

**“One person’s decision” or “Voting mechanism”:
Evidence of Collective Overconfidence in Chinese Listed Companies**

Chao Liang

School of Economics and Management, Changchun University of Science and Technology

No.7989 Weixing Road, Changchun, Jilin 130012, China.

liangchao@cust.edu.cn

*Bai Liu**

Business School, Jilin University

No.2699 Qianjin Street, Changchun, Jilin 130012, China.

Liubai@jlu.edu.cn

Yin-Che Weng

College of Management, National Dong Hwa University

No.1, Sec.2, Da Hsueh Road, Shoufeng District, Hualien 97401, Taiwan.

ycw@ndhu.edu.tw

*Corresponding author

Acknowledgements: This work was supported by the National Social Science Foundation of China under Grant 18BJY232.

Abstract: This study explores the voting mechanism of Chinese listed companies by examining whether overconfidence of the chair of the board could affect the relationship between overconfidence and investment–cash flow sensitivity by the board of directors. On average, board of directors’ overconfidence leads to increased investment–cash flow sensitivity. However, this influence is driven by state-controlled listed companies—but only when the chair is overconfident. The results suggest that the chair’s overconfidence may impact the relationship between board of directors’ overconfidence and investment–cash flow sensitivity. Furthermore, the investment distortion due to the board’s overconfidence behavior may be alleviated by supervising the chair.

Keywords: board of directors, overconfidence, chair, investment–cash flow sensitivity, decision-making mechanism

JEL classification: G41 G15 G30 D81

1. Introduction

Investment decision making is an important issue in corporate finance, which affects enterprises’ future development and steady growth. Behavioral corporate finance theory is different from traditional finance theory, as it holds that the decision maker is not entirely rational, in another words, enterprises may invest inefficiently as a result of their cognitive bias even though they are loyal to shareholders. The existing literature has documented that one of the main psychological deviations of managers is overconfidence; that is, managers tend to

overestimate the probability of success and underestimate the probability of failure (Langer 1975).

The extant literature has verified the impact of overconfidence on corporate investment from both theoretical and empirical perspectives (Heaton 2002; Malmendier and Tate 2005, 2008; Kolasinski and Li 2013). Recent studies have also documented that overconfidence may impact CEOs' compensation structure, that is, overconfident CEOs receive more option-intensive compensation contracts (Humphery-Jenner et al. 2016). Scholars have also found similar effects of overconfidence on investment in Chinese firms (Huang et al. 2011; Wang et al. 2016) using data from Chinese listed companies.

The aforementioned studies have examined the relation between managerial overconfidence and corporate decisions. However, the subjects who are the study of overconfidence differ between China and other countries. In the existing literature, researchers have tended to use the collective as the subject of overconfidence in research on Chinese firms, such as top executives and board of directors. By contrast, studies of Western companies have always focused on the effect of overconfidence by the CEO. The main reason is that corporate governance varies between countries, especially regarding the decision-making mechanism. In the United States, where there is a high degree of decentralization of equity, the CEO has decision-making power over daily operations. Therefore, the study of Western enterprises is more concerned about the impact of CEO's overconfidence. By contrast, Chinese companies adopt collective decision making, and the board is the day-to-day decision-making body. As a result, the board of directors or the executive group is often used as the subject of overconfidence in research on Chinese firms. On the other hand, although Chinese enterprises

have a nominal “voting mechanism”, in fact, the chair usually has a special status in many of the company’s board of directors. Thus, in the decision-making process of the board of directors, the chair seems to have greater discourse power than the other directors do.

Thus, an open question is which management level is the best subject of research in the context of China. If both personal and collective overconfidence lead to investment distortion within Chinese enterprises, what is the real decision-making mechanism in collectivist contexts—“one-person decision” or “voting mechanism”? In other words, who is the real decision-maker? Furthermore, different from the capital markets of developed countries, the Chinese capital market has relative heterogeneity in ownership of listed companies: affected by the planning economy, the majority of listed companies are state-owned enterprises (SOEs), although there is an increasing number of non-SOEs on the two stock exchanges. Compared with the relative marketization of private firms, with state ownership, the supervision and management of state-owned assets are undertaken on behalf of the state to fulfill the responsibility of investors, who are both owners and supervisors of the SOEs. Therefore, the government may intervene politically in the management of SOEs, thereby affecting their investment decisions. On the other hand, SOEs often lack supervision and the owner is absent, leading to “insider control”. Accordingly, is there a difference in the decision-making mechanism of different ownership enterprises? In an effort to shed light on these questions, this study uses a sample of Chinese listed firms to examine the mutual influence between managers’ personal overconfidence and collective overconfidence, in order to reveal the real decision-making method of Chinese enterprises.

To distinguish between the psychological biases of individuals versus groups, this study

adopts managers' relative salary as the measure of overconfidence. We test whether there is any difference (and to what degree) in the investment–cash flow sensitivity between overconfident boards of directors in SOE and non-SOE listed companies. Moreover, we investigate if there is any difference in the decision-making mechanism between different types of ownership. We group SOEs based on whether the chair of the board is overconfident to test the influence of the manager's personal overconfidence.

We conduct our study using a sample of CSMAR and WIND board directors' compensation packages and firms' financial data from 2009 to 2015. We confirm that board of directors' overconfidence strengthens the sensitivity of investment to cash flow only in SOEs. However, this positive relationship does not hold for non-SOEs. By dividing SOEs into two groups according to whether the chair is overconfident reveals an interesting pattern: only in the case of an overconfident chair can the overconfidence of the board change the sensitivity of investment to cash flow; this relationship does not hold when the chair is not overconfident. The empirical results are robust to various sensitivity analyses. In summary, increased investment–cash flow sensitivity owing to the board of directors' overconfidence occurs only in SOEs. Moreover, this influence occurs only when the chair is overconfident. Our results show that the chair's overconfidence has a significant impact on the relationship between the board of directors' overconfidence and investment–cash flow sensitivity in Chinese SOEs, although they adopt a nominal voting mechanism in decision making. Moreover, the investment distortion owing to collective managers' overconfidence behavior can be alleviated through increased supervision of the chair.

This study is designed to fill these research gaps by contributing to the literature in the

following three ways. First, we examine the psychological bias of the individual and the collective in investment distortion of enterprises in China, which is a collectivist society different from the more individualist Western context of prior studies. Existing studies take the individual or the collective as the research subject, whereas the present study focuses on both individual and collective psychological bias in the Chinese context, where the highest decision-making body of Chinese enterprises is the board of directors, and final decisions must be approved by the board of directors; that is, enterprise investment should result from a group decision. At the same time, owing to the central role of the chair in management decisions, investment decisions are inevitably influenced by the chair's personal psychological characteristics. Thus, it is important to discover the real decision-making body of Chinese enterprises in the voting system, and to reveal the impact of personal bias in a collective context.

Second, we identify the role that the boundary conditions of collective overconfidence play in investment distortion, thereby revealing the real decision-making mechanism of Chinese enterprises from the perspective of psychological deviation. This study discusses how managers' overconfidence plays a role in corporate governance and the nature of ownership. Previous studies have not sufficiently defined the boundary conditions of collective cognitive bias in the Chinese context. Owing to the unique ownership structure of Chinese enterprises, there is less effective supervision and more liquidity in SOEs than in non-SOEs. Different companies have different goals and motivations to exercise their control rights (Chen, Firth, and Xu 2009). In addition, SOE chairs are often appointed by the government and are rarely threatened by external control from the market. Thus, in the decision-making process of the board of directors, the chair's discourse power in SOEs seems stronger than in non-SOEs. This

study sets out to identify the role that the boundary conditions of collective overconfidence play in investment distortions.

The third contribution of this study is that we explore the interaction between collective and individual psychological bias in a collectivist context by analyzing overconfidence contagion from the chair to the board. The characteristics and behavior of the supervisor may affect subordinates through the vertical management level from top to bottom, and ultimately lead to the same characteristics and behavior of the subordinate and the team (Aryee et al. 2007). This study sets out to examine the influence on board's overconfidence of the chair's overconfidence in the Chinese context, particularly whether the firm is state owned. By doing so, this study attempts to explore how individual overconfidence actually affects investment.

The remainder of the paper is organized as follows. In Section 2, we develop the hypotheses. In Section 3, we discuss the data. In Section 4, we present the empirical analyses. In Section 5, we report robustness tests and additional tests. We conclude in Section 6.

2. Literature review and hypotheses development

The psychology literature shows that a main facet of overconfidence is the “better-than-average” effect, which is the tendency of individuals to overestimate their ability, judgment, or prospects for successful life outcomes (Skala 2008). Overconfident individuals also tend to believe that they can influence events that, in fact, are governed mainly by chance, which is known as the “illusion of control” (Taylor and Brown 1988).

One early work that pays attention to overconfidence and corporate policy is Roll (1986), who claimed that managerial hubris explains inefficient mergers and acquisitions (M&As), for the decision makers in acquiring firms pay too much for their targets in corporate takeovers.

Heaton (2002) developed a three-date, two-period model to examine the explanatory power of managerial overconfidence on investment. He showed that overconfident managers might make an under-investment or over-investment tradeoff related to free cash flow, as these managers believe that capital markets undervalue their firms' risky securities and overvalue their own corporate projects. Malmendier and Tate (2005) exploited holding options and purchasing stock as measures of overconfidence to test Heaton's predictions empirically. The authors found that managerial overconfidence can result in investment distortions, and the investment is more sensitive to cash flow if the CEO is overconfident, particularly for equity-dependent firms.

Cross-cultural research shows that the performance of overconfident Chinese is markedly different from the mediocre and modest impression. In the face of common sense and probabilistic judgments, Chinese are more overconfident than Americans are (Yates et al. 1998). In addition, most Chinese enterprises adopt a collective decision-making system, and the board of directors is the decision-making body. On the other hand, group decision making is the result of a compromise of individual decision makers, and the result may be more moderate. However, psychological research has found that in the process of group decision making, decision makers are inevitably influenced by group thinking, making the result of group decisions prone to deviation (Whyte 1989). This is because China's corporation law stipulates that the board of directors should determine the business and investment plans in a limited company, and that the mechanism for voting on a resolution is to give every director one vote. This study regards the board of directors as the subject of overconfidence. Therefore, our first prediction relates to the board's overconfidence and the sensitivity of investment to

cash flow, as follows.

HYPOTHESIS 1. The board's overconfidence leads to increased sensitivity of investment to cash flow.

Because of China's planned economy between the 1950s and 1970s, most enterprises were established and controlled by the state. As an important mechanism to promote the reform of SOEs and improve resource allocation, the capital market was established in the early 1990s, and many SOEs became listed companies, whose controlling shareholder is the government or other state entities. However, the government cannot achieve effective supervision and management of all SOEs, which causes these firms to be ownerless. Moreover, the board of directors often comprises political appointees who receive and follow directions from the government or regional ministries, and pursue the goals of political promotion in the company's operations (Chen, Firth, and Rui 2006). At the same time, there are increasing numbers of private exchange-listed companies on the two stock exchanges, whose controlling shareholders can perform more stringent supervision than the government can. As a result, the agency problems are different between the two holding structures. Owing to the lack of effective regulation, it is easier for overconfident managers to implement inefficient investment in SOEs than in non-SOEs. On the other hand, when the controlling shareholders are government or other state entities, SOEs have more resources and find it easier to obtain policy support; therefore, they have more funds for overinvestment than non-SOEs do.

Both these mechanisms suggest that the effect of managerial overconfidence on sensitivity of overinvestment is more visible in SOEs than in non-SOEs. Therefore, we form the second testable hypothesis as follows:

HYPOTHESIS 2. The effect of a board's overconfidence on increased sensitivity of investment to cash flow tends to be more significant in SOEs than in non-SOEs.

Prior researchers have tended to use the collective as the subject of overconfidence in analysis of Chinese firms, because Chinese companies adopt collective decision making, as mentioned above. Although Chinese enterprises have a nominal voting mechanism, in fact, among many companies' boards of directors, there is a special status for the chair. Chairs are either the main founders of the company or a strong executive director from the controlling shareholder. Thus, in the decision-making process of the board of directors, the chair's discourse power seems stronger than that of other directors. Especially in the Confucian cultural background, which advocates fair authority, the decision making of the board of directors is inevitably influenced by the personality traits of a strong chair, whose status is somewhat akin to that of the CEO of a US company. Huang et al. (2011) empirically found in companies with high agency cost that top executives' overconfidence increases the sensitivity of investment to cash flow, using data from Chinese listed companies. Without considering whether the board is overconfident or not, Li and Tang (2010) found a positive relationship between CEO hubris and firm risk-taking in Chinese firms, especially when the CEO also chairs the board.

According to the upper echelons theory (Hambrick and Mason 1984), a senior manager's personal background and cognitive structure affects the strategic decisions of the enterprise and the operation of the entire management team, ultimately affecting corporate behavior. Especially in SOEs, where directors are appointed by the government or regional ministries, the chair of the board often has a higher rank in terms of political title than the other directors

do. Therefore, the chair's position is more stable and less threatened by the market with external control. These leads to the third hypothesis.

HYPOTHESIS 3. On the premise of the chairman's overconfidence, the effect of board's overconfidence leading to the increased sensitivity of investment to cash flow in SOEs is more significant.

3. Research Design

3.1 Sample selection

In order to exempt our sample from the distortion of the global financial crisis on corporate investment, it comprises annual data of listed companies in Shanghai and Shenzhen A-share markets during 2009 and 2015. Those companies designated as special treatment (warning of delisting) and all financial companies were excluded, leaving a maximum of 9693 firm-year observations. We obtained all data from the China Stock Market Trading Database (CSMAR) and the Wind database.

3.2 Construction of variables

3.2.1 Managerial overconfidence

There are a number of ways to measure managerial overconfidence. Previous studies have used CEO's option-exercise behavior (Malmendier and Tate 2005, 2008; Malmendier, Tate, and Yan 2011; Hirshleifer, Low, and Teoh 2012; Hribar and Yang 2016), media portrayals of the CEO (Malmendier and Tate 2008; Hribar and Yang 2016), frequency of M&As (Doukas and Petmezas 2007; Malmendier and Tate 2008), bias between actual net profit and forecast net profit (Lin, Hu, and Chen 2005; Huang et al. 2011), and managers' relative salaries (Hayward and Hambrick 1997; Huang et al. 2011).

In view of the data availability and financial conditions of China's stock exchange-listed companies, we follow Hayward and Hambrick (1997) to measure managerial overconfidence, using top executives' relative salary as the proxy variable. Hayward and Hambrick (1997) argued that higher relative pay of the CEO represents a higher position, making it more likely that he or she is overconfident. The authors used CEO cash compensation divided by compensation of the second-highest paid officer to measure overconfidence. In their study of Chinese companies, Huang et al. (2011) used the ratio of the sum of the top three managers' salaries to the sum of all managers' salaries as a proxy for top executives' overconfidence.

Owing to limitations in Chinese company reporting, the salary information of the full board of directors is not available, and only the top three directors' salary are public knowledge. Therefore, we use the chair's salary to the top three directors' relative salaries as a measure for the chair's overconfidence; when the ratio is higher than the annual median, the chair's overconfidence is 1, and otherwise is 0. Similarly, we use the ratio of the sum of the top three directors' salaries to the sum of all top executives' salaries as a proxy for the board's overconfidence; it equals 1 if the ratio is higher than the annual median. Top executives include board members, boards of supervisors, managers, deputy managers, chief financial officers, assistants to the general manager, secretaries of the board of directors of the listed company, and other personnel specified in the articles of association of the company and other executives.

Table 1 provides the distribution of overconfident chairs and overconfident boards. There are slightly fewer SOEs than non-SOEs in our sample. As non-SOE managers' salaries are higher than those of SOE managers, the proportion of overconfident samples is significantly higher both for the board and chair. In addition, the proportion of overconfident chairs in SOEs

is higher than that of overconfident boards, and vice versa in non-SOEs, which illustrates that the chairs of SOE have stronger power to a certain extent. Owing to the lack of compensation data for chairs, the sample size of chairs is slightly lower than that of boards.

Table 1. Frequency and percentage of board’s overconfidence and chair’s overconfidence

Classification	Board			Chairman			Board & Chairman		
	observations	Overconfidence		observations	overconfidence		observations	overconfidence	
		#	%		#	%		#	%
SOE	4666	1588	34%	2374	1042	44%	2374	529	22%
non-SOE	5027	3078	61%	4221	2253	53%	4221	1576	37%
total	9693	4666	48%	6595	3295	50%	6595	2105	32%

Notes: This table provides the distribution of the number (#) and percentage (%) of overconfident chair, overconfident board, and both of the chair and the board are overconfident. We adopt the chair’s salary to the top three directors’ relative salaries as a measure for the chair’s overconfidence, and we use the ratio of the sum of the top three directors’ salaries to the sum of all top executives’ salaries as a proxy for the board’s overconfidence.

3.2.2 Over-investment and other control variables

We construct an expected investment model based on Richardson (2006), and measure expected investment using the following regression model.

$$\begin{aligned}
 NewInv_{i,t} = & \alpha_0 + \alpha_1 Grow_{t-1} + \alpha_2 Lev_{t-1} + \alpha_3 Cash_{t-1} + \alpha_4 Size_{t-1} + \alpha_5 Ret_{t-1} + \\
 & \alpha_6 Age_{t-1} + \alpha_7 NewInv_{i,t-1} + Industry\&Year\ Effects + \varepsilon_{i,t}
 \end{aligned} \tag{1}$$

where *NewInv* measures the cash to purchase fixed assets, intangible assets, and other long-term assets minus the cash to dispose of fixed assets, intangible assets, and other long-term assets, and is derived from the cash flow statement. *Grow* is the operating income growth rate of a company. *Lev* is leverage, measured by liabilities divided by assets. *Cash* represents the cash and cash equivalents held by firms, and is measured by the sum of cash and investment in

short-term liquid securities divided by total assets. *Size* is the natural logarithm of total assets measured at the start of the year. *Ret* is the stock returns for the prior year. *Age* is the number of years that a company has been listed, as of the start of the year. Since the independent variables contain the lag of the dependent variable, we use the system generalized method of moments to regress the model, and the residual is over-investment. To eliminate the effect of extreme values, we winsorize all continuous variables in this study by 1%.

Consistent with Richardson (2006), we define *FCF* as free cash flow, that is, cash flow beyond what is necessary to maintain assets and to finance expected (optimal) new investments. We calculate free cash flow as follows:

$$FCF_t = CFO - Inv_{M,t} - NewInv_t^* \quad (2)$$

where *CFO* is the cash flow from operating activities, and *Inv_{M,t}* is the investment expenditure necessary to maintain assets, and is measured by reported depreciation and amortization. *NewInv_t^{*}* is expected (or optimal) new investments calculated by Richardson's (2006) model. All investment expenditure variables are scaled by average total assets.

For each firm in the sample, we obtain the residuals from the regression above. Following previous studies, firms with positive residual are placed in the group of over-investing companies, while firms with negative residuals are placed in the under-investing group. *OverInv* is the residuals of the regression.

BoardOverconf and *ChairOverconf* represent the board of directors' overconfidence and the chair's overconfidence, respectively, which are calculated using relative salaries, as mentioned above. *Lev* is leverage measured by the total debt at the end of the previous year divided by total assets at the end of the previous year. *Size* is the size of a company, measured

by the natural logarithm of total assets at the end of the previous year. *Cash* is the cash and cash equivalents held by the firm, measured by the sum of cash and investment in short-term liquid securities divided by total assets. *Ret* represents stock returns for the year. *Zdx* is the power balance with shareholder structure, which is calculated by the proportion of the top three shareholders' shareholdings divided by that of the largest shareholder's shareholding. *First* is the percentage of shares held by the largest shareholder. *Risk* is business risk measured by the ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets. *Sharehold* is the ratio of board shareholding. *Grow* is the operating income growth rate for the year. *State* is dummy variable that takes 1 if the controlling shareholder in a company is a state entity, and 0 otherwise. Finally, we also control for industry effect, year effect, and area effect.

Table 2. Summary statistics

Variables	mean	Std.	p25	p50	p75	min	max
Panel A: Total sample							
OverInv	0.001	0.060	-0.030	-0.010	0.020	-0.154	0.244
FCF	-0.036	0.092	-0.084	-0.037	0.012	-0.325	0.277
BoardOverconf	0.491	0.500	0.000	0.000	1.000	0.000	1.000
Lev	0.464	0.211	0.303	0.464	0.621	0.048	1.030
Size	21.920	1.240	21.040	21.750	22.610	19.160	25.730
Cash	0.185	0.132	0.092	0.152	0.244	0.009	0.681
Ret	0.223	0.689	-0.222	0.077	0.496	-0.750	3.671
Zdx	1.438	0.408	1.111	1.301	1.663	1.008	2.708
First	0.352	0.150	0.232	0.334	0.456	0.065	0.747
Risk	0.154	0.115	0.061	0.132	0.221	0.002	0.514
Sharehold	0.071	0.150	0.000	0.000	0.022	0.000	0.634
Grow	0.167	0.435	-0.034	0.096	0.243	-0.533	2.939
State	0.481	0.500	0.000	0.000	1.000	0.000	1.000

Panel B: Subsample of SOEs

OverInv	-0.002	0.057	-0.033	-0.011	0.017	-0.154	0.244
FCF	-0.035	0.087	-0.082	-0.038	0.009	-0.325	0.277
BoardOverconf	0.340	0.474	0.000	0.000	1.000	0.000	1.000
Lev	0.515	0.199	0.367	0.523	0.666	0.048	1.030
Size	22.340	1.317	21.410	22.140	23.150	19.160	25.730
Cash	0.166	0.120	0.082	0.134	0.218	0.009	0.681
Ret	0.188	0.700	-0.277	0.034	0.467	-0.750	3.671
Zdx	1.339	0.365	1.068	1.181	1.513	1.008	2.708
First	0.395	0.152	0.272	0.393	0.506	0.065	0.747
Risk	0.135	0.112	0.045	0.109	0.194	0.002	0.514
Sharehold	0.003	0.022	0.000	0.000	0.000	0.000	0.599
Grow	0.146	0.408	-0.039	0.086	0.221	-0.533	2.939

Panel C: Subsample of Non-SOEs

OverInv	0.004	0.062	-0.028	-0.008	0.023	-0.154	0.244
FCF	-0.036	0.097	-0.085	-0.036	0.015	-0.325	0.277
BoardOverconf	0.630	0.483	0.000	1.000	1.000	0.000	1.000
Lev	0.417	0.212	0.250	0.410	0.568	0.048	1.030
Size	21.520	1.014	20.830	21.420	22.120	19.160	25.400
Cash	0.203	0.140	0.101	0.167	0.269	0.009	0.681
Ret	0.257	0.678	-0.176	0.118	0.518	-0.750	3.671
Zdx	1.530	0.424	1.186	1.411	1.778	1.008	2.708
First	0.312	0.138	0.211	0.292	0.402	0.065	0.747
Risk	0.172	0.115	0.082	0.156	0.240	0.002	0.514
Sharehold	0.133	0.187	0.000	0.009	0.263	0.000	0.634
Grow	0.186	0.459	-0.032	0.109	0.264	-0.533	2.939

Panel D: Difference between SOEs and Non-SOEs

Variables	Mean non-SOE	Mean SOE	T test
OverInv	0.003	-0.002	4.3554***
FCF	-0.036	-0.035	0.1075
BoardOverconf	0.630	0.340	29.776***
Lev	0.417	0.515	-29.443***

Size	21.520	22.340	-34.453***
Cash	0.203	0.166	14.017***
Ret	0.257	0.188	4.931***
Zdx	1.530	1.339	23.708***
First	0.312	0.395	-28.176***
Risk	0.172	0.135	15.780***
Sharehold	0.133	0.003	47.242***
Grow	0.186	0.146	4.538***

Notes: This table presents the descriptive statistics for variables used in regression analyses. Panels A, B and C are summary statistics for full-sample, sub-samples on SOEs, and sub-samples on non-SOEs, respectively. Panel D exhibits the difference in mean between SOEs and Non-SOEs. *OverInv* is the residuals calculated by the method of Richardson (2006). *FCF* is the free cash flow; *BoardOverconf* represents the board of directors' overconfidence; *Lev* is the firm's financial leverage; *Size* is the size of company; *Cash* is the cash and cash equivalents held by the firms; *Ret* denotes firm's stock returns for the year; *Zdx* is the power balance with shareholder structure; *First* is the percentage of shares held by the largest shareholder; *Risk* is business risk measured by the ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets; *Sharehold* is the ratio of board shareholding; *Grow* is the operating income growth rate; *State* is dummy variable that takes 1 if the controlling shareholder in a company is a state entity, and 0 otherwise. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 2 presents the descriptive statistics for all variables in the regression analyses. The total sample (Panel A), the subsample for SOE firms (Panel B), and the subsample for non-SOE firms (Panel C) are reported. We winsorize the variables at the 1% and 99% levels to mitigate the undue influences of outliers. As observed in Panel A, half of the quantile of *OverInv* is -0.01, indicating that most Chinese companies under-invest. Meanwhile, the average investment level is 0.001, which illustrates that the extent of over-investment is higher than that of under-investment. Free cash flow of Chinese companies is generally insufficient, and the mean *FCF* is -0.036. Almost half of the samples exhibit board of directors' overconfidence. We conduct a statistical test on the difference in mean (t-test) between SOE firms and non-SOE firms. The results show that there are significant differences between SOE and non-SOE firms

except *FCF*. The free cash flow of SOEs is slightly higher than that of non-SOEs, but the difference is not significant. SOE firms have a higher asset–liability ratio, size, and the largest shareholders. On the other hand, *OverInv*, *BoardOverconf*, *Cash*, *Ret*, *Zdx*, *Risk*, *Sharehold*, and *Grow* for SOE firms are significantly lower than those for non-SOE firms.

Table 3 Correlation matrix

Variables	OverInv	FCF	BoardOverconf	Lev	Size	Cash	Ret	Zdx	First	Risk	Sharehold	Grow	State
OverInv	1												
FCF	0.215***	1											
BoardOverconf	0.017*	0.026**	1										
Lev	0.019*	-0.064***	-0.119***	1									
Size	-0.092***	-0.044***	-0.238***	0.366***	1								
Cash	-0.065***	0.074***	0.028***	-0.377***	-0.182***	1							
Ret	0.052***	-0.00100	0.023**	-0.0130	-0.063***	0.049***	1						
Zdx	0.022**	0.00400	0.00300	-0.112***	-0.081***	0.081***	0.017*	1					
First	-0.047***	0.024**	-0.104***	0.051***	0.285***	-0.021**	-0.018*	-0.598***	1				
Risk	-0.039***	-0.031***	-0.00300	0.0130	-0.120***	-0.0150	0.039***	0.050***	-0.061***	1			
Sharehold	0.021**	-0.018*	0.098***	-0.304***	-0.228***	0.205***	0.053***	0.236***	-0.116***	0.170***	1		
Grow	0.180***	0.058***	0.00100	-0.002	-0.097***	0.041***	0.194***	0.045***	0.030***	0.063***	0.067***	1	
State	-0.044***	0.001	-0.290***	0.232***	0.330***	-0.141***	-0.050***	-0.234***	0.275***	-0.158***	-0.433***	-0.046***	1

Notes: This table presents the Pearson correlation coefficients for variables used in regression analyses. *OverInv* is the residuals calculated by the method of Richardson (2006). *FCF* is the free cash flow; *BoardOverconf* represents the board of directors' overconfidence; *Lev* is the firm's financial leverage; *Size* is the size of company; *Cash* is the cash and cash equivalents held by the firms; *Ret* denotes firm's stock returns for the year; *Zdx* is the power balance with shareholder structure; *First* is the percentage of shares held by the largest shareholder; *Risk* is business risk measured by the ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets; *Sharehold* is the ratio of board shareholding; *Grow* is the operating income growth rate; *State* is dummy variable that takes 1 if the controlling shareholder in a company is a state entity, and 0 otherwise. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3 shows the correlation coefficients matrix of variables. *BoardOverconf* and *FCF* are positively correlated with *OverInv*.

4. Empirical results

4.1 Board of directors' overconfidence, ownership structure, and firms' over-investment

We conduct ordinary least square regression to investigate whether the board of directors'

overconfidence increases the likelihood of investment–cash flow sensitivity and in particular, whether this relationship is different between SOEs and non-SOEs. The dependent variable is *OverInv*, which indicates the degree of deviation to the optimal investment level. Independent variables include measures for the board of directors’ overconfidence, the interaction of overconfidence with the firm’s free cash flow, and control variables for firm characteristics. We divide the sample into two groups according to the ownership structure. In the first group, the controlling shareholder is the government (SOE), while in the second group, the controlling shareholder is non-state entities (non-SOE). We first run the regression for the entire sample to test the influence of the board’s overconfidence. Then, we regress the SOE sub-sample and the non-SOE sub-sample to examine whether there is any difference in the relationship. Other control variables include *FCF*, *Lev*, *Size*, *Cash*, *Ret*, *Zdx*, *First*, *Risk*, *Sharehold*, *Grow*, *State*, *Industry*, *Year*, and *Area*, as defined in the previous section.

Table 4 Board’s overconfidence, chairman’s overconfidence, ownership structure and firm’s over-investment

Variables	All		SOE	non-SOE	SOE1	SOE2
	(1)	(2)	(3)	(4)	(5)	(6)
FCF		0.043*** (3.87)	0.032** (2.15)	0.061*** (3.61)	0.011 (0.38)	0.061* (1.79)
BoardOverconf		-0.000 (-0.07)	0.002 (1.04)	-0.002 (-0.97)	0.001 (0.20)	-0.001 (-0.21)
BoardOverconf*FCF		0.024* (1.83)	0.069*** (3.10)	-0.005 (-0.25)	0.077* (1.81)	0.038 (0.95)
Lev	0.013*** (3.51)	0.014*** (3.72)	0.012** (2.24)	0.017*** (3.13)	0.015 (1.28)	0.011 (1.16)
Size	-0.004*** (-5.87)	-0.004*** (-5.76)	-0.004*** (-5.04)	-0.004*** (-3.60)	-0.004** (-2.35)	-0.005*** (-2.70)

Cash	-0.031*** (-5.79)	-0.034*** (-6.25)	-0.029*** (-3.74)	-0.034*** (-4.57)	-0.014 (-0.84)	-0.035* (-1.93)
Ret	0.007*** (4.64)	0.006*** (4.48)	0.005** (2.42)	0.008*** (3.86)	0.003 (0.70)	0.005 (1.25)
Zdx	0.003 (1.49)	0.002 (1.14)	0.003 (0.94)	0.003 (1.32)	0.005 (0.77)	0.003 (0.58)
First	0.004 (0.66)	0.001 (0.20)	-0.014* (-1.85)	0.012 (1.46)	-0.021 (-1.34)	-0.011 (-0.65)
Risk	-0.057*** (-10.83)	-0.055*** (-10.45)	-0.064*** (-8.27)	-0.049*** (-6.75)	-0.051*** (-2.88)	-0.074*** (-5.38)
Sharehold	-0.000 (-0.02)	0.002 (0.41)	-0.056 (-1.13)	0.001 (0.29)	-0.027 (-0.22)	-0.199*** (-3.46)
Grow	0.027*** (12.11)	0.026*** (12.06)	0.028*** (8.36)	0.025*** (8.70)	0.023*** (3.06)	0.036*** (5.72)
State	-0.001 (-0.68)	-0.001 (-0.82)				
Constant	0.111*** (8.39)	0.112*** (8.11)	0.121*** (6.78)	0.109*** (4.73)	0.122*** (3.38)	0.115*** (3.04)
Observations	9693	9693	4666	5027	1042	1332
R-squared	0.254	0.261	0.279	0.259	0.244	0.31
Year	yes	yes	yes	yes	yes	yes
Ind	yes	yes	yes	yes	yes	yes
Area	yes	yes	yes	yes	yes	yes

Notes: t-statistics are in parentheses. This table presents the regression results of board of directors' overconfidence on investment–cash flow sensitivity. Column 1–2 present the regression of the full sample, and Columns 3–6 show the regression of the subsample of SOEs and non-SOEs. *OverInv* is the residuals calculated by the method of Richardson (2006). *FCF* is the free cash flow; *BoardOverconf* represents the board of directors' overconfidence; *BoardOverconf*FCF* is the interaction term of *BoardOverconf* and *FCF*; *Lev* is the firm's financial leverage; *Size* is the size of company; *Cash* is the cash and cash equivalents held by the firms; *Ret* denotes firm's stock returns for the year; *Zdx* is the power balance with shareholder structure; *First* is the percentage of shares held by the largest shareholder; *Risk* is business risk measured by the ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets; *Sharehold* is the ratio of board shareholding; *Grow* is the operating income growth rate; *State* is dummy variable that takes 1 if the controlling shareholder in a company is a state entity, and 0 otherwise. *Year*, *Ind*, and *Area* denotes the controlling variables

for year effect, industry effect and area effect, respectively. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4 reports the empirical results. The proxy for the board's overconfidence is *BoardOverconf*. It is based on the remuneration of the board of directors, which is the ratio of the sum of the top three directors' salaries to the sum of all top executives' salaries. When the ratio is higher than the annual median, the board's overconfidence is 1, and otherwise is 0. Columns 1–2 of Table 4 present the regression of the total sample. The coefficient of the interaction term *BoardOverconf*FCF* is significantly positive in the regression for the total sample, suggesting that boards of directors with higher levels of overconfidence than their peers also exhibit higher sensitivity of corporate investment to cash flow. We then regress the sample separately according to the nature of ownership; the results are presented in columns 3–4. The sub-sample results for state-controlled firms (SOE) and non-state controlled firms (non-SOE) show that the coefficient of the interaction term *BoardOverconf*FCF* is significantly positive only for the SOE sub-sample. It is not significant for non-SOE firms. The results are consistent with Huang et al. (2011), who argued that agency cost has a significant impact on the relationship between top executives' overconfidence and investment–cash flow sensitivity.

4.2 Board of directors' overconfidence, chair's overconfidence, ownership structure, and firms' over-investment

As discussed in Section 2, the psychological bias of the chair may have a significant impact on the board of directors. In order to test the influence of the chair's overconfidence on the board of directors, we further divide the SOE sample into two groups according to whether the chair is overconfident or not (SOE1 and SOE2), and thus, we examine the influence of the

chair's overconfidence on the relationship between the board's overconfidence and the investment–cash flow sensitivity. Column 5 of Table 4 shows the regression results of the overconfident chair subsample, which shows that the overconfidence of the board of directors can increase investment–cash flow sensitivity when the chair is overconfident. However, this relationship does not hold for the samples of chairs who are not overconfident. The interaction term of *BoardOverconf*FCF* is not significant in the subsample of chairs who are not overconfident (column 6). Owing to the lack of chair compensation data, some data were excluded in columns 5 and 6.

These results indicate that the positive effect of the board of directors' overconfidence on investment–cash flow sensitivity holds mainly for SOE companies. In addition, the chair's overconfidence has some influence on this relationship, that is, only when the chair is overconfident does the board of directors' overconfidence have the abovementioned effect.

5. Robustness check and additional test

5.1 Robustness check

5.1.1 Alternative measure of over-investment

In the regression in the previous section, we use the residual using the method of Richardson (2006) to measure over-investment, which is a continuous variable. To check the robustness of our results, we change the way in which we measure overinvestment. If the residual is negative, over-investment is 0, and otherwise is the residual itself. Table 5 reports the results, in which the coefficient of the interaction term is less than the main test but is consistent with the prior results.

Table 5 Board's overconfidence, chairman's overconfidence, ownership structure and

firm's over-investment with an alternative measure of over-investment

Variables	All	SOE	non-SOE	SOE1	SOE2
	(1)	(2)	(3)	(4)	(5)
FCF	0.009 (1.03)	-0.003 (-0.24)	0.026* (1.79)	-0.014 (-0.65)	0.016 (0.57)
BoardOverconf	-0.000 (-0.07)	0.001 (0.95)	-0.002 (-1.00)	-0.000 (-0.03)	-0.002 (-0.61)
BoardOverconf*FCF	0.018* (1.67)	0.050*** (2.86)	-0.005 (-0.34)	0.054* (1.74)	0.043 (1.28)
Lev	0.006** (2.14)	0.002 (0.61)	0.010** (2.46)	0.005 (0.49)	-0.004 (-0.47)
Size	-0.003*** (-5.96)	-0.003*** (-4.84)	-0.003*** (-4.09)	-0.003** (-2.02)	-0.003* (-1.84)
Cash	-0.016*** (-3.70)	-0.012** (-2.07)	-0.016*** (-2.62)	0.000 (0.02)	-0.020 (-1.37)
Ret	0.005*** (4.14)	0.003* (1.73)	0.007*** (3.94)	0.001 (0.23)	0.003 (0.88)
Zdx	0.003* (1.76)	0.003 (1.50)	0.003 (1.56)	0.003 (0.49)	0.006 (1.47)
First	0.008* (1.92)	0.001 (0.18)	0.013* (1.90)	-0.005 (-0.41)	0.003 (0.19)
Risk	-0.051*** (-11.92)	-0.053*** (-8.47)	-0.049*** (-8.28)	-0.038*** (-2.75)	-0.057*** (-5.14)
Sharehold	0.003 (0.64)	-0.012 (-0.27)	0.002 (0.40)	0.011 (0.12)	-0.107*** (-4.10)
Grow	0.022*** (12.06)	0.023*** (8.21)	0.022*** (8.74)	0.015*** (2.68)	0.034*** (6.28)
State	-0.002* (-1.87)				
Constant	0.102*** (9.33)	0.101*** (7.10)	0.105*** (5.88)	0.106*** (3.58)	0.075** (2.52)
Observations	9693	4666	5027	1042	1332
R-squared	0.18	0.195	0.181	0.153	0.257

Year	yes	yes	yes	yes	yes
Ind	yes	yes	yes	yes	yes
Area	yes	yes	yes	yes	yes

Notes: t-statistics are in parentheses. This table presents the regression results of board of directors' overconfidence on investment–cash flow sensitivity with an alternative over-investment measure. Column 1 presents the regression of the full sample, and Columns 2–5 show the regression of the subsample of SOEs and non-SOEs. $OverInv^{\wedge}$ is 0 if the residual of Richardson (2006) is negative, and otherwise is the residual itself. *FCF* is the free cash flow; *BoardOverconf* represents the board of directors' overconfidence; *BoardOverconf*FCF* is the interaction term of *BoardOverconf* and *FCF*; *Lev* is the firm's financial leverage; *Size* is the size of company; *Cash* is the cash and cash equivalents held by the firms; *Ret* denotes firm's stock returns for the year; *Zdx* is the power balance with shareholder structure; *First* is the percentage of shares held by the largest shareholder; *Risk* is business risk measured by the ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets; *Sharehold* is the ratio of board shareholding; *Grow* is the operating income growth rate; *State* is dummy variable that takes 1 if the controlling shareholder in a company is a state entity, and 0 otherwise. *Year*, *Ind*, and *Area* denotes the controlling variables for year effect, industry effect and area effect, respectively. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

5.1.2 Fixed effect regression

To control the potential impact of fixed factors, we run fixed-effect regression, Table 6 reports the regression results. The results are broadly consistent with the prior results and the coefficient of the interaction term is slightly higher than in the main test.

Table 6 Fixed effect regression

Variables	All	SOE	non-SOE	SOE1	SOE2
	(1)	(2)	(3)	(4)	(5)
FCF	0.032 (0.55)	-0.007 (-0.08)	0.070 (0.92)	-0.096 (-0.54)	0.032 (0.18)
BoardOverconf	0.001 (0.30)	0.003 (1.21)	-0.002 (-0.81)	-0.004 (-0.58)	0.001 (0.17)
BoardOverconf*FCF	0.024*	0.066***	-0.029	0.159***	-0.030

	(1.81)	(3.41)	(-1.46)	(2.80)	(-0.67)
Lev	-0.013*	-0.048***	0.020**	-0.073***	-0.032
	(-1.92)	(-5.06)	(2.02)	(-2.62)	(-1.26)
Size	-0.035***	-0.036***	-0.034***	-0.045***	-0.050***
	(-18.22)	(-13.06)	(-11.87)	(-5.04)	(-6.60)
Cash	0.057***	0.066***	0.066***	0.100***	0.081**
	(7.10)	(5.60)	(5.76)	(2.95)	(2.50)
Ret	0.003***	0.003**	0.003*	0.002	0.004
	(2.77)	(1.96)	(1.95)	(0.51)	(0.98)
Zdx	0.020***	0.013**	0.028***	0.013	0.037***
	(5.37)	(2.36)	(5.55)	(0.84)	(2.60)
First	0.086***	0.060***	0.117***	-0.016	0.140**
	(6.34)	(3.02)	(6.09)	(-0.23)	(2.40)
Risk	-0.067***	-0.052***	-0.073***	-0.046	0.060
	(-5.56)	(-2.89)	(-4.37)	(-0.83)	(1.11)
Sharehold	0.013	-0.105	0.015	-0.357	-0.278
	(0.79)	(-1.32)	(0.86)	(-0.54)	(-1.40)
Grow	0.019***	0.019***	0.020***	0.005	0.025***
	(14.00)	(9.49)	(9.86)	(0.63)	(4.75)
Constant	0.704***	0.778***	0.618***	1.009***	1.006***
	(16.85)	(12.90)	(10.18)	(5.11)	(6.06)
Observations	9693	4666	5027	1042	1332
R-squared	0.175	0.217	0.206	0.372	0.379
Number of id	2080	796	1284	334	393
Year	yes	yes	yes	yes	yes
Ind*FCF	yes	yes	yes	yes	yes
Area*Year	yes	yes	yes	yes	yes

Notes: t-statistics are in parentheses. This table shows the fixed-effect regression results of board of directors' overconfidence on investment–cash flow sensitivity. Column 1 presents the regression of the full sample, and Columns 2–5 show the regression of the subsample of SOEs and non-SOEs. *OverInv* is the residuals calculated by the method of Richardson (2006). *FCF* is the free cash flow; *BoardOverconf* represents the board of directors' overconfidence; *BoardOverconf*FCF* is the interaction term of *BoardOverconf* and *FCF*; *Lev* is the firm's financial leverage; *Size* is the size of company; *Cash* is the cash and cash equivalents held by the

firms; *Ret* denotes firm's stock returns for the year; *Zdx* is the power balance with shareholder structure; *First* is the percentage of shares held by the largest shareholder; *Risk* is business risk measured by the ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets; *Sharehold* is the ratio of board shareholding; *Grow* is the operating income growth rate. *Year*, *Ind*, and *Area* denotes the controlling variables for year effect, industry effect and area effect, respectively. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

5.1.3 Alternative measure of the board's overconfidence

Manager who is not overconfident should invest in stocks of other companies instead of the stock of the firms to which his or her human capital is completely exposed. Therefore, a voluntary increase in the shareholding of the corporation that the manager works for signals a degree of overconfidence. We change the measure of the board's overconfidence following Malmendier and Tate (2005, 2008). Specifically, when the proportion of directors who increase their stock holdings is greater than 0, the board is overconfident. Moreover, in order to avoid repeated measurement of the board's holding, the ratio of board shareholding is replaced by the number of board meetings held during the year in the controlling variables. The results of the alternative measure of the board's overconfidence are presented in Table 7.

Table 7 Board's overconfidence, chairman's overconfidence, ownership structure and firm's over-investment with an alternative measure of board's overconfidence

Variables	All (1)	SOE (2)	non-SOE (3)	SOE1 (4)	SOE2 (5)
FCF	2.448*** (5.59)	2.206*** (3.45)	2.695*** (4.37)	2.062* (1.91)	2.595*** (3.08)
BoardOverconf [^]	0.113 (1.42)	0.378*** (2.75)	-0.043 (-0.43)	0.558** (2.41)	0.182 (0.98)
BoardOverconf [^] *FCF	1.382* (1.82)	2.520* (1.70)	0.728 (0.80)	4.170* (1.74)	3.094 (1.45)
Lev	-0.6063* (-1.73)	-1.3093** (-2.40)	-0.0538 (-0.12)	-0.8323 (-0.92)	-1.4022* (-1.76)

Size	-1.110*** (-9.96)	-1.311*** (-7.54)	-0.976*** (-6.61)	-1.540*** (-4.70)	-1.194*** (-4.95)
Cash	2.558*** (6.02)	3.446*** (4.86)	2.204*** (4.1)	2.635** (2.27)	3.821*** (3.83)
Ret	0.158** (2.51)	0.163* (1.67)	0.179** (2.11)	0.388** (2.33)	-0.047 (-0.37)
Zdx	0.549*** (2.98)	0.466 (1.54)	0.726*** (3.07)	0.462 (1.01)	0.124 (0.27)
First	2.262*** (3.2)	1.364 (1.24)	3.516*** (3.69)	-0.147 (-0.07)	2.285 (1.48)
Risk	-2.206*** (-3.48)	-3.025*** (-2.98)	-1.459* (-1.77)	-2.964* (-1.65)	-2.324 (-1.62)
Meeting	0.062*** (5.19)	0.051*** (2.85)	0.066*** (4.07)	0.051 (1.59)	0.048** (2.02)
Grow	0.618*** (7.84)	0.798*** (6.48)	0.459*** (4.38)	0.753*** (3.14)	0.808*** (5.15)
Observations	7064	3537	3527	1243	1966
Number of id	1285	549	736	239	348
Year	yes	yes	yes	yes	yes

Notes: t-statistics are in parentheses. This table displays the regression results of board of directors' overconfidence on investment–cash flow sensitivity with an alternative board's overconfidence measure. Column 1 presents the regression of the full sample, and Columns 2–5 show the regression of the subsample of SOEs and non-SOEs. *OverInv* is the residuals calculated by the method of Richardson (2006). *FCF* is the free cash flow; *BoardOverconf^h* represents the alternative proxy of board of directors' overconfidence which equals 1 if the proportion of directors who increase their stock holdings is greater than 0, and 0 otherwise. *BoardOverconf^h*FCF* is the interaction term of *BoardOverconf^h* and *FCF*; *Lev* is the firm's financial leverage; *Size* is the size of company; *Cash* is the cash and cash equivalents held by the firms; *Ret* denotes firm's stock returns for the year; *Zdx* is the power balance with shareholder structure; *First* is the percentage of shares held by the largest shareholder; *Risk* is business risk measured by the ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets; *Meeting* is the number of board meetings held during the year. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

5.2 Additional test

As the empirical results show, only when the chair is overconfident can the board of directors' overconfidence adjust the sensitivity of investment to cash flow. Since Chinese enterprises implement a “voting system” for decision making, what role does the chair's overconfidence play in investment decision making? A number of studies about leadership hold

that in the context of the organization, the characteristics and behavior of a supervisor have an effect on subordinates through the vertical management level from top to bottom, and ultimately, lead to the same characteristics and behavior of the subordinate and the team, that is, the “trickle-down effect” (Aryee et al. 2007). The trickle-down effect is an emerging perspective that has received considerable empirical support. Ambrose, Schminke, and Mayer (2013) found that supervisors’ perceptions of how fairly they are treated by their own supervisors can influence their subordinates’ perceptions, attitudes, and behavior. Story et al. (2013) found a contagion effect of global leaders’ positive psychological capital on followers using a sample of Fortune 100 multinational firms.

To examine further the impact of the chair’s cognitive bias on the board’s decision making, we regress the board’s overconfidence on the chair’s overconfidence to test whether overconfidence has a trickle-down effect, and we control the corporate governance variables at the same time. Among them, *Lev* represents the enterprise’s asset–liability ratio, using the calculation method described in previous section. *Size* is the size of the firm measured by the natural logarithm of total assets. *Mtime* is the directors’ average term of office, measured on a monthly basis. *Board* is the size of board, measured by the number of directors on the board. *Independ* is the scaled number of independent directors, measured by the number of independent directors scaled by the total number of directors. *First* is the proportion of the largest shareholder holdings. *Zdx* is the degree of equity balance, measured by the ratio of the proportion of the first three shareholders to the proportion of the largest shareholder. *Meeting* represents the number of board meetings held during the year. *State* is a dummy variable that takes 1 if the controlling shareholder in a company is a state entity and 0 otherwise. The result

of the logit regression is reported in Table 8. The coefficient of the chair's overconfidence is significantly positive, which illustrates that the chair's cognitive bias can be transmitted to the entire board of directors, and may ultimately affect the board's decision making. Regression analysis of the subsample shows that a contagion effect of overconfidence exists in both SOEs and non-SOEs. To solve the possible endogeneity problems, we use a one-period lag of the chair's overconfidence as the instrumental variable in a two-stage least square (2SLS) regression. Panel B of Table 8 reports the 2SLS regression results.

Table 8 Logit regression of the board of directors' overconfidence on the chair's overconfidence

Variables	ALL		SOE		non-SOE	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:						
ChairOverconf	0.354***	-6.12	0.339***	-3.26	0.333***	-4.6
Lev	-0.408**	(-2.42)	-0.36	(-1.16)	-0.456**	(-2.15)
Size	-0.246***	(-7.37)	-0.276***	(-4.97)	-0.215***	(-4.68)
Mtime	0.005**	-2.36	0.006	-1.58	0.005*	-1.81
Board	-0.087***	(-4.21)	-0.072**	(-2.18)	-0.119***	(-4.06)
Independent	-2.241***	(-3.67)	-0.954	(-0.94)	-3.583***	(-4.38)
First	-0.305	(-1.15)	-0.535	(-1.11)	-0.23	(-0.67)
Zdx	-0.400***	(-4.53)	-0.670***	(-3.62)	-0.304***	(-2.84)
Meeting	-0.018**	(-2.20)	-0.058***	(-3.83)	-0.009	(-0.83)
State	-0.727***	(-10.13)				
Constant	8.750***	-11.86	8.323***	-7.14	8.965***	-8.37
Observations	6004		2044		3952	
Pseudo R2	0.1041		0.1352		0.0702	
year	yes		yes		yes	
ind	yes		yes		yes	
Area	yes		yes		yes	
Panel B:						
ChairOverconf	0.359***	-5.38	0.235*	-1.83	0.394***	-4.7
Lev	-0.307**	(-2.50)	-0.464**	(-2.06)	-0.282*	(-1.82)
Size	-0.152***	(-6.42)	-0.169***	(-4.36)	-0.142***	(-4.29)
Mtime	0.005***	-3.02	0.004	-1.53	0.005***	-2.71

Board	-0.051***	(-3.44)	-0.033	(-1.41)	-0.071***	(-3.34)
Independent	-1.566***	(-3.59)	-0.62	(-0.86)	-2.411***	(-4.07)
First	-0.052	(-0.27)	-0.394	(-1.12)	0.099	-0.39
Zdx	-0.217***	(-3.40)	-0.382***	(-2.98)	-0.145*	(-1.86)
Meeting	-0.006	(-0.98)	-0.027**	(-2.54)	0	-0.01
State	-0.449***	(-8.78)				
Constant	5.065***	-9.45	4.627***	-5.42	5.501***	-7.04
Observations	4322		1536		2780	
Year	yes		yes		yes	
Ind	yes		yes		yes	
Area	yes		yes		yes	

Notes: z-statistics are in parentheses. This table presents the Logit regression of the board of directors' overconfidence on the chair's overconfidence, where Panel A gives the basic results and Panel B displays the 2SLS regression results. ChairOverconf represents the chair's overconfidence; Lev is the firm's financial leverage; Size is the size of company; Mtime is the director's average term of office; Board is the number of directors on the board; Independent is the ratio of the number of independent directors divided by the number of all directors; First is the percentage of shares held by the largest shareholder; Zdx is the power balance with shareholder structure; Meeting is the number of board meetings held during the year; State is dummy variable that takes 1 if the controlling shareholder in a company is a state entity, and 0 otherwise. Year, Ind, and Area denotes the controlling variables for year effect, industry effect and area effect, respectively. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

6. Conclusions

Anchored on the upper echelons theory and behavioral finance research, the present study provides empirical evidence that board of directors' overconfidence tends to drive firms' sensitivity of overinvestment to free cash flow, and that this relationship is contingent on ownership and the chair's cognitive bias.

This study explicitly tests the relationship between the board of directors' overconfidence and the sensitivity of overinvestment on free cash flow as well as its boundary conditions in a non-Western context. Prior research has shown that overconfidence influences a firm's investment–cash flow sensitivity, but very few studies have focused on the impact of collective and personal overconfidence on the relationship synchronously. Most efforts have been

conducted in the Western context, and have not focused on the potential boundary conditions of the impact of the board's overconfidence on investment–cash flow sensitivity. By filling these gaps, this study extends our understanding of the impact of managerial overconfidence on investment–cash flow sensitivity.

This study investigates the theoretical boundary that the board's overconfidence plays against the background of collective decision making in China. We find that on average, there is a significant positive relationship between the board of directors' overconfidence and investment–cash flow sensitivity in Chinese listed companies. However, this positive relationship is driven by state-controlled listed companies. The effect of managerial overconfidence, however, is limited in non-SOEs. Analysis of the chair's overconfidence indicates that only when the chair is overconfident can the board of directors' overconfidence adjust the sensitivity of investment to cash flow in state-controlled enterprises. The result of the additional test provides a possible reason that overconfidence of the chair can be contagious for directors, and ultimately, influences board decision making in Chinese firms.

This study has several implications for management research. First, consistent with several recent studies (Huang et al. 2011; Wang et al. 2016), this study emphasizes the importance of managers' psychological characteristics and their effects on firm-level decisions and outcomes, which is a key prediction of the upper echelons theory (Hambrick and Mason 1984). Prior research has focused primarily on top executives' demographics rather than their psychological characteristics, in part due to the difficulty of collecting such data from top executives in field studies.

Second, this research explains the role of personal psychological deviation on decision

making in the collective context. China has long been considered to value collectivism rather than individualism. The Chinese context offers an opportunity to discover how collectives work under the influence of individuals. In general, state-controlled listed companies are more likely to display investment distortions caused by the board of directors' overconfidence, owing to less effective supervision by shareholders. Moreover, the cognitive bias of the chair can be transmitted to the board of directors, and ultimately influence the board decision making of SOEs.

Finally, this study finds that overconfidence can be contagious, which is an interesting and important area for future research. Based on the trickle-down effect, present research explores the way in which the chair's overconfidence affects investment decisions in the collective context. The empirical results show that the chair's cognitive bias can be transferred to the board of directors after controlling the existing corporate governance mechanism, which illustrates that in the collective decision-making system, the cognitive bias of an individual may also have a significant impact on corporate decision making.

The results of this study have several practical implications for managers. Chinese enterprises often adopt a voting mechanism in business decision making. However, cognitive bias may affect corporate investment by transmitting overconfidence to the board of directors. Therefore, supervision and interference with the board may reduce investment distortions due to overconfidence, but it is more important to focus on the chair's overconfidence. Compared with the board's overconfidence, the chair's overconfidence is more likely to be captured and controlled. Through intervening in the chair's overconfidence and overconfident contagion, inefficient investment may be restrained more effectively.

References

- Ambrose, M. L., M. Schminke, and D. M. Mayer. 2013. Trickle-down effects of supervisor perceptions of interactional justice: A moderated mediation approach. *J. Appl. Psychol.* 98:678–689.
- Aryee, S., Z. X. Chen, L.-Y. Sun, and Y. A. Debrah. 2007. Antecedents and outcomes of abusive supervision: Test of a trickle-down model. *J. Appl. Psychol.* 92:191–201.
- Chen, G., M. Firth, and O. Rui. 2006. Have China's enterprise reforms led to improved efficiency and profitability? *Emerg. Mark. Rev.* 7:82–109.
- Chen, G., M. Firth, and L. Xu. 2009. Does the type of ownership control matter? Evidence from china's listed companies. *J. Bank. Financ.* 33:171–181.
- Doukas, J. A., and D. Petmezas. 2007. Acquisitions, overconfident managers and self-attribution bias. *Eur. Financ. Manag.* 13:531–577.
- Hambrick, D.C., and P. A. Mason. 1984. Upper echelons: The organization as a reflection of its top managers. *Acad. Manag. Rev.* 9:193–206.
- Hayward, M. L. A., and D. C. Hambrick. 1997. Explaining the premiums paid for large acquisitions: Evidence of CEO hubris. *Admin. Sci. Q.* 42:103–127.
- Heaton, J. B. 2002, Managerial optimism and corporate finance. *Financ. Manag.* 31:33–45.
- Hirshleifer, D., A. Low, and S. Teoh. 2012. Are overconfident CEOs better innovators? *J. Financ.* 67:1457–1498.
- .Hribar, P., and H. Yang. 2016. CEO Overconfidence and management forecasting. *Contemp. Account. Res.* 33:204–227.
- Huang, W., F. Jiang, Z. Liu, and M. Zhang. 2011. Agency cost, top executives' overconfidence,

- and investment-cash flow sensitivity—Evidence from listed companies in China. *Pac. Basin Financ. J.* 19:261–277.
- Humphery-Jenner M., L. L. Lisic, V. Nanda, and S. D. Silveri. 2016. Executive overconfidence and compensation structure. *J. Financ. Econ.* 119:533–558.
- Kolasinski, A. C., and X. Li. 2013. Can strong boards and trading their own firm’s stock help CEOs make better decisions? Evidence from acquisitions by overconfident CEOs. *J. Financ. Quant. Anal.* 48:1173–1206.
- Langer, E. J. 1975. The illusion of control. *J. Personal. Soc. Psychol.* 32:311–328.
- Li, J., and Y. Tang. 2010. CEO hubris and firm risk taking in China: The moderating role of managerial discretion. *Acad. Manag. J.* 53:45–68.
- Lin, Y., S. Hu, and M. Chen. 2005. Managerial optimism and corporate investment: Some empirical evidence from Taiwan. *Pac. Basin Financ. J.* 13:523–546.
- Malmendier, U., and G. Tate. 2005. CEO overconfidence and corporate investment. *J. Financ.* 60 (6):2661–2700.
- Malmendier, U., and G. Tate. 2008. Who makes acquisitions? CEO overconfidence and the market’s reaction. *J. Financ. Econ.* 89:20–43.
- Malmendier, U., G. Tate, and J. Yan. 2011. Overconfidence and early-life experiences: The effect of managerial traits on corporate financial policies. *J. Financ.* 66:1687–1733.
- Richardson, S., 2006. Over-investment of free cash flow. *Rev. Account. Stud.* 11:159–189.
- Roll, R. 1986. The hubris hypothesis of corporate takeovers. *J. Bus.* 59:197–217.
- Skala, D. 2008. Overconfidence in psychology and financeAn interdisciplinary literature review. *Bank i Kredyt* 39:33–50.

- Story, J. S. P., C. M. Youssef, F. Luthans, J. E. Barbuto, and J. Bovaird. 2013. Contagion effect of global leaders' positive psychological capital on followers: Does distance and quality of relationship matter? *Int. J. Human Res. Manag.* 24:2534–2553.
- Taylor S., and J. D. Brown, 1988. Illusion and well-being: A social psychological perspective on mental health. *Psychol. Bull.* 103:193–210.
- Wang, Y., C. R. Chen, L. Chen, and Y. S. Huang. 2016. Overinvestment, inflation uncertainty, and managerial overconfidence: Firm level analysis of Chinese corporations. *North Am. J. Econ. Financ.* 38:54–69.
- Whyte, G. 1989. Groupthink reconsidered. *Acad. Manag. Rev.* 14:40–56.
- Yates, J. F, J. W. Lee, H. Shinotsuka, Al L. Patalano, and W. R. Sieck. 1998. Cross-cultural variations in probability judgment accuracy: Beyond general knowledge overconfidence? *Organ. Behav. Human Decis. Process.* 74:89–117.

Appendix A. Variable definitions

Variable	Definition
Over-investment variables	
<i>OverInv</i>	The residuals of Richardson's (2006) regression. Positive residuals indicate over-investment, and negative residuals indicate under-investment.
<i>OverInv[^]</i>	An alternative measure of over-investment. When the residual is negative, over-investment is 0, and otherwise is the residual itself.
Overconfidence variables	
<i>BoardOverconf</i>	An indicator variable that equals 1 if relative salaries of the sum of the top three directors' salaries to the sum of all top executives' salaries are higher than the annual median, and 0 otherwise.
<i>BoardOverconf[^]</i>	An alternative measure of the board's overconfidence. If the proportion of directors who increase their stock holdings is greater than 0, the board's overconfidence is 1, and otherwise is 0.
<i>ChairOverconf</i>	An indicator variable that equals 1 if relative salaries of the chair's salary to the top three directors' salaries are higher than the annual median, and 0 otherwise.
Variables in Richardson (2006) model	
<i>NewInv</i>	The cash to purchase fixed assets, intangible assets, and other long-term assets minus the cash to dispose of fixed assets, intangible assets, and other long-term assets, divided by total assets, which are taken from the cash flow statement.
<i>Grow</i>	The operating income growth rate of a company.
<i>Lev</i>	Leverage measured by liabilities divided by assets.
<i>Cash</i>	The cash and cash equivalents held by a firm, which is measured by the sum of cash and investment in short-term liquid securities divided by total assets.
<i>Size</i>	The natural logarithm of total assets measured at the start of the year.
<i>Ret</i>	The stock returns for the prior year.
<i>Age</i>	The years that a company has been listed as of the start of the year.

Control variables	
<i>FCF</i>	The free cash flow, which is cash flow beyond what is necessary to maintain assets and to finance expected (optimal) new investments. It is measured by the cash flow from operating activities, minus depreciation and amortization, and minus the residuals of Richardson's (2006) model. All investment expenditure variables are scaled by average total assets.
<i>Zdx</i>	The power balance with shareholder structure, which is calculated by the proportion of the top three shareholders divided by the largest shareholder's.
<i>First</i>	The percentage of shares held by the largest shareholder.
<i>Risk</i>	The ratio of the sum of accounts receivable, notes receivable, and other receivables divided by total assets.
<i>Sharehold</i>	The ratio of board shareholding.
<i>State</i>	An indicator that equals 1 if the controlling shareholder in a company is a state entity and 0 otherwise.
<i>Mtime</i>	The director's average term of office, measured on a monthly basis.
<i>Board</i>	The size of board, measured by the number of directors on the board.
<i>Independent</i>	The ratio of the number of independent directors divided by the number of all directors.
<i>Meeting</i>	The number of board meetings held during the year of the sample.
