logarithmic) by approximately 2.25 percentage points $[0.72 \times 0.0701/\ln(2.26) = 0.0225]$. Thus, with regard to Hypothesis $\mathbf{H_1}$, the evidence support that strong bank boards (at least small and less restrictive boards) involve with more risk-taking.

With regard to CEO power, as hypothesized the coefficient on CEOPOWER is negative across all bank risk measures and statistically significant for TR, IDIOR and ARR. That is, after controlling for other governance and bank characteristics, CEO power is associated with lower bank risk. Its economic significance is also important. For example, banks in which CEO chairs the board and is also internally-hired, would lower bank TR (in logarithmic) by approximately 1.43 percentage points $[1 \times -0.0117/\ln(2.26) = 0.0143]$. Thus, the second Hypothesis ($\mathbf{H_2}$) is also supported.

The coefficients on other bank characteristics variables offer some important insights. For instance, while no directional prediction was made on CEOWN, a statistically significant positive coefficient on CEOWN across three bank risk measures (i.e. for TR, IDIOR, and $1/Z$) indicates that as the percentage of bank CEOs shareholdings increase their risk preferences coincide with bank shareholders and so increases bank risk. The statistically significant coefficients on TA indicate that while bank size lowers TR, IDIOR, ARR and $1/Z$ it raises SYSR. At odds with the expectation, the statistically significant positive coefficient on CV indicates that banks with high charter value are exposed to more bank risk. Similarly, the statistically significant positive coefficient on CAPITAL for ARR and $1/Z$ indicates that the highly capitalized banks are subject to more risk. In addition, the statistically significant positive coefficient on FREQ for TR, IDIOR and $1/Z$ demonstrates that the greater the speed at which new information is reflected in the stock price the higher the bank risk (Anderson and Fraser 2000). The Wald (1943) test statistic (Π) for the joint significance of time dummies is statistically significant at 1% level and hence validates their inclusion in the structural model.

5. Robustness tests

5.1. Three-stage least squares (3SLS)

The reported coefficient estimates in Table 4 may be biased as board structure is in fact endogenously formed (e.g., Adams and Ferreira, 2007; Hermalin and Weisbach, 2003). For instance, both board size and independent directors decreases with firm uncertainty as measured by return variability (Linck et al., 2008). I address this endogeneity concern in two ways. To confirm that the causation runs from board structure to bank risk, I re-estimate the Eq. (2) using OLS while replacing the contemporaneous board structure variables with their lag values. The interpretation of the results remains qualitatively the same as those reported in Table 4

Table 4
GLS random effect (RE) regression results of bank risk.

	Explanatory variables	Pre. sign	(1) TR	(2) IDIOR	(3) SYSR	(4) ARR	(5) 1/Z
β_1	BS	–	−0.0671*	−0.056*	−0.116***	−0.0444*	−0.0179**
			(1.80)	(1.79)	(−3.54)	(1.69)	(1.98)
β_2	INDIR	+	−0.0750**	−0.0542*	−0.0781***	−0.0755**	−0.00524
			(−2.00)	(−1.68)	(2.22)	(−2.12)	(0.54)
β_3	GINDEX	–	−0.0701**	−0.0569***	−0.00837	−0.0296*	−0.00343
			(−3.07)	(−3.46)	(−0.55)	(−1.73)	(0.84)
δ_1	CEOPOWER	–	−0.0117*	−0.0286*	−0.0259	−0.0254	−0.00915*
			(−1.68)	(−1.73)	(−1.30)	(−1.28)	(−1.67)
δ_2	CEOWN	±	0.00293*	0.00471***	0.000454	−0.00206	0.00151***
			(1.76)	(3.62)	(0.36)	(−1.49)	(4.40)
ζ_1	LNTA	–	−0.0631***	−0.0961***	0.165***	−0.0361***	0.00403**
			(−5.72)	(−11.41)	(20.68)	(−4.03)	(1.80)
ζ_2	CV	–	0.326**	0.229*	1.191***	3.523***	0.0602
			(2.31)	(1.81)	(8.89)	(24.90)	(1.51)
ζ_3	CAPITAL	–	0.00157	−0.00252	0.00676	0.0457***	0.00408***
			(0.31)	(−0.55)	(1.33)	(8.99)	(2.85)
ζ_4	FREQ	+	0.0364**	0.0445**	0.0339	0.013	0.0165***
			(1.78)	(2.42)	(1.59)	(0.63)	(2.78)
ζ_5	MERGER	+	0.0298	0.0413*	0.00368	0.0754***	0.00847
			(1.36)	(1.96)	(0.13)	(3.09)	(1.09)
α	Constant		1.219***	1.437***	−2.200***	−2.003***	0.189***
			(5.24)	(7.18)	(−10.64)	(−9.05)	(3.12)
Ψ	Year dummies		Included	Included	Included	Included	Included
	Model fits:						
	Within R^2		0.4626	0.5638	0.2587	0.3947	0.0897
	Between R^2		0.1743	0.4541	0.7432	0.6813	0.0526
	Overall R^2		0.3349	0.5299	0.4362	0.54	0.0752
	Wald χ^2-statistics (17)		1168.90***	1864.84***	816.40***	1294.65***	129.37***
	Π: F-statistics (7, 1513)		819.66***	1221.14***	701.46***	633.11***	84.06***
	No. of pooled obs.		1534	1534	1534	1534	1534

This table presents the results of the generalized least squares random effect (GLS RE) estimates of Eq. (2).

$$\ln(RISK)_{i,t} = \begin{cases} \alpha + \beta_1 \ln(\underset{-}{BS})_{i,t} + \beta_2(\underset{+}{INDIR})_{i,t} + \beta_3(\underset{-}{GINDEX})_{i,t} + \delta_1(\underset{-}{CEOPOWER})_{i,t} + \delta_2(\underset{+/-}{CEOWN})_{i,t} \\ + \zeta_1 \ln(\underset{-}{TA})_{i,t} + \zeta_2(\underset{-}{CV})_{i,t} + \zeta_3(\underset{-}{CAPITAL})_{i,t} + \zeta_4(\underset{+}{FREQ})_{i,t} + \zeta_5(\underset{+}{MERGER})_{i,t} + \sum_{t=1}^{1998-2004} \psi_t(YEAR)_t + \varepsilon_{i,t} \end{cases}$$

Subscripts i denotes individual banks, t time period, ln natural logarithms. The dependent variable *RISK* is either total risk (*TR* in column 1) or idiosyncratic risk (*IDIOR* in column 2) or systematic risk (*SYSR* in column 3) or asset return risk (*ARR* in column 4) or insolvency risk (1/*Z* in column 5). *TR* is the standard deviation of the bank's daily stock returns over a year. *IDIOR* is calculated as the standard deviation of ε_{it} in Eq. (2). *SYSR* is the coefficient of *Rmt*, i.e. β_1 in the two-index market model as represented by Eq. (2). Flannery and Rangan's (2008) *ARR* is the natural logarithmic of the standard deviation of the daily stock return *times* the ratio of market value of equity to market value of total assets *times* square-root of 250 in a year. *Z*-score risk is calculated as [Average(Returns) + Average(Equity/Total assets)]/Std(Equity/Total assets). *BS* is the number of directors on the board. *INDIR* is the independent directors as a percentage of board size. *GINDEX* is the sum of the two dummy variables – staggered board and poison pill, and is an approximation of the Bebchuk et al. (2009) entrenchment index. *CEOPOWER* is the dummy variable which equals 1 if the CEO also chairs the board and also internally-hired, zero otherwise. *CEOWN* is the percentage of shares owned by the CEO. *TA* is the total assets at fiscal year-end. *CV* is the charter value of the bank calculated (following Keeley, 1990) as the book value of total assets *plus* market value of equity *minus* book value of equity, all *divided* by the book value of total assets. *CAPITAL* is the bank equity as a percentage of total assets. *FREQ* is the average volume of shares divided by the total number of shares outstanding. *MERGER* is the dummy variable which equals 1 if the bank has any M&A in the period, otherwise zero. *YEAR* is a time dummy. α is the constant. β, δ, γ, ζ, and Ψ are the parameters to be estimated. ε is the idiosyncratic error term. Finally, Π is the Wald (1943) test *F*-statistics for the joint significance of the year fixed-effects. The reported *t*-statistics with GLS RE estimates are robust to random fixed-effect and also for heteroskedasticiy. Figures in parentheses are *t*-statistics. Superscripts *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

and hence unreported. Then to eliminate the endogeneity problem from simultaneity bias (if any), first I endogenize both board size and independent directors given existing literature (such as Linck et al., 2008) on board structure determinants by developing the following two regression equations, i.e. Eqs. (3) and (4) for BS and INDIR, respectively:

$$\ln(BS)_{i,t} = \alpha + \beta_1(\underset{+}{INDIR})_{i,t} + \beta_2 \ln(\underset{-}{RISK})_{i,t} + \beta_3(\underset{+}{GINDEX})_{i,t} + \beta_4(\underset{-}{CEOWN})_{i,t} + \beta_5 \ln(\underset{+}{TA})_{i,t}, + \beta_6(\underset{+}{CAPITAL})_{i,t} + \beta_7(\underset{+}{MERGER})_{i,t} + \beta_8(\underset{+}{BOARDOWN})_{i,t} + \varepsilon_{i,t}, \quad (3)$$

$$INDIR_{i,t} = \alpha + \beta_1(\underset{+}{BS})_{i,t} + \beta_2 \ln(\underset{-}{RISK})_{i,t} + \beta_3(\underset{+}{GINDEX})_{i,t} + \beta_4 \underset{-}{CEOPOWER}_{i,t} + \beta_5 \ln(\underset{+}{TA})_{i,t}, + \beta_6(\underset{-}{CV})_{i,t} + \beta_7(\underset{+}{BOARDOWN})_{i,t} + \varepsilon_{i,t}x. \quad (4)$$

The definition of the variables except BOARDOWN remains the same as in Section 3.4.1 and also as summarized in Table 1. BOARDOWN is the percentage of shareholding by the board directors except CEO. The three equations, Eqs (2)–(4) are solved as a system of simultaneous equations using three-stage least squares (3SLS) estimation method.

Table 5 presents the results for such 3SLS estimation of the three equations in which RISK is proxied by total risk (TR). Column 1 of Table 5 shows the effect of bank board structure on bank risk (RISK) as specified by Eq. (2) but without CEOWN to make the system identified. The findings remain the same as with those reported in Table 4 except that the coefficient on CEOPOWER is no longer statistically significant. Although not the main focus of this paper, the results for Eqs (3) and (4) respectively for BS and INDIR in columns 2 and 3 of Table 5 provide some useful information. For example, the coefficient on TA indicates that both BS and INDIR increase with bank size. Likewise, the negative coefficient on GIN-

Table 5
Three-stage least squares (3SLS) regression results of bank total risk.

Explanatory variables	(1) RISK	(2) BS	(3) INDIR
BS	−0.455***	–	28.17***
	(−2.59)	–	(9.07)
INDIR	−0.00528*	0.0347***	–
	(−1.86)	(8.29)	–
RISK	–	−0.273***	−7.817***
	–	(4.01)	(−3.88)
GINDEX	−0.0562***	0.0810***	2.294***
	(−4.03)	(4.37)	(3.99)
CEOPOWER	−0.00916	–	0.0327
	(−0.50)	–	(0.16)
CEOWN	–	−0.00013	–
	–	(−0.28)	–
LNTA	−0.00076	0.0361**	0.975**
	(−0.03)	(2.88)	(2.29)
CV	−0.249	–	−0.276
	(−1.32)	–	(−0.14)
CAPITAL	0.00589	0.00104	–
	(1.17)	(0.53)	–
FREQ	−0.00867	–	–
	(−0.28)	–	–
MERGER	0.0966***	0.00778	–
	(2.78)	(0.58)	–
BOARDOWN	–	0.0233***	−0.666***
	–	(9.87)	(−14.02)
Constant	2.486***	−0.567**	17.25**
	(4.49)	(−2.05)	(3.1)
YEAR	Included	Included	Included
Model fits:			
Adjusted R^2	0.2186	0.1786	0.0400
χ^2-statistics (17|8|7))	650.30****	249.60***	432.21***
No. of pooled obs.	1534	1534	1534

This table present three-stage least squares (3sls) estimates of the system of three regression equations, i.e. Eqs. (2)–(4) for *RISK*, *BS* and *INDIR* respectively. *RISK* is proxied by TR which is the standard deviation of the bank's daily stock returns over a year. *BS* is the number of directors on the board. *INDIR* is the independent directors as a percentage of board size. *GINDEX* is the sum of the two dummy variables – staggered board and poison pill, and is an approximation of the Bebchuk et al. (2009) entrenchment index. *CEOPOWER* is the dummy variable which equals 1 if the CEO also chairs the board and also internally-hired, zero otherwise. *CEOWN* is the percentage of shares owned by the CEO. *TA* is the total assets at fiscal year-end. *CV* is the charter value of the bank calculated (following Keeley, 1990) as the book value of total assets *plus* market value of equity *minus* book value of equity, all *divided* by the book value of total assets. *CAPITAL* is the bank equity as a percentage of total assets. *FREQ* is the average volume of shares divided by the total number of shares outstanding. *MERGER* is the dummy variable which equals 1 if the bank has any M&A in the period, otherwise zero. *BOARDOWN* is the percentage shareholding by board directors except CEO. *YEAR* is a time dummy. α is the constant. β, δ, γ, ζ, and Ψ are the parameters to be estimated. ε is the idiosyncratic error term. Finally, Π is the Wald (1943) test *F*-statistics for the joint significance of the year fixed-effects. Figures in parentheses are *t*-statistics. Superscripts *, ***, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

DEX suggest that banks in which management has opportunity to secure more 'private benefits' benefits from larger and more independent directors. Thus, even with direct control for endogeneity with 3SLS, this study finds evidence that strong boards (i.e. smaller and less restrictive boards) increase bank risk. This result remains valid if RISK is proxied by other measures of bank risk such as IDIOR, ARR.

5.2. Two-step system generalized method of moments (GMM)[7]

Table 6 reports the results of Arellano and Bover (1995) and Blundell and Bond (1998) 'system GMM' estimation of Eq. (2) using different measures of bank risk. In the system GMM, first-differenced variables are used as instruments for the equations in levels and the estimates are robust to unobserved heterogeneity, simultaneity and dynamic endogeneity (if any).[8] The diagnostics tests in Table 6 show that the model is well-fitted with statistically insignificant test statistics for both second-order autocorrelation in second differences ($\Pi2$) and Hansen *J*-statistics of over-identifying restrictions. The residuals in the first difference should be serially correlated ($\Pi1$) by way of construction but the residuals in the second difference should not be serially correlated ($\Pi2$). Accordingly, in Table 6, we could see statistically significant $\Pi1$ and statistically insignificant $\Pi2$ for all bank risk measures. Likewise, the Hansen *J*-statistics of over-identifying restrictions tests the null of instrument validity and the statistically insignificant Hansen *J*-statistics for all the bank measures indicate that the instruments are valid in the respective estimation. Finally, the number of instruments (i.e. 183) used in the model is less than the panel (i.e. 212) which makes the Hansen *J*-statistics more reliable.

The interpretation of the coefficients on strong board measures (BS, INDIR, and GINDEX) and CEO power (CEOPOWER) in Table 6 qualitatively remains the same as in Table 4. For instance, the statistically significant negative coefficients on BS and GINDEX across all the measures of bank risk except SYSR suggest that strong boards are associated with greater bank risk. Similarly, the statistically significant negative coefficients on CEOPOWER across all measures of bank risk except SYSR suggest that CEO power negatively relate to bank risk. Overall, the 'system GMM' estimates in Table 6 supports that even after controlling for unobserved heterogeneity, simultaneity and dynamic endogeneity, strong boards and CEO power are found to relate to bank risk in a way consistent with the expectation.

5.3. Glejser's (1969) heteroskedasticity tests

Following Adams et al. (2005), I perform Glejser's (1969) heteroskedasticity tests to show the effect of strong boards and CEO power on bank risks. The estimates with Glejser (1969) procedure are robust to both within and across bank correlations of residuals. Glejser heteroskedasticity tests are performed in two steps. First, the residuals are derived from the pooled-OLS estimation of regression Eq. (2) but without CV and FREQ. The dependent variable RISK is either of the two bank performance measures, i.e. return on average total assets (ROAA) or return on average total equity (ROAE). ROAA is computed as the net income after tax as a percentage of bank's average total assets while ROAE is measured as the net income after tax as a percentage of bank's average total shareholders equity. In the second step, the absolute value of the residuals obtained in the first steps are used as a proxy for RISK and re-estimate Eq. (2) using pooled-OLS. Table 7 below reports the second step results of Glejser's (1969) heteroskedasticity tests for ROAA and ROAE in column (1) and (2) respectively. The *R*-squared of regression Eq. (2) is 3.2%, and 4.2% for absolute value of ROAA and absolute value of ROAE respectively with statistically significant *F*-statistics. The average variance inflation factor (AVIF) of 2.17 and the maximum VIF of 2.41 (with TA) indicate multicollinearity among the regressors should not be a concern. The Wald (1943) test statistic (Π) for the joint significance of time dummies is statistically significant at 1% level and hence validates their inclusion in the structural model.

With regard to strong bank boards, the interpretation of the statistically significant negative coefficients on BS, INDIR and GINDEX remain the same as in Table 4. In relation to CEO power, the

[7] The author thanks the reviewer for suggesting this dynamic panel data technique.

[8] The 'system GMM' estimates are obtained using the Roodman '*xtabond2*' module in Stata. Please see Roodman (2006) for detail estimation procedure of dynamic panel data using '*xtabond2*'.

Table 6
Two-step system GMM regression results of bank risk.

Explanatory variables		Pre. sign	TR	IDIOR	SYSR	ARR	1/*Z*
β_1	BS	–	−0.06538**	−0.0708*	−0.3401	−0.0878**	−0.0422*
			(2.05)	(1.74)	(−1.37)	(1.98)	(1.86)
β_2	INDIR	+	−0.1007*	−0.0577*	−0.3396*	−0.0899*	−0.0231
			(−1.69)	(−1.88)	(−1.68)	(−1.92)	(−0.74)
β_3	GINDEX	–	−0.0586***	−0.0430**	−0.4155	−0.0340*	−0.0061*
			(−2.62)	(−2.15)	(−1.26)	(−1.83)	(1.66)
δ_1	CEOPOWER	–	−0.0212*	−0.0730***	−0.3438	−0.0538*	−0.0277*
			(−1.74)	(−2.43)	(−1.35)	(−1.72)	(−1.79)
δ_2	CEOWN	±	0.0013	0.0027*	0.00085	−0.00085	0.0013***
			(0.88)	(1.67)	(0.12)	(−0.44)	(2.94)
ζ_1	LNTA	–	−0.0759**	−0.1048**	0.4436***	−0.0569***	0.0027*
			(−2.13)	(−2.34)	(2.64)	(−2.91)	(1.57)
ζ_2	CV	–	0.1627*	0.2015	3.5449	3.0232**	0.0225
			(1.81)	(1.27)	(1.51)	(1.59)	(1.14)
ζ_3	CAPITAL	–	0.0094*	0.0001	0.0129	0.0417*	0.0024
			(1.94)	(0.29)	(1.08)	(1.74)	(1.37)
ζ_4	FREQ	+	0.0710*	0.0572**	0.2493	0.0148	0.0309*
			(1.92)	(2.44)	(0.34)	(1.47)	(1.82)
ζ_5	MERGER	+	0.0756*	0.1409	−0.0187	0.1335*	0.0474
			(1.71)	(0.43)	(−0.26)	(1.65)	(1.21)
α	Constant		1.359***	1.333**	−1.001*	−1.5871***	0.3232*
			(2.81)	(2.35)	(−1.79)	(−2.35)	(1.90)
Ψ	Year dummies		Included	Included	Included	Included	Included
	Model fits:						
	Wald χ^2-statistics (16)		12398.07***	16029.60***	5487.06***	9463.45***	1923.917***
	*Π*1		−6.00***	−6.53***	−6.69***	−6.29***	−6.21***
			[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
	*Π*2		0.23	−0.68	−0.61	−0.92	−0.86
			[0.818]	[0.50]	[0.539]	[0.355]	[0.431]
	Hansen *J*-statistics		179.85	178.67	174.46	181.00	155.64
			[0.219]	[0.237]	[0.311]	[0.202]	[0.726]
	No. of instruments		183	183	183	183	183

This table presents the results of the two-step system generalized method of moments (GMM) estimates of Eq. (2):

$$\ln(RISK)_{i,t} = \begin{cases} \alpha + \beta_1 \ln(\underset{-}{BS})_{i,t} + \beta_2(\underset{+}{INDIR})_{i,t} + \beta_3(\underset{-}{GINDEX})_{i,t} + \delta_1\,(\underset{-}{CEOPOWER})_{i,t} + \delta_2(\underset{+/-}{CEOWN})_{i,t} \\ +\zeta_1 \ln(\underset{-}{TA})_{i,t} + \zeta_2(\underset{-}{CV})_{i,t} + \zeta_3(\underset{-}{CAPITAL})_{i,t} + \zeta_4\,(\underset{+}{FREQ})_{i,t} + \zeta_5\,(\underset{+}{MERGER})_{i,t} + \sum_{t=1}^{1998-2004} \psi_t(YEAR)_t + \varepsilon_{i,t} \end{cases}$$

Subscripts *i* denotes individual banks, *t* time period, ln natural logarithms. The dependent variable *RISK* is either total risk (*TR* in column 1) or idiosyncratic risk (*IDIOR* in column 2) or systematic risk (*SYSR* in column 3) or asset return risk (*ARR* in column 4) or insolvency risk (*1/Z* in column 5). *TR* is the standard deviation of the bank's daily stock returns over a year. *IDIOR* is calculated as the standard deviation of ε_{it} in Eq. (2). *SYSR* is the coefficient of *Rmt*, i.e. β_1 in the two-index market model as represented by Eq. (2). Flannery and Rangan's (2008) *ARR* is the natural logarithmic of the standard deviation of the daily stock return *times* the ratio of market value of equity to market value of total assets *times* square-root of 250 in a year. *Z*-score risk is calculated as [Average(Returns) + Average(Equity/Total assets)]/Std(Equity/Total assets). *BS* is the number of directors on the board. *INDIR* is the independent directors as a percentage of board size. *GINDEX* is the sum of the two dummy variables – staggered board and poison pill, and is an approximation of the Bebchuk et al. (2009) entrenchment index. *CEOPOWER* is the dummy variable which equals 1 if the CEO also chairs the board and also internally-hired, zero otherwise. *CEOWN* is the percentage of shares owned by the CEO. *TA* is the total assets at fiscal year-end. *CV* is the charter value of the bank calculated (following Keeley, 1990) as the book value of total assets *plus* market value of equity *minus* book value of equity, all *divided* by the book value of total assets. *CAPITAL* is the bank equity as a percentage of total assets. *FREQ* is the average volume of shares divided by the total number of shares outstanding. *MERGER* is the dummy variable which equals 1 if the bank has any M&A in the period, otherwise zero. *YEAR* is a time dummy. α is the constant. β, δ, γ, ζ, and Ψ are the parameters to be estimated. ε is the idiosyncratic error term. Finally, *Π*1 and *Π*2 are the test statistics for first-order and second-order serial correlation, respectively. Hansen *J*-statistics is the test of over-identifying restrictions. Figures in parentheses are *t*-statistics while *p*-values are in brackets. Superscripts *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

coefficient on CEOPOWER is negative as expected for both absolute value of ROAA and absolute value of ROAE but not statistically significant. Thus, the positive effect of strong boards on bank risks is also supported by Glejser's (1969) heteroskedasticity tests.

6. Conclusion

This study investigates whether strong bank boards (a board more representing bank shareholders interest) and CEO power (CEO's ability to influence board decision) relate to bank risk-taking in a way consistent with the bank contract environment. To that end, evidence is sought whether strong bank boards (small board size, more independent directors, less restrictive shareholders rights) positively associate with bank risk-taking as bank shareholders have preferences for 'excessive risk' in the presence of 'moral hazard' problem from limited liability, incomplete debt contract, and mispriced deposit insurance premium. Similarly, evidence is also sought as to whether CEO power negatively relate to bank risk-taking because bank managers including CEOs may prefer lower risk due to their un-diversifiable wealth including human capital vested in their banks and comparatively fixed salary.

Using a sample of 212 US BHCs over 1997–2004 periods, i.e. 1,534 bank observations, consistent with the expectation, the results support that strong bank boards (at least small board size and less restrictive boards) positively relate to bank risk-taking. However, contrary to expectation, the negative relation between independent directors and bank risk measures suggests that directors, in particular independent directors, may view their role as balancing between the interests of shareholders and the other relevant bank stakeholders including depositors and regulators. This paper also provide some evidence that CEO power negatively relate to bank risk-taking. These findings are robust to various bank risk

Table 7
Glejser's (1969) heteroskedasticity tests for bank risk.

	Explanatory variables	Pre. sign	(1) Absolute value of ROAA residuals	(2) Absolute value of ROAE residuals
β_1	BS	–	−0.0647*	−1.351**
			(−1.83)	(−2.38)
β_2	INDIR(x1000)	+	−0.0466**	−0.0697***
			(−01.93)	(−1.98)
β_3	GINDEX	–	−0.00822*	−0.0418**
			(−1.73)	(−2.24)
δ_1	CEOPOWER	–	−0.00738	−0.565
			(−0.53)	(−1.01)
δ_2	CEOWN	±	0.00274***	0.0285***
			(3.59)	(3.10)
ζ_1	LNTA	–	0.0140*	0.231*
			(1.73)	(1.74)
ζ_2	CV	–	0.0457	3.742
			(0.34)	(1.76)
ζ_3	CAPITAL	–	0.00527	−0.203
			(0.67)	(−1.57)
ζ_4	FREQ	+	0.0471*	0.116
			(1.85)	(0.43)
ζ_5	MERGER	+	−0.0270*	−0.0940
			(−1.57)	(−0.40)
α	Constant		0.252	1.392
			(1.04)	(0.34)
Ψ	Year dummies		Included	Included
	Adjusted R^2		0.032	0.042
	F-statistics (17, 1516)		2.83***	4.25***
	Π: F-statistics (7, 1516)		2.17**	3.18***
	AVIF (max.)		1.65 (2.41)	1.65 (2.41)
	No. of pooled observations		1534	1534

This table presents the results of the Glejser's (1969) heteroskedasticity tests for bank risk. To perform the tests, in the first step the residuals of return on average total assets (ROAA) and the residuals of return on average total equity (ROAE) are obtained first from the pooled-OLS estimation of Eq. (2) excluding CV and FREQ. In the second step, the absolute value of the residuals obtained in the first step are used as a proxy for *RISK* and re-estimate the following Eq. (2) with pooled-OLS and robust standard errors:

$$(RISK)_{i,t} = \begin{cases} \alpha + \beta_1 \ln(\underset{-}{BS})_{i,t} + \beta_2(\underset{+}{INDIR})_{i,t} + \beta_3(\underset{-}{GINDEX})_{i,t} + \delta_1\,(\underset{-}{CEOPOWER})_{i,t} + \delta_2(\underset{+/-}{CEOWN})_{i,t} \\ +\zeta_1 \ln(\underset{-}{TA})_{i,t} + \zeta_2(\underset{-}{CV})_{i,t} + \zeta_3(\underset{-}{CAPITAL})_{i,t} + \zeta_4\,(\underset{+}{FREQ})_{i,t} + \zeta_5\,(\underset{+}{MERGER})_{i,t} + \sum_{t=1}^{1998-2004} \psi_t(YEAR)_t + \varepsilon_{i,t} \end{cases}$$

Subscripts i denotes individual banks, t time period, ln natural logarithms. The dependent variable *RISK* is either absolute value of ROAA residuals (in column 1) or absolute value of ROAE residuals (in column 2). *ROAA* is calculated as the net income after tax divided by the average book value of total assets. *ROAE* is calculated as the net income after tax divided by the average book value of total equity. *BS* is the number of directors on the board. *INDIR* is the independent directors as a percentage of board size. *GINDEX* is the sum of the two dummy variables – staggered board and poison pill, and is an approximation of the Bebchuk et al. (2009) entrenchment index. *CEOPOWER* is the dummy variable which equals 1 if the CEO also chairs the board and also internally-hired, zero otherwise. *CEOWN* is the percentage of shares owned by the CEO. *TA* is the total assets at fiscal year-end. *CV* is the charter value of the bank calculated (following Keeley, 1990) as the book value of total assets *plus* market value of equity *minus* book value of equity, all *divided* by the book value of total assets. *CAPITAL* is the bank equity as a percentage of total assets. *FREQ* is the average volume of shares divided by the total number of shares outstanding. *MERGER* is the dummy variable which equals 1 if the bank has any M&A in the period, otherwise zero. *YEAR* is a time dummy. α is the constant. β, δ, γ, ζ, and Ψ are the parameters to be estimated. ε is the idiosyncratic error term. Finally, Π is the Wald (1943) test F-statistics for the joint significance of the year fixed-effects. *AVIF* is the average 'variance inflation factor' shows the degree of collinearity problem among the regressors. The reported t-statistics with pooled-OLS estimates are robust to heteroskedasticiy. Figures in parentheses are t-statistics. Superscripts *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

measures including total risk, idiosyncratic risk and systematic risk as well as different estimation methods.

The findings in this study imply that bank board structure is an important determinant of bank risk-taking. Given that board structure is instrumental to bank risk-taking, regulators should monitor more intensely those banks where both shareholders and managers interests are aligned (such as banks with small and less restrictive boards) in an attempt to control their potential for 'excessive risk-taking'.

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