

8 VIGOROUS BOARDS AND CASH HOARDING: DERIVING MODERATING EFFECTS OF GREEN INNOVATION, AGENCY COSTS, AND INDEPENDENT DIRECTORS VIA MOMENT QUANTILE REGRESSION

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Abstract

The objective of the study is to accentuate the impact of vigorous board on firms' cash holdings. Significantly, the contributive concept of vigorous board (VGB) has been formulated employing data employment analysis (DEA), a statistical technique while embedding the specific attributes of corporate board. Specifically, Chinese listed firms have been endorsed for empirical analysis for the years 2016-2020. Empirical underpinnings substantiate that vigorous board mitigates the cash holdings. Further, innovation (INVS) and independent directors (IND) have been examined to be a deterrent for the cash holdings while agency cost (Agency) augment the cash holdings. Implicatively, the method of moment quantile regression has been executed signifying the impact of vigorous board on cash holdings for the all quantiles (10th to 90th). Conclusively, innovation and agency cost influence the cash holdings in higher quantiles (50th, 75th and 90th) while independent directors affect the cash holdings for the lower quantiles (10th, 25th and 50th). Meanwhile, the impact of State-owned enterprises (SOE) on cash holdings sustains for the all quantiles (10th to 90th). Lastly, generalized method of moment (GMM) instrumental regression has been executed which authenticates the veracity of the empirical results.

Keywords: Method of moment quantile regression (MMQR), Data employment analysis, Vigorous Board, Cash holdings, agency cost, innovation, independent directors

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1. Introduction

Undeniably, the role of corporate governance is necessary for the future growth of the firms (Andries *et al.*, 2020). Corporate governance promulgates new rule and new strategies with the assistance of corporate board who have direct interaction with the employees and indirect relation with the customers. Arguably, the impact of board is also quite important (Khandelwal *et al.*, 2023) which can inform the chief executives about the current trends of the market and recommends to adopt such strategies through which both customers and investors are satisfied. Remarkably, a competent board can be a source of having competitive advantage upon others (Naciti, Cesaroni and Pulejo, 2022) which is why the higher authorities endeavor to provide them perk and privileges via compensation so that the board member may perform diligently. Specifically, board composition has been examined to be positively interlinked with firms' performance (Ahmadi, Nakaa and Bouri, 2018; Paniagua, Rivelles and Sapena, 2018)⁵. However, it is the corporate board which can aggravate the agency cost problem (Su and Jiang, 2023) however, it can be curtailed, only if board ownership is vigorous (Rashid Khan *et al.*, 2020; Le and Nguyen, 2023). Additionally, board ownership and firms' innovation are positively interlinked which can be synchronized through the vigilant role of independent directors (Zhou *et al.*, 2023). Doubtlessly, talented board is also necessary for adoption of innovative strategy within the firms (Valenti and Horner, 2020).

Conclusively, cash holding among emerging economies has been signified to be a promoter of corruption (Magerakis and Tzelepis, 2023). Deliberately, firms endorse cash hoarding either due to weak surveillance of upper echelon or to amass the funds for future compensation. Specific deriving forces such as security rules and regulation, competition in the market and economic condition of the country compel the firms to hold the cash (Demir and Ersan, 2017). Moreover, firms hold cash either confronting with financial constraints or cash flow risk (Marwick, Hasan and Luo, 2020). Additionally, firms hold cash as "safe for the rainy day" to compensate either during financial crisis or some uncertainties (Diaw, 2020). Accordingly, firms with in emerging economies, specifically in China, cash hoarding is the casual phenomena.

Argumentatively, board diversity has been examined to be a catalyst for promoting the organizational innovation (Attah-Boakye *et al.*, 2020). Moreover, board specific characteristics also affect the cash holdings, and the presence of independent directors augments the cash hoarding within the firms (Chen *et al.*, 2020). Allegedly, Chinese firms are criticized for manipulating the cash holdings via agency cost problem. Though upper echelon has been compensated splendidly but comparing to the advanced countries, still less perks and privileges have been provided. Even the incumbent CEO⁶ of board is answerable, specifically among SOEs in case of devastated performance. Distinguishably, Chinese board structure is unique along with categorization of state-owned and non-state owned enterprises (Li, Hang, Shah, Akram, & Ozturk, 2020; Shah, Sarfraz, & Ivascu, 2020). Moreover, Chinese corporate structure is quite novel where minority shareholders still have weak rights as compared to western countries. Despite of this, Chinese firms are performing splendidly. Though CSRC⁷ have promulgated the rule to have one third independent directors but still agency problem has not been eradicated comprehensively (Muddassar Sarfraz *et al.*, 2020), so, cash hoarding among Chinese firms is futile and risky.

Despite of this empirical research, still it is required to contemplate the impact of a vigorous board

⁵ (Ahmadi, Nakaa, & Bouri, 2018) have analyzed the board diversity, CEO teneure and board composition while signifying the asymmetrical relation with firms' performance.

⁶ According (Wu *et al.*, 2018) the incumbent CEO of SOEs and Non-SOEs are politically connected who promote governmental agenda.

⁷ Chinese security regularity commission (CSRC), which promulgated new rules in 2001 for the amelioration of corporate structure (Haß, Johan and Schweizer, 2016)

on cash hoarding. Further, under the aegis of vigorous board, the moderating impact of innovation, agency cost and independent director will specify the implication of the study. The current study has contributed in several directions. Firstly, vigorous board has been formulated while emphasizing on eight attributes of the board. Specifically, DEA (data envelopment analysis) technique has been endorsed to construct the vigorous board. Secondly, firms' innovation has been demonstrated as moderator to contemplate its effectiveness on cash holdings. Thirdly, the role of independent directors and agency cost have been demonstrated as moderator between vigorous board and cash holdings. Fourthly, GMM instrumental regression has been executed to accentuate the authenticity of the results. Lastly, implication of the study has been signified through executing the method of moment quantile regression (MMQ) which signifies the short run and long run effectiveness of vigorous board.

2. Contribution to the Theoretical Literature

The extant literature has emphasized that gender diversity enhances the firms' performance. Arguably, gender diversity invigorates the surveillance which also mitigate the agency cost problem. Similarly, some study demonstrates that board diversity is necessary for vigorous firms' growth (Pandey *et al.*, 2023). Meanwhile, board diversity influences the board decision which pave the way towards future success of the firms. Certainly, corporate governance of an organization is the back bone which constitutes on board of directors. Significantly, corporate board' characteristics are illustrated through different corporate governance theories. Agency cost theory sheds light on the surveillance pattern (Vitolla, Raimo and Rubino, 2020) to limit the unnecessary embezzlements of top management team. On contrast, stewardship theory justifies the significance of internal directors for the enhancement of firms (Kiel and Nicholson, 2003). Despite of all these aspects, still these theories have not suggested the aspect of corporate board efficiency via specific attributes.

Unlike the previous studies, the current study has formulated a vigorous board which indicates the intensity of a board while having some specific characteristics. Our contributive concept of vigorous board enriches the corporate governance theory while recommending to formulate such types of corporate board which will ultimately be conducive for the firms' growth. We have emphasized on the financial aspect to witness whether such type of an efficient board utilizes the cash holding properly or not? Further, the three significant aspects such as agency cost, independent directors and innovation has been contemplated as moderator to elucidate the impact of vigorous board.

3. Literature Review and Hypotheses formulation

Distinguishably, Chinese firms are partially independent due to vigorous surveillance of Chinese government (Wu *et al.*, 2018). Through governmental ownership, government intervene among state-owned enterprises which are accountable in case of detrimental performance. The extant literature witnesses that Chinese firms, specifically state-owned enterprises are replete with agency cost problem (Lin, He, Wang, & Huang, 2020). Henceforth, it is quite risky to hold the cash which can be spent extravagantly for the sake of perks and privileges. Though Chinese firms have adopted technological innovation (Yang, Shi and Wang, 2021) within their firms but still agency cost problem is vigorous. Moreover, cash holdings among Chinese firms have been

witnessed to agitate the agency problem⁸. Henceforth, it is quite significant for upper echelon team to regulate the cash holding for the sake of boosting the firms' performance.

The extant literature has revealed that Chinese CEO are political connected (Bai *et al.*, 2023) who work for the governmental agenda. In this regard, they are compensated through governmental policies. However, whenever, political uncertainty emerges, firms prefer to mitigate the cash (Zhang, Zhan and Liu, 2023). Significantly, prior study has revealed that the excessive cash hoarding for self-beneficiary of incumbent CEO leads to agitate the agency cost problem (Jebran, Chen and Tauni, 2019). Moreover, excessive cash holdings also indicate the weakness of corporate governance which ultimately augments the principal agent problem (Bhuiyan and Hooks, 2019). Henceforth, mitigation of cash holding will indicate the splendid strategy of upper echelon team for curtailing the agency cost problem. Arguably, a capable board prefer to allocate the funds in innovative strategies (Xia *et al.*, 2022) so that manipulation of funds may be curtailed. Moreover, the extant literature has witnessed that corporate board hold the cash to mitigate the risk among firms (Xian *et al.*, 2023). However, some literature has witnessed that the presence of audit committee members mitigate the cash holdings (Choi *et al.*, 2020). Similarly, (Mun, Han and Seo, 2020) have demonstrated that CEO having specific educational back ground endorses to reduce the cash holdings. To encapsulate a corporate board with specific characteristics such as foreign experience of board members, foreign education of board members, executive shares percentage, non-duality of CEO, number of executives, number of committees and number of board meetings should be efficient while providing less opportunity to hold the cash. Hence our first hypothesis can be proceeded as follow:

H1: Vigorous board mitigate the cash holdings

4. Agency cost and Vigorous Board

Remarkably, among Chinese firms, the rights of minority shareholders are weak as compared to excessive shareholders which is why there has been threat of agency cost problem among these firms. The prior study has unveiled that agency cost cash holding are positively interlinked (Jebran, Chen and Tauni, 2019). However, prior study has also witnessed that board gender diversity mitigates the cash holdings (Yang and Xue, 2023) while emphasizing that corporate board can mitigate the agency cost problem. Meanwhile, it has been demonstrated that if cash hoarding is minimized then opportunity of agency cost will be curtailed (Javadi *et al.*, 2021). Henceforth, agency cost and cash holdings are positively linked but whenever corporate structure of a firm is weak, there will be excessive agency cost problem (Yun *et al.*, 2021). So, agency cost as a moderator will intensify the cash holding under the aegis of vigorous board. Our second hypothesis can be formulated as follow:

H2: Agency cost as a moderator will boost the cash holding

5. Vigorous Board, Independent directors and Innovation

Significantly, (Wang and Chen, 2020) have pointed out that managerial perspective of organizational innovation emphasizes on the firms' growth. Some study argue that corporate innovation and cash holdings are positively interlinked. The cash hoarding is beneficial in this case only if there is vigorous corporate governance mechanism while orientating their firms to acquire patents (Li and Lin, 2021). However, (Yang, Chou and Zhao, 2020) have identified that firms having intensive allocation of funds with in R&D, prefer to mitigate the cash holdings. They

⁸ According to (Tran, 2020), cash hoarding is a costly phenomenon which augments agency cost problem

demonstrated the augmentation in dividend payouts but examined mitigation in the cash holdings. Moreover, organizational innovation has been signified to be vigorous under the surveillance of independent directors (Shen *et al.*, 2020). Comprehensively, the presence of independent directors also orientates the incumbent CEO to adopt innovative strategies (Fu, 2019) which ultimately escalated the firms' performance (Li, Hang, Shah, Akram, & Ozturk, 2020). Moreover, the presence of independent directors enhances the capability of surveillance which orientate the incumbent CEO to utilize the funds properly (Hsu, Huang and Lai, 2015). Even multi-directorship synchronize the utilization of cash hoarding. (Chou and Feng, 2019).

However, still there still scant literature contemplating the impact of independent directors and organizational innovation as a moderator on cash hoarding. To encapsulate the above discussion, vigorous board and innovation as a moderator should mitigate the cash holdings. Additionally, having a vigilant identity, independent directors should mitigate the cash holdings so that opportunity to agitate the agency cost problem may be curtailed. So, our hypotheses are formulated as follow:

H3: Innovation as a moderator mitigate the cash holdings

H4: Independent directors as a moderator deter cash holdings

6. Data and Variable Measurement

We have selected all listed Chinese firms on Shenzhen and Shanghai Stock exchanges for the years 2016-2020. Due to missing data, our sample size has been squeezed to 10395 number of observations. Through authenticated data resources CSMAR and WIND (Sha, Shah and Muddassar, 2023), the data of board characteristics and firms' characteristics have been accumulated. The contributive concept of vigorous board has been formulated via specific board characteristics such as percentage of board meetings attendance, foreign experience of board members, foreign education of board members, executive shares percentage, non-duality of CEO, number of executives, number of committees. Instituitively, the extant literature has unveiled that number of meetings and foreign exposure are positively interlinked with firms' growth (Chou, Chung and Yin, 2013; Iliev and Roth, 2018). Moreover, non- duality of CEO indicates the board independence (Zona, 2016)⁹ which is also conducive for firms' performance. Further, number of executives and number of committees indicate the intensity of board surveillance to mitigate the agency problem. Lastly, executive compensation signifies the motivational behavior (Pepper and Gore, 2015) which has already been witnessed to be conducive for firms' growth. Arguably, the characteristics of vigorous board are based on board independency, board versatility in education and the motivational capacity of board members. Following (Demerjian *et al.*, 2013) DEA technique has been executed to formulate the vigorous board.

$$VGB = \sum_{\phi=1}^m k_{\phi} z_{\phi\rho} / \sum_{\sigma=1}^q l_{\sigma} x_{\sigma\rho} \quad \text{Where } \rho = 1, 2, \dots, p \quad (1)$$

The equation (1) illustrates the concept of vigorous board via DEA (data envelopment analysis) technique. In equation (1), there are "q" inputs and "m" outputs. We have endorse "Board shares" as an output whereas there are seven inputs (percentage of board meetings attendance, foreign experience of board members, foreign education of board members, executive shares percentage, non-duality of CEO, number of executives, number of committees) (Shah and Ivascu, 2023; Shah, Palomino and Abbas, 2025)

The dependent variable cash holdings has been demonstrated via proxies Lncash (ratio of cash

⁹ According to (Zona, 2016), board independence indicates the indepedant intensity to promulagate the new strategies. Henceforth, for being indepdnedant board, we have preferred non-dual CEO. Moreover, has illustrated that the the charactersitics of non-dulity enhances the motitoring cabability (García-Sánchez, 2020) which ultimately boosts the working efficiency of the board.

and cash equivalents to net assets) and LnCash2 (ratio of cash to net assets) (M. Sarfraz *et al.*, 2020). Further, control variables such as leverage, profitability (ROA) and number of employees are interlinked with firms' performance (Li *et al.*, 2020). Moreover, the control variable "sales" represents sales expense which has been measured through the proxy (operating expense/total assets) (Pan *et al.*, 2020). Specifically, the variable "SOE" state-owned enterprises has been endorsed for Chinese firms. Similarly, "Fage" (firm's age) indicates when firms are listed on the Shenzhen or Shanghai stock exchanges (M. Sarfraz *et al.*, 2020). Meanwhile, the moderators such as agency cost and innovation are measured through the proxies (operation ratio) and (R&D investment intensity) respectively (Shah *et al.*, 2019; Wang and Chen, 2020).

7. Method of Moment Quartile Regression Estimation

Arguably, the normal panel regression either over estimates or under estimates the coefficients. Henceforth, we have endorsed Method of Moment quantile regression technique which is robust and it can also tackle the problem of outliers in a regression. Further, MMQR also deals with the problem of panel cross sections and unobserved heterogeneity issues (Machado and Santos Silva, 2019). Even non-linearity issues have not been solved by Non-linear Autoregressive Distributed Lag (NARDL) but MMQR has resolved this issue predominantly (An *et al.*, 2021). The distinctive characteristic of MMQR is its estimation for non-cross quantile structures. Significantly, estimate of quantile regression models dealing with fixed effect for panel data via method of moment as it also considers unit fixed effects while tackling the unobserved variables and heterogeneity. Mathematically, method of quantile regression is given by

Let $Y_{it} = Q_{\tau}(Y_{it}/X_{it})$, where τ th quantiles ($0 < \tau < 1$) can be specified as the distribution function of our explanatory variable given as follow

$$Q_{\Delta}(Y_{it}/X_{it}) = \vartheta_{\Delta} + \gamma_{\Delta}X_{it} + \vartheta_{\Delta}\varepsilon_{it} \quad (2)$$

In equation (2) the vector " X_{it} " represents the set of independent variables (including control variables). Further, " ε_{it} " indicates the residuals (the unobservable effects orthogonal to our dependent variable). Table 6 and 7 indicates the results of our all-independent variables (vigorous board) and moderators which has affected the cash holdings in quantiles (10th, 25th, 50th, 75th, 90th).

8. Empirical Models

Firstly, Hausman test has been executed on STATA to confirm the preference of fixed effect panel regression. However, we have directly interpreted the results of GMM instrumental regression following the prior study (Larcker and Rusticus, 2010). Significantly, for the method of moment quantile regression, to remove the biasness, jackknife estimator command has been executed. Further, we have formulated the instrumental variable "specific vigorous board" by adding independent directors having foreign experience and general manager shares. Through correlation, it has been confirmed that instrumental variable has maximum relation with vigorous board while less correlated with cash holdings. Mathematically, panel regressions have been signified as follow:

$$\text{Cashholdings}_{i,t} = \alpha_{0,t} + \alpha_{1,t}VGB_{i,t} + \alpha_{2,t}profitability_{i,t} + \alpha_{3,t}Leverage_{i,t} + \alpha_{4,t}Sales_{i,t} + \alpha_{5,t}LNEMP_{i,t} + \alpha_{6,t}CEOage_{i,t} + \alpha_{7,t}SOE_{i,t} + \alpha_{8,t}Fage_{i,t} + \theta Yeardummy + \delta Industrydummy + \varepsilon_{i,t} \quad (3)$$

$$Cashholdings_{i,t} = \alpha_{0,t} + \alpha_{1i,t}(VGB_{i,t} * Agency\ cost) + \alpha_{2i,t}Profitability_{i,t} + \alpha_{3i,t}Leverage_{i,t} + \alpha_{4i,t}Sales_{i,t} + \alpha_{5i,t}LNEMP_{i,t} + \alpha_{6i,t}CEOage_{i,t} + \alpha_{7i,t}SOE_{i,t} + \alpha_{8i,t}Fage_{i,t} + \theta Yeardummy + \delta Industrydummy + \varepsilon_{i,t} \quad (4)$$

$$Cashholdings_{i,t} = \alpha_{0,t} + \alpha_{1i,t}(VGB_{i,t} * IND) + \alpha_{2i,t}Profitability_{i,t} + \alpha_{3i,t}Leverage_{i,t} + \alpha_{4i,t}Sales_{i,t} + \alpha_{5i,t}LNEMP_{i,t} + \alpha_{6i,t}CEOage_{i,t} + \alpha_{7i,t}SOE_{i,t} + \alpha_{8i,t}Fage_{i,t} + \theta Yeardummy + \delta Industrydummy + \varepsilon_{i,t} \quad (5)$$

$$Cashholdings_{i,t} = \alpha_{0,t} + \alpha_{1i,t}(VGB_{i,t} * INVS) + \alpha_{2i,t}Profitability_{i,t} + \alpha_{3i,t}Leverage_{i,t} + \alpha_{4i,t}Sales_{i,t} + \alpha_{5i,t}LNEMP_{i,t} + \alpha_{6i,t}CEOage_{i,t} + \alpha_{7i,t}SOE_{i,t} + \alpha_{8i,t}Fage_{i,t} + \theta Yeardummy + \delta Industrydummy + \varepsilon_{i,t} \quad (6)$$

In equations (3)-(6) the variable “VGB” indicates the vigorous board whereas “ $\theta Yeardummy$ and $\delta Industrydummy$ ” represent year dummy and industry dummy. The interaction terms ($(VGB_{i,t} * Agency\ cost)$, ($VGB_{i,t} * IND$) and $(VGB_{i,t} * INVS)$) in equations (4)- (6) indicate the impact of moderators (agency cost, independent directors and innovation respectively).

9. Empirical results

Table 1 illustrates the descriptive statistics of all the variables embedded in panel regression (equations (3)- (6)). Table 1 signifies that the standard deviation **of all variables which have been embedded in panel regression for empirical analysis**. All the observations of dependent and independent variables are same except cash holdings (Incash) and CEO age (AGE) due to missing data. The variables “Profitability”, “Leverage”, “LNEMP”, “Sales” and Fage represent firms’ return on assets, total debt by book value of total assets, firms’ size (logarithm of number of employees), sales expense with respect to total assets and firms age (since when it listed on Chinese Stock exchanges)

Table1: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Incash	10200	21.72121	1.471613	11.93087	29.41306
VGB	10394	.5267812	.0396922	.4387139	.6812709
Profitability	10394	.044256	1.180378	-8.31592	108.3657
Leverage	10394	.4324457	.7098347	.007969	63.97121
AGE	10200	.0391182	.1938867	0	1
LNEMP	10394	7.478802	1.25068	1.609438	13.02058
Sales	10388	.5318949	4.38635	0	2170.53
SOE	10394	.3848374	.4865803	0	1
Fage	10394	11.14153	1.797525	4	26

Description: table1 describes the number of observations, standard deviation, mean, maximum and minimum value of all the variables

Table 2 witnesses the truthfulness of hypothesis H1. Significantly, table 2 has revealed that vigorous board mitigates the cash holdings ¹⁰ (coefficients values are -6.486*, -2.700** respectively) which suggest that an efficient board always endorse to utilize the funds rather than

¹⁰ According to (M. Sarfraz et al., 2020), hierarchical CEO successor mitigate the cash holdings among Chinese SMEs which support our results emphatically

to agitate the agency cost problem. Further, "Leverage", "profitability" and firms' size (LNEMP) have identified the positive relation with cash holdings. Necessarily, firms prefer to hold the cash to compensate their loan burden. Moreover, maximum profitability allows the firms for cash hoarding. Meanwhile, the variable "SOE" has represented positive relation with cash holdings illustrating that state-owned enterprises prefer to hold the cash. Arguably among state-owned enterprises, the governmental indulgence is excessive which ultimately causes to augment the agency cost issue. Our results has been satisfied as Chinese firms suffer from agency cost problem (H. Lin, He, Wang, & Huang, 2020) and ultimately excessive forceful turnover has observed among these firms (Jiang and Kim, 2015). Meanwhile sales expense (Sales) has indicated the negative significant relation with cash holdings which means sales expense mitigate the cash holdings to miniscule level.

Table 2: GMM Instrumental Regression for Vigorous board and cash holdings

	(1)	(2)	(3)	(4)
VARIABLES	Lncash	Lncash	LnCash2	LnCash2
VGB	-6.486*	-6.324*	-2.700**	-1.922*
	(3.854)	(3.602)	(1.131)	(1.153)
Profitability	2.053***	2.316***	1.001**	1.335***
	(0.296)	(0.318)	(0.449)	(0.506)
Leverage	0.0808**	0.0808***	0.124**	0.114*
	(0.0315)	(0.0311)	(0.0616)	(0.0600)
AGE	-0.0499	-0.0499	-0.113	-0.127
	(0.0314)	(0.0311)	(0.0863)	(0.0860)
Sales	-0.00263***	-0.00357***	-0.00199***	-0.00259***
	(0.000543)	(0.000583)	(0.000245)	(0.000337)
LNEMP	0.397***		0.236***	
	(0.0144)		(0.0196)	
SOE	0.226***	0.281***	0.180***	0.217***
	(0.0378)	(0.0406)	(0.0457)	(0.0474)
Fage	0.00452	0.00428	0.00640**	
	(0.00399)	(0.00365)	(0.00316)	
Industry Dummy	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Constant	1.627	1.520	12.81*	12.66*
	(2.323)	(2.159)	(0.712)	(0.727)
Observations	9,952	9,949	9,952	10,113
R-squared	0.294	0.183	0.073	0.029

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2 indicates that vigorous board has mitigated the cash holdings comprehensively (1st row of table 2).

Moreover, the variables Profitability, Leverage, SOE and LNEMP are positively related with cash holdings while "Sales" is negatively significant for cash holdings

Table 3 justifies our hypothesis H2 signifying that agency cost (coefficient values are 0.410** and 0.262** respectively) as a moderator augments the cash holdings. Reasonably, Chinese firms are confronting with agency cost problem, which is why firms having excessive cash holding will provide an opportunity to exacerbate the agency cost problem. The remaining variables have

indicated the same results as described by the previous Table2.

Table 3: GMM Instrumental regression for agency cost as a moderator

	(1)	(2)	(3)	(4)
VARIABLES	Lncash	Lncash	LnCash2	LnCash2
VGB * Agency	0.410** (0.242)	0.439** (0.238)	0.246** (0.121)	0.262** (0.140)
Profitability	2.680*** (0.427)		1.169** (0.519)	
Leverage	0.0926*** (0.0341)	0.0973*** (0.0339)	0.595*** (0.216)	0.444* (0.229)
AGE	-0.0403 (0.0295)	-0.0399 (0.0294)	-0.0870 (0.151)	-0.0866 (0.157)
Sales	-0.00266*** (0.000413)	-0.00250*** (0.000411)	-0.00173*** (0.000249)	-0.00165*** (0.000226)
LNEMP	0.397*** (0.0218)	0.403*** (0.0220)	0.0715** (0.0305)	0.0759** (0.0317)
SOE	0.109** (0.0512)	0.108** (0.0525)	0.0603* (0.0248)	0.0591* (0.0213)
Fage	0.00464*** (0.00171)	0.00455*** (0.00168)	0.00465 (0.00762)	
Industry Dummy	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Constant	-1.973*** (0.210)	-1.976*** (0.195)	9.154*** (0.927)	9.222*** (0.921)
Observations	9,690	9,690	9,701	9,701
R-squared	0.332	0.315	0.062	0.060

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3 has revealed that agency cost as a moderator boosts the cash holdings (First row of table 3).

Additionally, the variables Profitability, Leverage, LNEMP and SOE are positively significant while "Sales" is negatively significant for cash holdings

Table 4 investigates the hypothesis H3 elucidating that independent director as a moderator mitigate the cash holdings. The argument can be justified as the presence of independent directors invigorates the surveillance capability. Henceforth, they compel the incumbent CEO and board members to allocate the funds either in socially responsible activity or with in the R&D. Significantly, the opportunity of agency cost problem will also be curtailed. Our result is also justified as the extant literature has witnessed that the presence of independent directors curtails the agency cost problem (Armstrong *et al.*, 2015).

Table 4: GMM Instrumental Regression for Independent directors as a moderator

	(1)	(2)	(3)	(4)
VARIABLES	Lncash	Lncash	LnCash2	LnCash2
VGB* IND	-0.118*	-0.125*	-0.371**	-0.373**
	(0.0726)	(0.0747)	(0.158)	(0.158)
Profitability	2.059***		0.994**	
	(0.404)		(0.477)	
Leverage	0.0481**	0.0616***	0.122**	0.135**
	(0.0200)	(0.0195)	(0.0618)	(0.0612)
AGE	-0.0391	-0.0356	-0.116	-0.121
	(0.0244)	(0.0245)	(0.0865)	(0.0863)
Sales	-0.00268***	-0.00237***	-0.00221***	-0.00215***
	(0.000434)	(0.000404)	(0.000276)	(0.000283)
LNEMP	0.0107**	0.0106**	0.116***	0.119***
	(0.00479)	(0.00479)	(0.0167)	(0.0167)
SOE	0.236***	0.289***	0.224***	0.224***
	(0.0511)	(0.0593)	(0.0514)	(0.0514)
Fage	0.0284***		0.0229***	0.0230***
	(0.00606)		(0.00440)	(0.00438)
Industry Dummy	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Constant	-2.340***	-2.371***	11.92***	11.95***
	(0.111)	(0.110)	(0.375)	(0.371)
Observations	9,949	9,949	10,110	10,110
R-squared	0.284	0.275	0.057	0.053

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4 has revealed that independent directors as moderator mitigate the cash holdings (1st row of table 4).

The variables Profitability, Leverage, LNEMP and SOE are positively significant while sales is negatively significant for cash holdings.

Table 5 supports our Hypothesis as it has manifested that innovation as a moderator (coefficient values are -0.521* and -0.354** respectively) deters the cash hoarding. Convincingly, firms' innovation is a costly phenomenon, which require huge allocation of funds which is why whenever a firm adopts innovative strategies, enormous amount of fund has to allocate in the R&D department. Logically, our results is justified by the prior study which recommends that hoarding the cash is conducive for innovating the firms (He and Wintoki, 2016). Meanwhile, Profitability, Leverage, LNEMP, SOE boost the cash holdings. While Sales (sales expense) declines the cash holdings. **Our results are justified as** (Guney, Ozkan and Ozkan, 2007) **concluded the positive**

relation between leverage and cash holdings. Further, (Lei, Xu and Jin, 2022) has witnessed that SOEs endorse to hold the cash for curtailing future uncertainties.

Table 5: GMM instrumental Regression for Innovation as a moderator

	(1)	(2)	(3)	(4)
VARIABLES	Lncash	Lncash	LnCash2	LnCash2
VGB*INVS	-0.521** (0.244)	-0.542** (0.211)	-0.354** (0.169)	-0.323** (0.170)
Profitability	0.986*** (0.406)		0.925** (0.449)	
Leverage	0.314** (0.152)	0.353** (0.135)	0.112* (0.0620)	0.0928* (0.00604)
AGE	-0.0306 (0.0562)	-0.0233 (0.0608)	-0.113 (0.0872)	-0.131 (0.0868)
Sales	-0.00266*** (0.000431)	-0.00254*** (0.000427)	-0.00197*** (0.000247)	-0.00182*** (0.000231)
LNEMP	0.394*** (0.0237)	0.397*** (0.0234)	0.237*** (0.0199)	0.249*** (0.0202)
SOE	0.238*** (0.0473)	0.232*** (0.0473)	0.191*** (0.0463)	0.234*** (0.0443)
Fage	0.0275*** (0.00580)	0.0272*** (0.00570)	0.0179*** (0.00410)	
Industry Dummy	YES	YES	YES	YES
Year Dummy	YES	YES	YES	YES
Constant	7.151* (5.680)	7.723* (5.438)	12.88*** (0.628)	12.66*** (0.631)
Observations	9,904	9,904	9,164	9,164
R-squared	0.294	0.287	0.066	0.063

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5 indicates that innovation (as a moderator) negatively significant for cash holdings (First row of table 5). Additionally, the variables profitability, Leverage, LNEMP and SOE are positively significant for cash holdings while sales has represented negative significance.

Table 6: Method of Moment Quantile regression for vigorous board and cash holdings

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	location	scale	qtile_10	qtile_25	qtile_50	qtile_75	qtile_90
VGB	-3.113** (1.582)	-5.541*** (1.076)	-5.770** (2.490)	-1.192 (1.879)	-3.458** (1.573)	-7.490*** (1.698)	-11.50*** (2.131)
Profitability	0.0366 (0.0401)	0.0491* (0.0272)	0.0421 (0.0629)	0.00151 (0.0476)	0.0397 (0.0399)	0.0754* (0.0430)	0.111** (0.0538)
Leverage	0.786*** (0.264)	0.648*** (0.179)	0.241 (0.360)	0.256 (0.283)	0.740*** (0.262)	1.263*** (0.311)	1.780*** (0.408)
AGE	-0.166** (0.0692)	0.0281 (0.0471)	-0.210** (0.0944)	-0.189** (0.0743)	-0.168** (0.0688)	-0.145* (0.0817)	-0.122 (0.107)
Sales	-0.00258** (0.00120)	0.000478 (0.000815)	-0.00334** (0.00163)	-0.00297** (0.00129)	-0.00262** (0.00119)	-0.00223 (0.00141)	-0.00185 (0.00185)
LNEMP	0.469*** (0.0138)	-0.000639 (0.00939)	0.470*** (0.0188)	0.470*** (0.0148)	0.469*** (0.0137)	0.469*** (0.0163)	0.468*** (0.0213)
SOE	0.222*** (0.0337)	0.0648*** (0.0229)	0.120*** (0.0459)	0.169*** (0.0362)	0.218*** (0.0335)	0.270*** (0.0397)	0.322*** (0.0520)
Fage	0.0263*** (0.00324)	-0.00925*** (0.00220)	0.0410*** (0.00443)	0.0339*** (0.00348)	0.0270*** (0.00322)	0.0195*** (0.00382)	0.0121** (0.00501)
Constant	17.82*** (0.193)	1.234*** (0.131)	15.86*** (0.265)	16.81*** (0.207)	17.73*** (0.192)	18.72*** (0.228)	19.71*** (0.299)
Observations	10,124	10,124	10,124	10,124	10,124	10,124	10,124

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6 illustrates the short run and long impact of vigorous board on cash holdings' quantiles (10, 25, 50, 75 and 90 quantiles respectively). Significantly VGB has affected for both short run (10, 25 and 50 quantile) and long run (75 and 90 quantile). Profitability has only affected for the long run (75 & 90 quantiles) while sales expense has affected for short run (10, 25 and 50 quantiles). Additionally, SOE and LNEMP have influenced the cash holding for both short and long run.

Table 7: Method of Moment Quantile Regression for Moderators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	location	scale	qtile_10	qtile_25	qtile_50	qtile_75	qtile_90
VGB*Agency	0.110*** (0.0395)	4.766** (1.272)	0.114* (0.0431)	0.118** (0.0623)	0.150*** (0.0692)	0.157** (0.0737)	0.213** (0.0842)
VGB*IND	-0.0576 (0.0353)	-0.0407* (0.0143)	-0.107* (0.0567)	-0.0807* (0.0422)	-0.155* (0.0651)	-0.153 (0.1375)	-0.116 (0.1467)
VGB*INVS	-0.00108 (0.00899)	-0.140** (0.0619)	-0.0215 (0.0144)	-0.0956 (0.0608)	-0.215* (0.0893)	-0.421* (0.0953)	-0.522* (0.119)

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7 has indicated that agency cost (as a moderator) boosts the cash holdings for both short run and long run while independent director has mitigated the cash holdings for the short run. Additionally, innovation as a moderator mitigates the cash holdings for the long run.

Table 6 has revealed results via executing the method of moment Quantile Regression (MMQ). Significantly, vigorous board has negatively influenced the cash holding for the short and long run (as quartile 10, quartile 50, quartile 60 and quartile 90 are negatively significant). Moreover, leverage and profitability has affected the cash holdings for the long run. Doubtlessly, leverage influences the firms' performance in the long run which is why firms prefer to hold the cash. However, sales expense has influenced the cash holdings only for the short run. Arguably, with the passage of time firms attain growth, which is why the impact of sales expense becomes miniscule. Further, LNEMP, SOE and Fage affect the cash holdings for short run and long run both. Argumentatively, state-owned enterprises are suffering from agency cost problem, therefore, these firms prefer to cash holdings for both short and long run. Additionally, mature firms prefer to hold cash because at early stage, agency cost affects comprehensively while long run, firms' growth becomes sluggish. Henceforth, firms manipulate to survive through productivity (Li and Wang, 2018), thus holding the cash is the better option in such scenario.

Table 7 has indicated that the moderator agency cost affects the cash holdings for both short and long run which suggests that while hoarding the cash may exacerbate the already miserable plight. So, the mitigation of cash holding by vigorous board is a conducive strategy. Meanwhile, independent directors have only influenced the cash holding for the short run which is why the agency cost prevails for the long run. Further, the innovation as a moderator affects the cash holdings for the long run. Reasonably, organizational innovation is highly risky phenomena in short run but it is a useful vehicle which is beneficial for the long run firms' growth.

10. Discussion

The current study elucidates the impact of vigorous board on corporate cash hoarding reciprocally. Further, the moderating impact of agency cost, innovation and independent directors has also been substantiated through empirical analysis. Being a naïve corporate structure, Chinese firms are alleged to be uncertain in the matter of minority shares holders. further, the influence of Chinese government on state-owned enterprises is quite massive which causes hurdles while making abrupt decisions. However, the growth of Chinese firms is spectacular which is why the characteristics of corporate board among Chinese firms are quite significant which influences their performance and other aspects. In this regard, the current study has endorsed specific characteristics such as foreign experience and foreign education which indicate the versatility and professional aptitude of corporate board which bring innovative strategies to perform splendidly. Further, the characteristics of corporate such as number of executives, executive shares cause to enhance the vigilance among corporate board vehemently. Further, executive compensation is a key factor which motives the executives promulgate their strategies enthusiastically. Lastly, the characteristics such as non-duality, percentage of meetings and number of committees indicate the independence and professional capability of the corporate board which are necessary for the firms' growth. Comprehensively, this study has formulated the vigorous board via data employment analysis while considering the most significant characteristics. Empirical results verifies that the vigorous board deters the cash hoarding among Chinese firms suggesting that an efficient corporate board deters the misemploying of funds. So, it verifies the hypothesis H1. Further, the moderator agency cost has enhanced the cash holdings signifying the truthfulness of our hypothesis H2. This result witnesses that whenever there will be agency cost problem the cash hoarding will be misemployed. Further, the empirical results have demonstrated that moderators such as innovation has mitigated the cash holdings which substantiates our hypothesis H3. Lastly, independent directors as a moderator mitigates the cash holding which confirms the truthfulness of our hypothesis H4. Further, this result identifies that the role of independent directors who act the role as a vigilant promoter of absolute strategies while orientating the CEOs to utilize the funds either among innovative strategies or for the optimal growth of the firms.

Conclusion

Despite of naive corporate governance, Chinese firms have acquired spectacular performance. Distinguishably, Chinese firms have been categorized into state-owned and non- state-owned enterprises. However, SOEs are controlled via government intervention. Moreover, the rights of minority shareholders¹¹ among Chinese firms are weak and Chinese firms are also suffering from agency cost problem. In this regard, Chinese security regulatory commission has promulgated the new rules for ameliorating the corporate structure among Chinese firms. Specifically, among all board members, the presence of one third independent directors have been made compulsory for the listed firms.

It has also been examined by the previous study that Chinese firms have adopted innovative strategy so that to compete the dynamic environment of business. Chinese government has declared the transition period (2012-2020) from "imitation to innovation" which has motivated the listed firms to adopt innovative strategy. However, these enormous steps will be futile if there will be severe agency cost. Henceforth, it would be quite significant to analyze whether cash holdings among Chinese firms is manipulated for the sake of upper echelon' perks and privileges. Intuitively, the current study has contemplated the role of moderators such as independent directors, agency cost and innovation which influence the firms' cash holdings asymmetrically.

The current study has formulated vigorous board while employing the DEA technique. Specifically, the attributes of board such as board meeting, no of committee, number of supervisors, no of executives, compensation of executive and supervisors, Non- duality of CEO, total number of committee and board foreign exposure. Intuitively, all these attributes signify the motivation level and their independency while making decision. Significantly, the empirical results witness that vigorous board mitigate the cash holdings of the Chinese firms while identifying that its effect is for both short run and long run. Further, agency cost problem always favors the cash holding which affects for both short and long run. However, independent directors influence the firms' cash holdings for the short run signifying the deficiency of surveillance capability of independent directors for the long run. On contrary, innovation mitigate the cash holding for the long run. Arguably, innovation is highly expansive which require enormous amount of money. Henceforth, innovation as a moderator deter the cash holdings decisively. Additionally, among control variables, state-owned enterprises have been signified as the vigorous promoter of the cash holdings which identifies that SOEs provide an opportunity for agitating the agency cost problem. Similarly, the impact of firms' size and firms age on cash holdings has been accentuated for both short run and long run.

Implicatively, the current study recommends that vigorous board intensifies the firms' efficiency while utilizing the cash. Hence forth, it would be worthwhile to compensate the board members so that they remain diverted form agency issue. Further, as agency cost has short and long run impact on cash holdings, henceforth it must be curtailed emphatically. Moreover, the presence of independent directors is inevitable for compelling the incumbent CEO to deter the cash holdings. Their presence can be revitalized either increasing in their numbers or making them authoritative. Suggestively, the higher authority should promote innovative strategies, which will ultimately utilize the funds while curtailing the agency cost issue.

Limitations of the Study

Doubtlessly, the current study has contributed comprehensively but still it has some limitations which pave the way towards new directions. Suggestively, it would be interesting to analyze

¹¹ According to (Huyghebaert and Wang, 2012), still board independence is required to protect the rights of minority shareholders. Large shareholders are dominant through their voting rights.

whether vigorous board mitigate the firms' risk or not? Additionally, it would also be worthwhile to contemplate whether vigorous board endorse CSR activity or not? Lastly, the impact of vigorous board should be demonstrated for the firms' performance working in the advanced countries.

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