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Managerial overconfidence, internal financing, and investment efficiency: Evidence from China☆

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ABSTRACT

Using companies listed in China's Shanghai Exchange and Shenzhen Exchange in 2010–2015 as a sample, we test the impact of managerial overconfidence on choice of internal financing and investment efficiency (investment scale; overinvestment and underinvestment). We show that internal financing can fund business opportunities and alleviate capital shortages but may also cause excessive investment, especially in firms with managerial overconfidence. This over-investment problem is more significantly related to managerial overconfidence in state-owned than non-state enterprises.

1. Introduction

Investment plays a critical role in ensuring companies' sustainable development in market competition and creating new value for shareholders. Corporate investment policies are determined by a wide range of factors, including the overall economy, macro monetary policies, capital markets, and firm operations (Richardson, 2006). Managerial factors, such the irrationality of managers, also matters, especially in inefficient financial markets and in firms with poor corporate governance (Malmendier et al., 2011).

Roll (1986) proposed that overconfidence is a typical irrational behavior and that corporate managers tend to exhibit it when they make business decisions. Previous studies have shown that overconfident managers make investment decisions that result in over-investment or under-investment problems (Heaton, 2002; Bates, 2005; Xin et al., 2007). However, these studies focused on the impact of managerial overconfidence on corporate capital structure, external financing (new equity financing and debt financing), debt maturity, and other corporate finance issues (Shefrin, 2001; Barros and Silveira, 2007 Yu et al., 2006; Li et al., 2009). Managerial overconfidence has never been studied in-depth in relation to internal sources of financing.

According to pecking order theory (Myers, 1984), companies prioritize their sources of financing on the basis of their costs, so they prefer internal financing, and then debt, and as a last resort raising new equity. Overconfident managers who believe that their company is undervalued view external financing as overpriced, especially equity financing. As a result, they display pecking-order preferences for internal financing over debt and for debt over equity (Malmendier et al., 2011). From the perspective of behavioral finance, corporate managers tend to choose internal financing over other sources because they have more control over internal funds. Therefore, overconfident managers are more likely to affect the efficiency of investment projects with internal financing. If over-confident CEOs have sufficient internal funds for investment and are not disciplined by the capital market or corporate governance mechanisms, they systematically overestimate the return to their investment projects. If they do not have sufficient internal funds,

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however, they are reluctant to issue new equity because they perceive the stock of their company to be undervalued by the market. As a result, they curb their investment. Managerial overconfidence can account for corporate investment distortions (overinvestment and underinvestment), especially in a market like China, where effective internal governance and external monitoring mechanisms are not well established.

First, we found a positive relationship between managerial overconfidence and internal financing in Chinese firms. Overconfident managers tend to have controlling illusions about technologies they own and the accuracy of their judgement, so when they make decisions, they tend to overestimate the likelihood of success. They believe that their companies will show good profits and have great potential, and that outside investors underestimate the actual value of these companies. Due to asymmetric information and transaction costs, managers tend to choose internal financing, and remain cash inside.

Second, we found that state-owned enterprises have more serious overinvestments made by overconfident managers than non-state enterprises do. In state-owned enterprises in China, the largest shareholder is a government official who acts as agent of the government. This system, in which the enterprise lacks an owner, results in lower motivation for supervision of financial decisions than in private corporations. State-owned enterprise managers are often appointed by the government. This is a non-market technique, which can easily lead to opportunistic behavior by managers, who have a much higher risk of pursuing their private interests (Jiang et al., 2009). In fact, state-owned enterprise managers pay more attention to political "success" than to operating performance of their companies. When certain industries or projects become "hot" in the market, overconfident managers, eager to prove their competence in discovering investment opportunities, tend to expand the scale of investment without considering returns and other factors, and they are more likely to blindly follow other enterprises' excessive investment behaviors.

Third, we found that overconfident managers are more likely in non-state enterprises than in state enterprises to use internal financing to alleviate the shortage of investment. State-owned enterprises are responsible for strengthening infrastructure, expanding domestic demand, and promoting local GDP growth. When they face financing constraints, the government will help them in time. They can also get more favorable terms on market access in their industries, and credit institutions are more willing to provide them with funding (Zhang et al., 2010). These advantages often lead to investment myopia. By contrast, private enterprises face greater financing constraints. They have fewer opportunities for government assistance, so they tend to make conservative investment decisions. To meet their investment needs, their managers have to reduce corporate dividends and increase retained earnings and internal financing capability. These managers have a strong consciousness of risk. They tend to reduce blind investments, alleviate underinvestment, and improve investment efficiency.

The rest of the paper is organized as follows. Section 2 summarizes previous research on managerial overconfidence, financing decisions, and investment efficiency. Section 3 introduces and develops the hypothesis and explains how our research advances the existing literature. Section 4 provides a detailed description of the sample and data sources. Section 5 presents the empirical results. The final section provides a summary and conclusions.

2. Literature review

The rational behavior of managers was questioned by a school of finance theory that appeared in 1980s. The new behavioral finance literature laid the groundwork for theoretical and empirical research into irrationality among managers and the impact of this on corporate finance. For example, irrational behavior such as overconfidence was applied from cognitive psychology to corporate investment and financial decision-making. Studies showed that, because of their own characteristics and cognitive biases, managers tend to make investment decisions that deviate from maximization of expected utility. Overconfidence is generally a cognitive bias, reflecting a probability to overestimate one's ability to complete tasks and to underestimate one's chance of losing a job. This bias affects corporate finance and investment decisions. Earlier literature, assuming that company managers were fully rational, analyzed the relationship between investment and financing decisions due to an imperfect market caused by conflicts in agency and information asymmetry. However, in real decision-making processes, managers often show irrational features, such as excessive optimism and over confidence, that can have a significant impact on corporate financing and investment strategies.

Previous studies focused mainly on three aspects of the effects of managerial overconfidence on corporate financing decisions. *(1) Managerial overconfidence and financing preference.* Managers' optimism influences their decisions about external financing. Frank and Goyal (2003) found that managers may optimistically overestimate future returns of projects and tend toward over-investment, and as a result they do not always follow the pecking order theory of financing. That is, internal financing is used first; when that is depleted, debt is issued; and when it is no longer sensible to issue more debt, equity is issued. Hackbarth (2003) proposed that when managers' expectations of investment earnings are very high, they are conservative about analyzing future earnings with new shareholders and incline more to debt financing than equity financing. *(2) Managerial overconfidence and capital structure.* Ting et al. (2015) examined CEO characteristics such as overconfidence, age, education, work experience, gender, tenure, network, and whether he or she is a founder. In a sample of 1404 public firms taken before 2012 in Malaysia, they found that CEOs' overconfidence is negatively correlated with their company's debt ratios. *(3) Managerial overconfidence and debt maturity structure.* Previous studies have showed mixed findings. Ben-David et al. (2007) found that companies with overconfident managers tend to invest more, use more debt, and invest in long-term rather than short-term projects. Xiao et al. (2011) also found that companies with overconfident managers have more investment spending and greater long-term debt ratios. But Landier et al. (2009) concluded that overconfident managers would choose short-term debt contracts and rational managers would prefer long-term ones. Yu et al. (2006) studied managerial overconfidence and corporate radical liability behaviors among 1281 companies listed in the China's Shenzhen A-share market from 2001 to 2004 and found that managerial overconfidence was significantly positively correlated with the asset-liability ratio, especially the short-term debt ratio, and with debt maturity structure.

Previous studies on the impact of overconfidence on corporate investment efficiency have shown that overconfident managers tend to overinvest. March and Shapira (1987) found that overconfident managers may have the illusion of control and expand their business empires constantly, underestimating investment risks and overestimating revenues. Heaton (2002) pointed out that even without asymmetric information and agency costs, managerial overconfidence exists on issues related to investment-related cash flows. At different levels of free cash flow, executives' overconfidence can lead to both insufficient investment and excessive investment respectively. Goel and Thakor (2008) found that to some extent, overconfidence can alleviate previously generated investment shortages. Using a sample of 895 Chinese companies from 2002 to 2004, Wang et al. (2008) found a positive correlation between managerial overconfidence and excessive investment. Li et al. (2014) concluded that when managers are overconfident, they overestimate good investment opportunities and unconsciously magnify their benefits but underestimate the likelihood of adverse events. This irrationality leads managers to ignore market factors, which in turn influences the accuracy of their future expectations and results in continued investment expansion on unnecessary projects.

Scholars have done considerable research into managerial overconfidence and financing decisions, but internal financing, as the lowest-cost financing approach, has not been studied in depth. Although scholars have done some empirical researches into managerial overconfidence and investment efficiency, studies of the relationship between managerial confidence and internal financing and of how managerial overconfidence affects investment efficiency funded by internal financing are still very weak. Another important question is whether the effects above are different in diverse enterprise property rights.

Due to China's unique institutional context, the principal-agent problem is not embodied as conflicts between principals and agents in Western countries with highly dispersed shareholding, but as big shareholders' encroaching upon the interests of small and medium shareholders. In Chinese listed companies, almost all top managers, including presidents, managers, general managers, are appointed by controlling shareholders (Wang et al., 2009). Therefore, when a company's decision-making power is in the hand of an overconfident manager appointed by controlling shareholders, he/she is usually reluctant to finance externally out of consideration that the market underestimates the value of the company's shares. Under such circumstances, a company's investment efficiency has higher sensitivity to internal funds.

3. Hypotheses development

3.1. Managerial overconfidence and internal financing

Economists believe that agents normally behave rationally. However, on the basis of a large number of psychological experiments, scholars have found that people exhibit overconfidence when they assess their skills. People tend to exaggerate their own wisdom (Larwood and Whittaker, 1977; Svenson, 1981; Alicke, 1985) and think they are more wise than average. This "better than average" effect is easily extended into economic decision making (Camerer and Dan, 1999). The role of managerial leadership also boosts managers' overconfidence: they can control their company using their own rights and dedicate them to producing self-interested results. Goel and Thakor (2008) developed a model to show overconfident managers are more likely than others to be promoted to CEO. Paredes (2004) used executive compensation as a measure of managerial achievement and found that managers owe their recent success, such as high salaries to their personal ability, which increases their overconfidence. Heaton (2002) supported this view excessive optimism and overconfidence. His results showed that agents easily become optimistic because they believe they are good at controlling and are highly committed.

More and more researchers have recognized the importance of overconfidence bias in business operations. Despite the pecking order theory that companies will prioritize sources of financing on the basis of their costs, Graham and Harvey (2001) showed that most managers believe that they have the ability to control financing decisions and affect business performance. Managers' personal wealth and human capital are typically closely associated with fluctuations in companies' stock prices. From their personal perspectives, managers prefer internal financing because it has the lowest capital cost and limits fluctuations from external borrowing markets and stock markets.

In addition, overconfident managers tend to have controlling illusions about technologies they own and the accuracy of their own judgement. When they make decisions, overconfident managers tend to overestimate the likelihood of success. They also believe that their companies will show good profits and have great potential, and that outside investors underestimate the their actual value. Due to asymmetric information and transaction costs, managers tend to choose internal financing and remain cash inside. Previous studies have also showed that overconfident managers are often associated with a low dividend-payout ratio (Deshmukh et al., 2013). Similarly, Ben-David et al. (2007) found that overconfident CFOs are less likely to pay dividends, supporting the view that overconfident managers prefer internal financing by reducing dividends. Therefore, we propose the following hypothesis:

Hypothesis 1. Manager overconfidence and internal financing are positively correlated.

3.2. Internal financing and investment efficiency

How to improve the efficiency of investment has been a matter of public attention in industry and academia for a long time. In this study, we examine the efficiency of corporate investment by two means: investment scale and non-efficiency investment. The evaluation of investment projects is usually determined by the project's net present value (NPV). If a company invests in projects with negative NPV, this will be viewed as overinvestment; if it abandons projects with positive NPV, this will be viewed as underinvestment. Both overinvestment and underinvestment are classified as inefficient investment. In reality, listed companies often deal

with issues of expansion of investment scale and non-efficiency investments (overinvestment and underinvestment).

Since Schumpeter (1942) reported that companies prefer investing their profits in innovative activities to maintain monopoly power, the importance of internal financing to companies' investment and financing decision-making has been widely studied (Hall, 2002; Hubbard, 1998). The pecking order theory proposed by Myers (1984) showed that internal financing decreases information asymmetry, avoids the adverse selection risks of external financing, and reduces conflicts among corporate stakeholders. When a company's internal financing is abundant, excess free cash flow is generated, so companies can take advantage of excess internal funds for investment. But due to moral hazards, excess free cash flow can also lead to overinvestment, in line with the free cash flow overinvestment theory. When managers, as corporate agents, have excess cash on hand, they may pursue personal interests and expand the investment scale using received funds. This lets managers improve their income, status, and power and build their own "business empires." Renneboog et al. (2007) proposed that there are two types of errors in corporations. The first, or "type I error," is overinvesting when cash flow is sufficient. The second, or "type II error," is underinvesting with a cash flow shortage. Increases in internal financing increase the occurrence of type I errors but reduce type II errors. Reductions in internal financing result in a shortage of free cash flow, so that the cash flow cannot meet the corporation's investment needs. Even if there are investment opportunities or projects with positive NPV, the company will make insufficient investments. Therefore, we propose the following hypotheses:

Hypothesis 2a. Internal financing and business investment scale are positively correlated.

Hypothesis 2b. Internal financing is positively correlated with overinvestment.

Hypothesis 2c. Internal financing is negatively correlated with underinvestment.

3.3. Managerial overconfidence, internal financing and investment efficiency

Managerial overconfidence affects not only financing decisions but investment efficiency (Malmendier and Tate, 2005, 2008). When managers are highly overconfident, they hold optimistic attitudes on the company's prospects and see rises in investment as good news. They therefore improve the level of investment by increasing internal financing in order to improve the company's performance—and to obtain personal benefits. They may mistakenly think that projects with negative NPV have positive NPV. Furthermore, junior managers, who want to quickly establish their reputations to attract investors, are more likely than older managers to improve short-term performance by making companies select non-efficient investments (Baker and Wurgler, 2000). Overconfident managers also believe that their companies' stocks are undervalued in the market, and they tend to overestimate the likelihood of success, so they more easily overinvest using the cash flow generated by future internal financing, and ease the underinvestment caused by shortage of cash flow. In summary, internal financing plays a transmission role between managerial overconfidence and investment efficiency. Therefore, this paper advances the following hypothesis:

Hypothesis 3. Overconfident managers tend to expand the scale of investment by increasing internal financing. This can alleviate shortage of investment but can also lead to overinvestment.

4. Research design

4.1. Sample selection and data sources

The data used in this study are drawn from the China Stock Market. Because of the infrequent trading of the B-shares and their relatively small number, we focus on the A-shares traded on the Shanghai and Shenzhen stock exchanges in 2010–15. The following companies are excluded from this initial sample: (1) listed companies whose profit-forecast reports were undisclosed; (2) companies in the financial sector; (3) delisted companies, ST (Special Treatment) and PT (Particular Transfer) companies on probation as well as other special treatment companies; (4) companies listed after January 1, 2009; (5) companies whose managers were changed within the current year; and (6) companies whose financial data could not be obtained. All the data used in this paper came from the GTA database, WIND database, and annual financial reports of the listed companies.

4.2. Variable definitions

4.2.1. Managerial overconfidence
Psychological bias in managers is difficult to measure directly. Attempts have been made to use managers' decisions and actions as proxies for their confidence. For example, it is believed that an overconfident manager will undertake more mergers and acquisitions, issue more debt, overestimate the firm's future earnings, defer the execution of stock options, and buy more shares of their firm's stocks (Huang and Kisgen, 2013; Ahmed and Duellman, 2013). Prior research has adopted the following measures for managerial overconfidence: (1) CEO's share holdings (Malmendier and Tate, 2005; Yu et al., 2006); (2) frequency of mergers and acquisitions (Doukas and Petmezas, 2007); (3) mass-media comments on managers (Brown and Sarma, 2007; Malmendier and Tate, 2008); (4) corporate earnings forecasts (Hribar and Yang, 2011; Wang et al., 2008); (5) executive compensations (Hayward and Hambrick, 1997; Jiang et al., 2009); and (6) manager characteristics (age, gender, education, tenure, work experience, etc).Taking into account all these measures, and constrained by the availability and reliability of data in China, we believe that corporate earnings forecasts

better reflect the degree of managerial overconfidence. Managers overestimate their abilities and the future performances of their firms. If a company's actual earnings are lower than the earnings expected by managers, we define the managers as overconfident, with a dummy variable of 1, and as not overconfident (= 0) otherwise. In this article, "managers" refers to the CEO, president, and chief manager.

4.2.2. Investment efficiency

Two models are generally used to measure investment efficiency. One was proposed by Vogt (1994), using the interactive term of cash flows and investment opportunities (Tobin's Q). The second was proposed by Richardson (2006), who divided corporate total investment into expected investment and non-expected investment. The determinants of investment include measures of growth opportunities, leverage, firm age, firm size, cash balance, industry-fixed effects, and annual fixed effects. Non-expected investment is measured by residuals between total investment and expected investment. In this paper, we use Richardson's model and develop the expected investment as follows:

$$INV_t = \alpha_0 + \alpha_1 Q_{t-1} + \alpha_2 Cash_{t-1} + \alpha_3 Age_{t-1} + \alpha_4 Size_{t-1} + \alpha_5 Lev_{t-1} + \alpha_6 Return_{t-1} + \alpha_7 INV_{t-1} + \mathscr{E} \tag{1}$$

where INV is total investment expenditure in current year t, calculated as the sum of fixed assets, construction in process, intangible assets, and long-term investments, all scaled by total assets; Q_{t-1} is growth opportunities in the previous year, represented by Tobin's Q; $Cash_{t-1}$ is the balance of cash and short-term investments deflated by total assets measured at the start of the year; Age_{t-1} is the company's age since being listed; $Size_{t-1}$ is the size of the company, measured by natural logarithm of total assets at the beginning of the year; Lev_{t-1} is the financial leverage in the previous year, expressed by total debt ratio; and $Return_{t-1}$ is the rate of stock returns for the year before the investment year. *Industry* and *year* are the dummy variables for industry and year.

Following Richardson (2006), the predicted value in Model (1) is the proxy for the expected investment in year *t*. Positive residuals represent overinvestments, and negative residuals represent under-investments. This paper uses the absolute value of the negative residuals as the degree of underinvestment, as the larger this absolute value is, the more severe the underinvestment. We rank the groups of overinvestment and underinvestment from high to low and select the top 75% of each group, focusing on an overinvestment sample, the cases with severe inefficiency, as represented by *overINV,* and an underinvestment sample, represented by *underINV*. The remaining part is defined as a normal investment sample.

Table 1 summarizes the definitions of variables such as investment scale (*INV*), investment non-efficiency (overinvestment, *overINV*; underinvestment, *underINV*), internal financing (*Intern*), and control variables (company size, *Size*; investment opportunities, *TobinQ*; financial leverage, *Lev*; operation efficiency, *ROA*; profitability, *EPS*; cash holdings, *CF*; ownership concentration, *TOP10*; and *Industry* and *Year* effects).

4.3. Empirical models

Following Baron and Kenny (1986) and Wen et al. (2004), we construct the following equations to test the interactions among managerial overconfidence, internal financing, and investment efficiency:

$$Intern = \alpha_0 + \alpha_1 OC \sum Control + \varepsilon \tag{2}$$

where OC is managerial overconfidence, measured by earnings-forecast bias. If managers overestimate their firms' future earnings, the dummy variable is 1, otherwise it is 0.

Table 1
Descriptions of Variables.

Type	Variable	Symbol	Definition
Dependent Variable	Investment	INV	Total investment expenditure, calculated as the sum of fixed assets, construction in process, intangible assets, and long-term investments, all scaled by total assets
	Overinvestment	overINV	Positive residuals between total investment and expected investment, excluding the bottom 25%
	Underinvestment	underINV	Absolute values of negative residuals between total investment and expected investment, excluding the bottom 25%
Intermediate Variable	Internal financing	Intern	Retained earnings over total assets
Independent Variable	Managerial overconfidence	OC	Managerial overconfidence, measured by earnings-forecast bias. If managers overestimate their firms' future earnings, the dummy variable is 1, otherwise it is 0.
Control Variables	Company size	Size	Size of the company, measured by natural logarithm of total assets.
	Investment opportunities	TobinQ	Tobin's Q
	Financial leverage	Lev	Financial leverage, expressed by total debt ratio.
	Operating results	ROA	Return on assets, as the ratio of net profit over total assets
	Profitability	EPS	Earnings per share, calculated as the ratio of profit after tax over total equity
	Cash holdings	CF	Cash flows from operating activities scaled by total assets
	Ownership concentration	TOP10	% of shares held by top ten shareholders
	Industry effect	Industry	According to the "Industry Classification Guidelines" by China Securities Regulatory Commission, we divide the listed companies by sector.
	Year effect	Year	Six reference variables on the base of 2009

Model (2) examines the relationship between managerial confidence and internal financing, testing Hypothesis 1 that manager overconfidence and internal financing are positively correlated: that the more optimistic managers are about future earnings (when their expected earnings are higher than the actual earnings), the more they would like to invest retained earnings.

$$INV\,(overINV/underINV) = \alpha_0 + \alpha_1 Intern + \sum Control + \varepsilon \tag{3}$$

Model (3) tests Hypotheses 2a, 2b, and 2c: the relationship between investment efficiency and internal financing without the managerial confidence factor. It is expected that internal financing and business investment scale are positively correlated and that internal financing is positively correlated with overinvestment and negatively correlated with underinvestment.

Next, we investigate the relationship between investment efficiency and internal financing, with managerial confidence taken into considerations. This tests Hypothesis 3, that overconfident managers tend to expand the scale of investment by increasing internal financing, alleviating investment shortages but also possibly leading to overinvestment. Our first question is, are investment problems (investment scale, overinvestment or underinvestment) significantly related to managerial overconfidence (Model 4)?

$$INV\,(overINV/underINV) = \alpha_0 + \alpha_1 OC + \sum Control + \varepsilon \tag{4}$$

Second, if manager overconfidence and internal financing are positively correlated (Model 2) and internal financing is related to investment efficiency (Model 3), does managerial overconfidence still cause investment problems beyond its impact on internal financing? If not, internal financing plays a fully intermediary role, carrying all the impact of managerial confidence on investment problems. We thus develop Model (5):

$$INV\,(overINV/underINV) = \alpha_0 + \alpha_1 OC + \alpha_2 Intern + \sum Control + \varepsilon \tag{5}$$

If both α_1 and α_2 are significant, internal financing acts as a partial intermediary. If α_1 is no longer significant, then internal financing acts as a full intermediary.

$$INV\,(overINV/underINV) = \alpha_0 + \alpha_1 Intern + \alpha_2 OC*Intern + \sum Control + \varepsilon \tag{6}$$

We run Model (6) as a robustness check testing the significance of the interactive term *OC*Intern*. If this term is significant, we can conclude that managerial overconfidence causes investment problems through more its impact on internal financing. Otherwise, internal financing acts in a fully intermediary role, carrying all the impact of managerial confidence on investment problems. We examine the interactive term in the state-owned and non-state-owned cases separately.

5. Empirical analysis and results

5.1. Descriptive statistics

Table 2 reports descriptive statistics of the main variables. Panel A shows that there were 3500 firm-year observations from 2010 to 2015, including 248 state-owned and 3252 non-state-owned observations. The mean of internal financing is 1.601 for state-owned and 2.758 for non-state-owned, indicating that non-state enterprises are more likely to use internal financing. The leverage in state-owned enterprises is higher than in non-state-owned ones, consistently with state-owned enterprises getting more favorable external financing and tending to raise debt to finance investments. The mean of Tobin's Q (2.591) and ROA (1.182) for non-state-owned enterprises is higher than for state-owned ones (2.083 and 0.253, respectively).

Panel B shows that 75% of the sample is investment inefficient. There are 1173 overinvestments and 1453 underinvestments. The state-owned sample has 89 overinvestments and 103 underinvestments, and there are 2434 investment-inefficient observations in the non-state-owned sample, including 1084 overinvestments and 1350 underinvestments. The percentage of inefficiency is slightly higher in the state-owned cases ($192/248 = 77.42\%$, vs. $2434/3252 = 74.85\%$). The percentage of managerial overconfidence ($OC = 1$) is 29.17% (56/192) in the state-owned group and 27.03% (658/2434) in the other. Furthermore, investment inefficiency (over- and underinvestment) also occurs in firms without managerial overconfidence. The next section will examine the impact of managerial overconfidence on investments by regression analysis.

5.2. Regression analysis

Manager overconfidence and internal financing are expected to be positively related. The regression results of Model 2 are shown in Table 3. The coefficient of managerial overconfidence is 0.029 for all firms, 0.028 for state-owned firms, and 0.029 for non-state-owned firms. This supports Hypothesis 1, that managers tend to choose internal financing over other sources because they have more control over internal funds. Due to asymmetric information and transaction costs, managers tend to choose internal financing and remain cash inside when they are overconfident and believe that their companies are undervalued by outside investors.

The control variables include company size (*Size*), investment opportunities (*TobinQ*), financial leverage (*Lev*), operating efficiency (*ROA*), profitability (*EPS*), cash flow from operations (*CF*), ownership concentration (*TOP10*), and industry and year variables. The regressions indicate that internal financing is positively related to company size, operating efficiency, and ownership concentration. Debt usage and leverage are negatively related to internal financing in non-state-owned enterprises but are insignificant in state-owned ones. Managers of non-state enterprises often face greater financing constraints in external capital markets than managers of state enterprises.

Table 2
Descriptive Statistics.

Panel A. Full Sample

Variable	Total (N = 3500)		State-owned (N = 248)		Non-state-owned (N = 3252)	
	Mean	STD	Mean	STD	Mean	STD
Intern	2.676	12.708	1.601	7.453	2.758	13.020
INV	0.425	0.219	0.433	0.227	0.424	0.218
Size	21.723	1.072	22.042	1.156	21.698	1.062
Lev	0.437	0.206	0.518	0.197	0.431	0.206
TobinQ	2.555	2.658	2.083	2.353	2.591	2.677
ROA	1.116	3.924	0.253	3.653	1.182	3.937
EPS	0.392	0.532	0.451	0.636	0.387	0.523
CF	0.041	0.088	0.040	0.076	0.041	0.089
TOP10	0.564	0.154	0.559	0.142	0.564	0.155

Panel B. Investment Inefficiency Sample

Overinvestment (overINV)		Underinvestment (underINV)		State-owned				Non-state-owned			
				OC = 1		OC = 0		OC = 1		OC = 0	
				overINV	underINV	overINV	underINV	overINV	underINV	overINV	underINV
Mean	STD	Mean	STD	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
1.956	10.183	2.363	14.432	0.393	1.594	1.814	0.783	2.202	2.338	1.935	2.516
1.020	0.756	−0.815	0.652	0.896	−1.066	1.196	−0.748	1.042	−0.807	1.004	−0.817
21.790	1.110	21.679	1.043	22.212	21.776	22.145	21.887	21.872	21.656	21.715	21.669
0.450	0.204	0.438	0.211	0.544	0.565	0.525	0.504	0.496	0.454	0.423	0.423
2.283	2.588	2.727	2.820	2.023	1.826	1.836	2.365	2.488	2.998	2.247	2.681
0.618	3.026	1.252	4.196	−1.988	0.290	0.515	0.323	0.650	1.221	0.719	1.360
0.369	0.512	0.402	0.459	0.109	0.451	0.533	0.504	0.213	0.246	0.428	0.448
0.047	0.077	0.033	0.095	0.030	0.041	0.052	0.034	0.034	0.014	0.052	0.040
0.567	0.159	0.563	0.153	0.578	0.570	0.523	0.571	0.554	0.533	0.574	0.573
1173		1453		32	24	57	79	302	356	782	994

The data are drawn from the China Stock Market. There were 3500 firm-year observations from 2010 to 2015, including 248 state-owned and 3252 non-state-owned observations. All the data used in this paper came from the GTA database, WIND database, and annual financial reports of the listed companies. Descriptions of these variables are presented in Table 1.

The regression results of Models 3, 4, and 5 are shown in Table 4. The findings of Model 3 include the following: (1) The coefficient of internal financing and investment scale is 0.107. Internal financing is significantly positively related to corporate investment, indicating that the more internal financing, the larger the scale of investments the company will make. (2) The coefficient of internal financing and overinvestment is 0.164, indicating that internal financing and overinvestment have significant positive correlation at the 1% level. Therefore, with more internal financing, companies are more inclined to excessive investment. (3) The coefficient of internal financing and corporate underinvestment is –0.074. (To measure company underinvestment, this paper uses the absolute value of underinvestment: the bigger this is, the greater the company's underinvestment.) Its relationship is significant at the 1% level. Thus, internal financing has a negative relationship with the level of underinvestment: the more internal financing there is, the lower the company's underinvestment. Therefore, internal financing can reduce underinvestment.

Internal financing thus plays a dual role in investments. On the one hand, it can improve investment efficiency by increasing the scale of investment and reducing underinvestment. On the other, it can lead to overinvestment. Hypotheses 2a, 2b, and 2c are all supported.

Model 4 tests the impact of managerial overconfidence on investment efficiency. Investment scale, overinvestment, and underinvestment are dependent variables in the analysis. Consistent with Hao et al. (2005), the results reveal that top managers' overconfident behaviors are positively and significantly related to their companies' investment scale. The regression results also show that managerial overconfidence is significantly positively related to overinvestment and significantly negatively related to underinvestment. This means that investment problems (investment scale, overinvestment or underinvestment) are significantly related to managerial overconfidence.

Managerial overconfidence and internal financing are positively correlated (Model 2), internal financing is related to investment efficiency (Model 3), and managerial overconfidence is directly related to investment efficiency (Model 4). Will managerial overconfidence still cause investment problems other than through its effect on internal financing? If not, internal financing will play a fully intermediary role, carrying all the impact of managerial confidence on investment problems. Model 5 tests the role of internal financing in this dynamic process.

If α_1 and α_2 in Model 5 are both significant, internal financing plays a partial intermediary role. If $\alpha1$ is not significant, internal financing plays a fully intermediary role. The regression results of Model 5 show the following: (1) When internal financing is under

Table 3
Managerial Overconfidence and Internal Financing.

Independent Variables	Internal Financing (INV)					
	All	State-owned	Non-state-owned	All	State-owned	Non-state-owned
OC	0.029**	0.028*	0.029**			
	(2.047)	(1.855)	(2.028)			
Size	0.057***	0.135*	0.052***	0.059***	0.134***	0.054***
	(3.211)	(1.894)	(2.855)	(3.334)	(1.891)	(2.983)
TobinQ	− 0.292***	0.082	− 0.314***	− 0.289***	0.226***	− 0.312***
	(-17.592)	(1.206)	(-18.377)	(-17.481)	(3.863)	(-18.266)
Lev	− 0.221***	− 0.107	− 0.222***	− 0.219***	− 0.108	− 0.220***
	(-13.57)	(-1.520)	(-13.361)	(-13.447)	(-1.532)	(-13.239)
ROA	0.564***	0.395***	0.587***	0.563***	0.397***	0.586***
	(35.617)	(6.756)	(35.605)	(35.550)	(6.857)	(35.545)
EPS	− 0.076***	− 0.114***	− 0.075***	− 0.080***	− 0.111*	− 0.079***
	(-4.896)	(-1.794)	(-4.718)	(-5.234)	(-1.781)	(-5.050)
CF	0.026*	0.057	0.023	0.024*	0.057	0.020
	(1.864)	(0.979)	(1.573)	(1.710)	(0.984)	(1.411)
TOP10	0.028**	0.124**	0.024*	0.027*	0.122**	0.066***
	(2.002)	(2.189)	(1.674)	(1.907)	(2.181)	(4.098)
industry	control	control	control	control	control	control
year	control	control	control	control	control	control
Adj. Rsq	0.359	0.278	0.373	0.358	0.247	0.372
N	3500	248	3252	3500	248	3252

Note: (1) "***", "**", "*", indicate the value is significant at 1%, 5%, 10% level, respectively; (2) Inside() denotes t values; (3) See Table 1 for variable definitions; (4) The regresstions (Model 2) examine the relationship between managerial confidence and internal financing, testing Hypothesis 1 that manager overconfidence and internal financing are positively correlated: that the more optimistic managers are about future earnings (when their expected earnings are higher than the actual earnings), the more they would like to invest retained earnings.

Table 4
Full Sample- Managerial overconfidence, Internal Financing and Investment Inefficiency.

Independent Variable	Investment Size (INV)			Overinvestment (overINV)			Underinvestment (underINV)		
	Model 3	Model 4	Model 5	Model 3	Model 4	Model 5	Model 3	Model 4	Model 5
OC		0.087***	0.085***		0.085**	0.079**		− 0.048**	− 0.004
		(5.966)	(5.855)		(2.331)	(2.102)		(-2.086)	(-0.166)
Intern	0.107***		0.099***	0.164***		0.114***	− 0.074***		− 0.049***
	(6.048)		(5.686)	(4.798)		(3.129)	(-2.695)		(-2.134)
Size	0.161***	0.142***	0.141***	− 0.225***	0.194***	0.188***	− 0.049**	− 0.073***	− 0.074***
	(9.690)	(8.617)	(8.619)	(-6.363)	(5.800)	(5.732)	(-2.137)	(-2.667)	(-2.689)
TobinQ	0.104***	0.090***	0.124***	0.110 ***	0.171***	− 0.218***	− 0.053	− 0.07	− 0.053
	(4.516)	(4.192)	(5.589)	(3.251)	(4.942)	(-6.037)	(-1.004)	(-1.409)	(-1.003)
Lev	− 0.049***	− 0.041***	− 0.029**	0.071 **	0.121***	0.109***	− 0.036*	− 0.045*	0.063***
	(-3.274)	(-2.832)	(-1.974)	(2.120)	(3.760)	(3.437)	(-1.446)	(-1.897)	(2.613)
ROA	0.543***	0.209***	0.149***	− 0.018	− 0.064*	0.041	− 0.104	− 0.072	− 0.104
	(15.283)	(11.710)	(7.266)	(-0.537)	(-1.682)	(0.983)	(-1.329)	(-1.027)	(-1.333)
EPS	− 0.142***	− 0.111***	− 0.104***	0.021	0.021	− 0.001	0.063***	0.067***	0.034***
	(-8.925)	(-6.972)	(-6.555)	(0.665)	(0.577)	(-0.028)	(2.614)	(2.773)	(0.923)
CF	0.239***	0.205***	0.194***	− 0.021	− 0.019	0.005	− 0.028	− 0.007	− 0.029
	(12.716)	(11.208)	(10.535)	(-0.749)	(-0.581)	(0.170)	(-0.598)	(-0.164)	(-0.612)
TOP10	− 0.012	− 0.004	− 0.008	0.088 ***	− 0.039	0.048*	− 0.052**	− 0.053**	− 0.052**
	(-0.800)	(-0.248)	(-0.535)	(3.089)	(-1.298)	(1.615)	(-2.180)	(-2.194)	(-2.185)
industry	control	control	control	control	control	control	control	control	control
year	control	control	control	control	control	control	control	control	control
Adj. Rsq	0.211	0.204	0.211	0.130	0.277	0.328	0.161	0.159	0.161
N	3500	3500	3500	1173	1173	1173	1453	1453	1453

Note: (1) "***", "**", "*", indicate the value is significant at 1%, 5%, 10% level, respectively; (2) Inside() denotes t values; (3) See Table 1 for variable definitions; (4) The regression results of Models 3, 4, and 5 are shown in Table 4. Investment scale, overinvestment, and underinvestment are dependent variables in the analysis. Model 3 tests Hypotheses 2a, 2b, and 2c: the relationship between investment efficiency and internal financing without the managerial confidence factor. Model 4 tests the impact of managerial overconfidence on investment efficiency. Model 5 examines how the dynamics between managerial overconfidence and internal financing affect investment inefficiency. If both α1 (coefficient of OC) and α2 (coefficient of Intern) in Model 5 are significant, internal financing acts as a partial intermediary. If α1 is no longer significant, then internal financing acts as a full intermediary.

Table 5

The Impact of Managerial Overconfidence on Internal Financing and Investment Inefficiency for State-owned and Non-state-owned Enterprises.

Independent Variable	State-owned			Non-state-owned		
	INV	overINV	underINV	INV	overINV	underINV
Intern	0.089	0.292***	−0.069	−0.022	0.066	−0.012
	(0.837)	(3.142)	(-0.891)	(-0.480)	(0.814)	(-0.204)
OC*Intern	0.197***	0.545***	−0.016	−0.028	−0.033	−0.140**
	(2.928)	(2.939)	(-0.193)	(-0.714)	(-0.445)	(-2.128)
Size	0.111*	0.470***	0.355***	0.050**	0.088***	0.157***
	(1.640)	(4.295)	(3.297)	(2.283)	(2.614)	(4.639)
TobinQ	−0.134	0.309***	0.204*	−0.128***	0.178***	−0.061*
	(-0.798)	(2.967)	(1.910)	(-5.906)	(5.391)	(-1.784)
Lev	0.069	0.338*	0.175	−0.078***	0.142***	−0.207***
	(0.426)	(1.892)	(1.077)	(-3.796)	(4.703)	(-6.212)
ROA	−0.562***	0.332***	−0.141	−0.064**	0.018	0.067
	(-6.157v	(3.495 v	(-0.920)	(-2.495)	(0.449)	(1.228)
EPS	−0.127**	−0.209	0.245***	−0.073***	0.040	0.009
	(-2.070)	(-1.249)	(2.716)	(-3.852)	(1.331)	(0.293)
CF	0.145**	0.107	0.156***	0.103***	−0.067***	−0.430***
	(2.371)	(1.252)	(3.359)	(5.987)	(-2.595)	(-14.638)
TOP10	0.035	−0.083	0.057***	−0.054***	0.071***	−0.014
	(0.619)	(-0.913)	(4.128)	(-3.067)	(2.698)	(-0.501)
industry	control	control	control	control	control	control
year	control	control	control	control	control	control
Adj. Rsq	0.282	0.439	0.529	0.099	0.040	0.263
N	248	89	103	3252	1084	1350

Note: (1) "***", "**", "*", indicate the value is significant at 1%, 5%, 10% level, respectively; (2) Inside() denotes t values; (3) See Table 1 for variable definitions; (4) The regression results of Model 6 are shown in Table 5. Investment scale, overinvestment, and underinvestment are dependent variables in the analysis. We run Model (6) as a robustness check testing the significance of the interactive term OC*Intern. If this term is significant, we can conclude that managerial overconfidence causes investment problems through more its impact on internal financing. Otherwise, internal financing acts in a fully intermediary role, carrying all the impact of managerial confidence on investment problems. We examine the interactive term in the state-owned and non-state-owned cases separately.

control, the *T* value of managerial overconfidence and investment decreases slightly, from 5.966 to 5.855. The coefficients of both internal financing and managerial overconfidence are still significantly positive. (2) The *T* value of managerial overconfidence and overinvestment decreases from 2.331 to 2.102. Following the approach of Freedman and Schatzkin (1992), we tested the difference between the coefficients of managerial overconfidence in Model 4 and Model 5. It is significantly different from 0 at the 1% level. In addition, the coefficients of both internal financing and managerial overconfidence are still significantly positive. This means that managerial overconfidence does not affect overinvestment solely through its impact on internal financing. (3) The absolute *T* value of managerial overconfidence and underinvestment decreases from 2.086 to 0.166. The coefficient of managerial overconfidence is not significantly related to underinvestment once the factor of internal financing is added. This shows that overconfident managers alleviate underinvestment through internal financing.

5.3. State-owned enterprises and non-state-owned enterprises

We also tested the impact of internal financing on investment efficiency with overconfident managers in state-owned enterprises and non-state-owned enterprise separately using Model 6. Table 5 shows that among the 248 state-owned firm-year observations, there are 192 investment inefficiencies, including 89 overinvestments and 103 underinvestments. When managers are not overconfident (*OC* = 0), internal financing (*Intern*) is insignificant in relation to investment scale (*INV*) and underinvestments (*underINV*), but significantly positive in relation to overinvestments (*overINV*). However, when managers are overconfident (*OC* = 1), *Intern* is positively significant in relation to *INV*, but still insignificant in relation to *underINV*. The coefficient of internal financing and overinvestments increases from 0.292 to 0.837 (+0.545). Managerial overconfidence leads to more excessive investments.

Among the 3252 non-state-owned firm-year observations, there are 2434 investment inefficiencies, including 1084 overinvestments and 1350 underinvestments. When managers are not overconfident (*OC* = 0), *Intern* is insignificant in relation to *INV*, *underINV*, and *overINV*. However, when managers are overconfident (*OC* = 1), *Intern* is insignificant in relation to *INV* and *overINV*, but negatively significantly in relation to *underINV*. Thus in the non-state-owned sample, managerial overconfidence helps to fund business opportunities by internal financing and to alleviate capital shortages.

6. Conclusions and recommendations

We used non-financial companies listed in China's Shanghai and Shenzhen stock markets from 2010 to 2015 as a sample to explore the impact of managerial overconfidence on internal financing from a behavioral finance perspective. We also examined how

the dynamics between managerial overconfidence and internal financing affect investment inefficiency (investment scales, over-investments, and underinvestments) in state-owned and non-state-owned enterprises.

We found that increased internal financing expands business investment, reduces underinvestment, and thus improves investment efficiency. However, it can also lead to overinvestment. Internal financing is a mediator between managerial overconfidence and investment efficiency. Overconfident managers are more inclined to increase internal financing. Due to the single-dominant-shareholder ownership structure and the absence of efficient corporate governance, managerial overconfidence and overinvestment are intensified in state-owned enterprise. In non-state enterprises, by contrast, they have no significant relationship. Non-state-owned enterprise have poorer access to external financing than state-owned ones, and they face serious financing constraints. Internal financing thus becomes their main source of financing, and investments become more efficient in non-state-owned enterprises.

This study shows that under our special institutional background, managers tend to exhibit "irrational" traits that affect investment decisions and financing efficiency. These findings help us understand the mechanism of internal financing and the effects of managerial overconfidence on specific paths of investment efficiency. Our results not only enrich the literature and empirical research, they provide practical policy implications for enterprises to improve investment efficiency and address the importance of supervision of managerial behaviors, corporate governance, and property-rights systems. A manager whose incentives are perfectly aligned with shareholders and who does not face any informational asymmetries may still overinvest or underinvest if he/she is overconfident. The manager believes that he/her is acting in the best interest of shareholders. Thus, refined corporate governance structures in both state and non-state enterprises, involving a more active board of directors or constraints on the use of internal funds, may be necessary to achieve optimal investment levels.

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