
RELATIONSHIP BETWEEN CEO OVERCONFIDENCE, PAY GAP AND EXTERNAL GUARANTEE

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Abstract

This paper attempts to disclose the intrinsic relationship between CEO overconfidence, pay gap and external guarantee. First, the CEO overconfidence was measured by four personal traits of the CEO, namely, gender, age, education level and tenure. Then, an empirical analysis was performed to disclose the impact of CEO overconfidence on the pay gap of senior executives and the decisions on external guarantee of a listed company. Moreover, the authors analyzed how this impact is regulated by corporate governance mechanism. The results show that the level of CEO overconfidence is negatively correlated with the pay gap of senior executives; the external guarantee of the company is greatly suppressed by CEO overconfidence.

Key words: CEO overconfidence, Pay Gap, External Guarantee, Corporate Governance.

Received: 13-02-19 | Accepted: 01-06-19

INTRODUCTION

In behavioral corporate finance literatures, overconfident CEOs have been shown to have a substantial impact on corporate decision making. The overconfidence concept examined in this study is defined as the tendency of individuals to most overestimate their own abilities and underestimate the risks. For example, overconfident managers tend to overestimate the future returns of their investment projects or underestimate the volatility of uncertain events. There is a series of studies examined the impact of CEO overconfidence on firm performance. However, there is no consistent conclusion to show that the overconfident CEOs would reduce/increase firm value (Malmendier, Tate, & Yan, 2011; Hirshleifer, Low, & Teoh, 2012). It is of important significance to under the corporate decision behavior from the perspective of manager overconfidence. It can promote the

development and perfection of strategic management theory and the corresponding psychology basis, which has provided a solid explanation for the bounded rational or irrational behavior of corporate managers. Previous studies mainly research the managers' overconfident investment and financing behaviors from two aspects, focusing on the external investment behavior. For example, in terms of external behavior, the studies mainly focus on the impact of managerial overconfidence in the context of other areas of corporate activity. The studies had shown that overconfident managers would make investment decisions that result in over investment or under-investment problems. A series of subsequent 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. Malmendier & Tate (2008) found that overconfident managers overestimate their ability to generate returns, they tend to undertake value-destroying mergers. The same evidences that overconfident managers are more acquisitive than other managers (Lee, Lin, Lin et al., 2019). In terms of

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the research on the impact of overconfidence on internal behavior, Malmendier & Tate (2005) empirically use executive stock option exercise behavior to determine confidence levels and find that overconfident CEO's investments are more sensitive to internal cash flow. CEO overconfidence also affects the managers' choice of debt maturity (Graham, Harvey, & Puri, 2013; Huang, Tan & Faff, 2016), overconfident CEOs are more likely to take on short-term debt. Overconfident managers believe that more short-term debt can increase stockholder value, they overestimate the probability of the benefits, that is the refinance lower costs of short-term debt and future arriving favorable news. Existing literatures also argue that firms with overconfident managers have significantly higher leverage ratios, such as dividend policy risk management; management forecasting (Hribar & Yang, 2016); CEO turnover; innovation (Hirshleifer, Low, & Teoh, 2012). Overconfident CEOs prefer internal financing over external capital markets and prefer debt to equity, conditional on access to public securities markets. Some researches verified that overconfident managers would result in over investment from the perspective of internal financing and investment results. Despite there are a large amount of research investigating the concept and impact of overconfidence on financial decision-making, for the effects of managerial character traits on the salary, there is still no clear conclusion. Due to overconfidence and cognitive bias, managers are prone to irrational behaviors such as overestimate future returns or underestimate possible risks and uncertainties during the decision-making process, which would result in second-best choices in business decisions; and the payment issue is a typical internal corporate governance issue of overconfident behavior research. The concept of payment behavior believes that salary is an important reason for the cognitive bias of managers. High salary indicates the success of the manager, but it can further lead to overconfidence. Moreover, managers with a lower-level overconfidence can make more appropriate behavioral decisions and naturally they would demand a higher payment. Social cognition theory believes that the external environment can affect individual behavior by affecting the individual's psychological cognition. Based on this, the managers' cognition of the salary incentive system will also

be reflected in their decision-making behavior, which will ultimately affect their decision-making behavior of external guarantee. Therefore, when irrational factors exist, the set-up of corporate governance mechanism needs to consider the influence of manager overconfidence on salary incentives, and thus the internal decision-making behavior of managers is generated. Now, there are relatively few studies on the pay gap and internal business decisions from the perspective of overconfidence. Accordingly, the primary objective of this study is to examine whether the overconfidence of CEOs is related to the pay gap in the firm, and the generated external guarantee behavior decision-making of the firm. External guarantees are guarantee contracts given by the banks to the related institution for the benefit of natural and legal entities in the country and abroad involving the commitments of the delivery of a good, the completion of a work or a project or the payment of a debt etc., and the commitment of conditional or unconditional payment of the amount of the letter in case of failure of the fulfillment of an action. Therefore, this study attempts to enrich the studies in this field and provide some suggestions for the improvement of the salary incentive system.

In this study, we extend the investigation of the linkage between CEO overconfidence, pay gap, and the external guarantee activity of the overconfident CEO. We argue that CEOs with lower-level overconfidence might receive a higher salary, which has a big pay gap with other managers. This is because compared to CEOs with higher-level overconfidence, CEOs with lower-level overconfidence are more rational in the decision-making, and they can make more appropriate managerial behavior decisions for the company, and thus they would demand a higher salary. CEOs with lower-level overconfidence are more cautious in risk decision making, which are manifested in that they are more conservative in external guarantees, and these two show a significant negative relationship.

This study contributes to the literatures on the association between the CEO overconfidence, the pay gap, and the external guarantee behavior. First, this study connects the stance of literature on overconfidence and pay gap of managers. We find that in the firms, overconfident CEOs are not necessarily able to

get a salary that is higher than the average salary level of the managers, which is shown in the negative correlation between overconfidence and pay gap. Second, overconfident CEOs are more cautious in making external guarantee decisions. Since the guarantee risk cannot bring corresponding benefits, they would prefer a smaller guarantee size, which is in line with the theory of overconfident CEOs that they are willing to take high risks and pursue high returns, and this is not conducive to the governance of the company.

The rest of the paper is structured as follows. Section 2 explains our key hypotheses. Section 3 describes the data and methodology used in the empirical study. Section 4 presents data and the results. Section 5 is the robustness checks and section 6 concludes the research.

HYPOTHESES DEVELOPMENT

According to related literatures measuring the relationship between CEO overconfidence and the pay gap of the firm, and the behaviors of overconfident CEOs in the decisions of external guarantee, it shows that overconfidence cannot bring large pay-gap for high executives. Overconfident CEOs are reluctant to take risks to guarantee for subsidiaries. In their view, it is not in line with their principle of high-risks and high-returns, so they would adopt a conservative external guarantee decision.

This study provides a better understanding of the sources of CEO overconfidence by examining the impact of the firm's pay gap and external guarantee behavioral biases. We investigate the exposure and decisions, and considers the positive impact of the interaction between CEO duality and overconfidence on the internal pay gap. A panel containing data on stock market returns and balance sheets of listed A-shares of 2007–2015 is collected. This paper focuses on analysis of pay gap and the main impact of CEO overconfidence on the external guarantee of the company.

CEO overconfidence and CEO-TMT (Top Management Team) pay gap

In the academic field, although the corporate internal pay gap problem has been receiving much attention for a long time, scholars at home and abroad still have different opinions on it, and no consensus has been concluded yet. The most prominent manifestation of

overconfidence is self-serving bias, and this wrong cognitive bias will be more prominent under the high salary incentive system. The large pay gap with other high executives will be regarded by the manager as a recognition of the organization for his/her abilities, it is a kind of compensation for his/her contribution, and a symbol of his/her rights. The manager would be more confident for this reason, and when his/her confidence exceeds the normal behavioral threshold, it will turn into overconfidence. The managerial power hypothesis believes that the pay gap is a manifestation of higher internal agency costs in the company. In firms with poor corporate governance, the pay gap is larger. The research results of behavioral finance show that due to environmental uncertainty, incomplete information and limited individual ability, various psychological characteristics of managers, such as overconfidence, psychological accounts and risk preferences, will affect the investment decisions of the company. In recent years, under the guidance of relevant policies such as the "pay ceiling" and the "eight-point austerity rules", more and more company are paying attention to the salary gap between CEO and TMT when formulating manager performance compensation, so as to avoid excessive investment and other behaviors that harm the interests of the company due to the overconfidence of managers. Therefore, from the perspective of the CEO's personal traits, this paper discusses the characteristics of CEO overconfidence and its impact on the sensitivity of pay gap. Effective corporate governance mechanisms have a positive effect on mitigating agency problems and managers' cognitive bias. CEO overconfidence appears to have an impact on the firm and CEO-TMT pay gap. The expansion of CEO's power may lead to CEO overconfidence, weakening the supervision of the board of directors, and the CEO will further control the board and intervene the formulation of the his/her own salary contract, thus aggravating the agency problem and weakening the supervision of the board of directors. On the other hand, CEOs with lower-level overconfidence are more rational in corporate decision-making. They won't take risks to obtain higher returns, and they are more stable and calmer in behavioral decision-making. Such CEOs naturally receive higher payment, so the manager pay gap becomes larger. Thus, we propose our first hypothesis:

Hypothesis 1. The CEO's level of overconfidence is negatively correlated with the pay gap.

We categorize the personal traits of CEOs into four types: gender, age, tenure and education level (the definitions are shown in Table 1), according to formula (1), a measure of executive overconfidence (Overconf) was constructed, and we apply this method to explore the impact of executive overconfidence on the pay gap and external guarantee over the period of 2003–2015. We estimate a measure for CEO overconfidence to understand the relationship between CEO overconfidence, the pay gap, and the external guarantee behavior decision made by overconfident CEOs. We develop hypothesis tests related to the expected impact of firms with overconfident CEOs when the pay gap is large. Previous studies have shown that overconfident CEOs are more willing to undertake risky projects as they often overestimate the benefits and underestimate the risks. Overconfident CEOs also tend to be convinced of their ability to obtain higher returns from their investment projects (Campbell, Gallmeyer, Johnson et al., 2011). Listed companies' guarantee for subsidiaries would increase the risks of the company, but it won't bring more potential profits, therefore, overconfident CEOs may be reluctant to make such low-return, high-risk decisions. According to these results, we thus propose our second hypothesis. Therefore, for CEOs with higher-level overconfidence, when making internal risk decisions, they are not willing to make more guarantees because the company cannot obtain higher returns from its external guarantees for the subsidiaries.

Hypothesis 2: There is a negative relationship between CEO overconfidence and firm external guarantee behavior.

DATA AND VARIABLE DEFINITION

To exam the hypotheses developed in the previous section, it's necessary to collect the proxies of measuring CEO overconfidence, firm pay gap, external guarantee measures, the firms' characteristics, and corporate governance variables. In this section, we would illustrate the data resource, the measuring procedures of CEO overconfidence, pay gap, and the level of external guarantee measures. A proxy based on the CEO personal traits for the measurement of

CEO overconfidence was constructed, and the data was drawn from the CSMAR database between 2003 and 2015. The balanced panel data of listed companies in Shanghai and Shenzhen stock markets from January 1, 2003 to December 31, 2017 was selected as the sample data, since there is certain delay in the implementation effect of salary incentives, the financial data of 2002-2016 was selected. To measure the external guarantee, we employ the data of the guarantee size of the subsidiaries that come from the CSMAR database. The sample data was gradually screened according to the following criteria: excluding the financial industry and ST, * ST, PT companies; excluding companies whose data is incomplete; excluding IPO companies of the current year; in order to avoid the potential impact of extreme values on the results, each pair of data of main continuous variables was subject to the Winsorize processing, and finally the observation values of balanced panel of 8661 enterprise samples were obtained. The sample data were come from the CSMAR database, the Wind Database, and the annual reports of the enterprises, and the stata116 software was adopted for data processing. Combining with the research purpose of this paper, we limit the CEOs to the general manager, the president, or the chief executive officer.

Measures of overconfidence

People tend to be overconfident or optimistic about what they can control, or what they have promised. Corporate managers with this feature have a risk-taking tendency, they are more likely to succeed (they may fail as well), and their probability of becoming a top manager or entrepreneur is higher. This paper is consistent with the definitions in previous corporate financial literatures (Hirshleifer, Low, & Teoh, 2012), and defines overconfidence as that one subjectively thinks that he/she is better than his/her real self in ability, judgment, and the expectation of success, etc.

Measurement of overconfidence

Overconfidence is a psychological feature of business managers, the research of Gervais et al. (2002) show that managers of American companies tend to overestimate their abilities and are willing to invest in riskier projects due to overconfidence, but the failure of the project would bring loss to the company. In general,

overconfident managers would overestimate their abilities and underestimate the risks of external guarantees, so overconfident managers tend to make excessive external guarantees. Since the research focus of this paper is CEO overconfidence and its impact on the pay gap and the company's external guarantee behavior, this paper defines overconfidence as that one subjectively thinks that he/she is better than his/her real self in ability, judgment, and the expectation of success, which is consistent with the definition in previous corporate financial literatures. In current financial literatures, scholars mainly measure the three related economic variables as follows:

The first method is the stock option measurement, which takes the data of company stocks and stock options as an indicator to measure the manager overconfidence of the company. If the company manager who got option incentives from the company does not exercise the right after the option expires, or even buys the company stock during the term of office, it can be considered that he/she is optimistic about the company's follow-up operations, and believes that the company's value will further increase, indicating that the manager is overconfident about his/her own management level (Lee, Lin, Lin et al., 2019). However, the existing research found that ownership concentration has a positive impact on the level of overconfidence of the executives. At the same time, due to China's special social system, the management team may hold the options or the shock equity to maintain the controlling interest or they can't reduce the holding shares because of the law or restrictions, so this does not apply to this paper.

The second method is the external mainstream media evaluation. We can infer whether a manager is overconfident or not through the descriptions in media articles about the manager. In the media description, if the frequency of words such as "optimistic" or "confident" is more than that of words such as "cautious" and "conservative", then the manager is considered to be overconfident (Malmendier & Tate, 2008; Malmendier, Tate, & Yan, 2011). This kind of media evaluation method is widely used by foreign scholars, the evaluation of external mainstream media depends on the preference of the media, but it's not a good measuring indicator for the overconfidence of executives in China since

there is a lack of relevant domestic database.

The third method is earnings estimate deviation, which judges whether a manager is overconfident or not according to the prediction result of the company's future earnings. If the manager's forecast of the company's earnings is higher than the actual income, the manager is considered to be overconfident and overestimate his/her own management ability (Hribar & Yang, 2016). However, currently, in China, literatures have found that the earnings estimate of listed companies are surprisingly accurate, which can hardly be used to measure overconfidence. This is because China's listed companies rarely make earnings estimate in advance, most of the earnings estimate are released near the performance disclosure, at this time, the CEO has already known the actual performance of the company, so this measuring indicator has certain deviation.

The advantage of the above indicator is that the data is easy to get, but has a lot of noise, and it is impossible to accurately measure the level of overconfidence of the managers. In addition, when we study the interaction of the executive pay gap, the executive overconfidence, and the external guarantee behavior, the salary of the manager itself is affected by his/her overconfidence, so the related analysis can hardly solve the collinearity problem that independent variables are highly correlated with each other. The questionnaire survey method that is commonly used in psychology studies cannot be applied to the research on enterprise managers, therefore, researchers have to use some indirect indicators instead of direct measurement.

Recent studies found that the heterogeneity of personal background characteristics has a good explanatory power for the degree of overconfidence and the behavioral decision-making pattern. In terms of individuals, the influencing factors of manager overconfidence are mainly demographic characteristics such as the manager's gender, education level, experience, tenure, age etc. The existed found that CEO's age and educational background would affect his/her decision-making pattern. Older CEOs are more conservative, while MBA managers tend to make more radical decisions; the study confirmed that overconfidence is affected by personal factors such as the age, or whether the individual is the founder of the company, etc.; the existing paper proved that

the personal traits of the chairman such as age, tenure, education level and educational background are related to the degree of overconfidence, which in turn significantly affects the company's choice of the level of debt. Based on these studies, this paper argues that for the measure of CEO overconfidence, we can construct measuring indicators based on the personal traits of the CEO. Moreover, the objectivity of the CEO's personal traits can solve the subjectivity and uncertainty of psychological measurement, and it also solves the endogeneity problem in empirical analysis.

Age. According to psychological research, with the increase of age, the individual's basic cognitive abilities such as memory, information processing speed, and attention capacity show significant differences. As people grow older, their social and life experience become richer and their mentality becomes more mature and stable, so it's more likely that they can conduct multi-angle rational analysis when making related decisions. For young people, middle aged people, and old people, there are significant differences in young people, middle aged people, and old people's willingness to take risks; young people are more willing to take risks and pursue earnings, in contrast, middle-aged and old people are more willing to bear the risk of loss. The study found that the overconfident behavior of older managers is significantly reduced because they constantly correct their judgment of their own abilities from past investment experience, and thus reducing judgmental bias caused by the overestimation of their abilities and knowledge. As a result, we believe that the degree of overconfidence of managers will decrease with the growth of age.

Gender. Some studies found that gender is an important factor causing decision-making differences of company managers. Men have characteristics such as self-reliant, arbitrary, enterprising, competitive, etc., while women are more elegant, gentle, and meticulous. In terms of the degree of overconfidence, men are significantly higher than women. Therefore, currently the number of male executives is significantly more than that of female executives, and existing research has also found that male executives are more confident than female executives.

Education level. Higher education level would make the individuals become more stable and implicit, and be more rational and logical when analyzing things, and it can inhibit irrational behaviors of the individuals such as overconfidence. For instance, the study shows that the lower the education level of the chairman, the higher the degree of overconfidence. Therefore, we believe that the degree of overconfidence of the managers will be improved as the education level of the managers increases.

Tenure. The time of appointment of a company's executives has a significant impact on both the managers and the risk level. Most CEOs are ambitious in the early stages of their tenure, but after gaining some achievements and a firm foothold, they would gradually relax with the progress of the tenure; and the study believes that during the later stage of the tenure, they would tend to avoid risks, keep steady, and be insensitive to the changes in the external environment. Therefore, executives have different attitudes toward targets and risks in different stages of their tenure, the longer the executives are in their term of office, the more likely they can keep rational. As a result, executives will demand more salary, and will be more rational in their risk decisions, and thus the objectivity of external guarantee decisions will be enhanced.

Therefore, according to the existing literatures on the indicators of overconfidence of managers and the actual situation of Chinese listed companies, this paper selects four personal traits of gender, age, tenure and education level (the definitions are shown in Table 1) to construct a measure of executive overconfidence (Overconf) according to Formula (1), smaller value indicates lower degree of overconfidence, and higher level of rationality.

$$\text{Overconf}_{i,t} = w_1 Dg\text{end}_{i,t} + w_2 Dage_{i,t} + w_3 Dgegr_{i,t} + w_4 Dtime_{i,t} \left(\sum_{i=1}^4 w_i = 1 \right) \quad (1)$$

In this paper, we choose the principal component method to determine the weights of the four sub-variables in Formula (1) respectively. At first, the four sub-variables in Table 1 were subject to the principal component analysis, and

Table 1. Variable of personal characteristics of CEO

Variable	Variable definition	Calculation method
Dgend	gender	male=1, female=0
Dage	age	4, under 30 years old; 3, 30-40 years old; 2, 41-50 years old; 1, 51-60 years old; 0, over 60 years old
Dgegr	education level	0, doctor; 1, master; 2, undergraduate; 3, junior college; 4, technical secondary school and below
Dtime	tenure	4, within 12 months; 3, 12-24 months; 2, 24-36 months; 1, 36-48 months, 0, under 48 months

Date source: collected by the author

Table 2. Weights of overconfidence indicator obtained via principal component analysis

Variable	Comp1	Comp2	Comp3	Comp4	Cumulative	weight
Dgend	0.0017	-0.7555	0.6495	0.0854	0.3053	0.3053
Dage	0.704	0.0498	-0.037	0.7075	0.5594	0.2542
Dgegr	-0.3668	0.5824	0.6315	0.357	0.8047	0.2453
Dtenure	0.6081	0.2958	0.4218	-0.604	1	0.1953

the principal component variance contribution rate of each variable was obtained; then the normalization processing was conducted and the weight coefficients of each variable were obtained. The weights of the variables determined by the principal component analysis are shown in Table 2, and the analysis of the correlations among the indicators of principal component analysis is shown in Table 3:

Table 3. Correlations among indicators of principal component analysis

	Gender	Age	Education level	Tenure
Dgend	1			
Dage	-0.0131*	1		
Dgegr	-0.0219*	-0.1114*	1	
Dtenure	0.0026	0.1887*	-0.0042	1
	0.6469	0	0.4625	

Pay gap indicator: internal pay gap of executives

This paper uses the following method to measure the internal pay gap of executives, and draws on the method proposed by existing researches; it uses the differences between the salary of CEO and the average salary of TMT (exclude CEO) to represent the internal pay gap of executives TMTGAP. For the measurement of the pay gap, the absolute gap (the natural logarithm of the difference in the salaries of the two) and the relative gap (the ratio of the salaries of the two) can be adopted, and larger value indicates greater pay gap. In the

robustness test, the absolute pay gap was adopted, then to eliminate the impact of data dimension, the natural logarithm of the absolute pay gap was taken. Unlike the United States, the share-based payment of Chinese companies has smaller coverage and ratio, so the share-based payment is not included in the salary in this paper, but in the regression, the executives' shareholdings are controlled. Therefore, the measurement of the pay gap has formed the following two indicators:

Relative pay gap of TMT (TMTGAP1) = general manager salary / average salary of the management team

Absolute pay gap of TMT (TMTGAP2) = Ln (general manager salary - average salary of the management team)

Measure of external guarantee

The external guarantee of a listed company refers to the direct or indirect guarantee provided by the listed company for the loans of other companies. China's company law stipulates that listed companies' external guarantees must be approved by the board of shareholders or the board of directors. The company CEOs may participate in the decision of external guarantees because they have seats in the board of shareholders or the board of directors. The guarantee for subsidiaries is the most common form of listed companies' external guarantee, and executives with a lower-level overconfidence tend to avoid risks when making decisions. Therefore, this paper takes the subsidiary guarantee size (Subgua) as the

guarantee dependent variable, the subsidiary guarantee size refers to the proportion of the subsidiary guarantee amount to the total assets by the end of the period, in the robustness test, the high-risk guarantee was applied.

The control variables

The regression model of hypothesis testing includes the control variables contain the firm accounting data obtained from the CSMAR database during the period 2003-2017. In the sample firms, we take the log of total assets as SIZE; the size of the company affects the salary of the managers, the ability to assume external responsibility, and the external guarantee behavior. The ratio of the book value of debt to the market value of equity is taken as the leverage ratio (LEV). The asset-liability ratio represents the company's attitude towards liabilities. The company's financial leverage is one of the measures for the company's ability to bear external guarantee, and it has an impact on the company's external guarantee decisions. As the company's high debt ratio may limit its external guarantee ability, the coefficient of LEV is expected to be negative; the proxy of ROA (return on assets) which is a ratio of net income to total assets is taken as the control variable; TWO represents the CEO duality situation, that

is, the value takes 1 when the chairman and the general manager is the same person; otherwise it takes 0; INDD is the proportion of independent directors in the board of directors; AGE is the company's listing period. The age and scale of the enterprise are important influencing factors of organizational inertia. The greater the age and scale of the enterprise, the more discretionary power of the managers will be constrained, and thus it will further affect the relationship between the overconfidence of the company executives, the pay gap, and the external guarantee. The age and size of the enterprise will weaken the positive correlation between manager overconfidence and corporate risk taking. *Industry* is the industry variable; its value takes 1 in case of manufacturing industry, and takes 0 in case of other industries; *Year* is the factor of year. The definitions of the basic variables are shown in Table 4. In order to control possible endogeneity problems, all explanatory variables were lagged for one period.

Model design

First, a basic model for the overconfidence, the internal pay gap of executives and the control variables is established:

$$TMGAP = \alpha_i + \beta * OVERCONF + CONTROLS_{it} + \varepsilon_{it} \quad (2)$$

Table 4. Variables

	Variable name	Variable definition	Calculation method
Firm feature control variables	LNSIZE	Firm size	The standardized value of the logarithm of the total assets is taken as a measure of the size of the firm
	LEV	Asset-liability ratio	Year t, total liabilities / total assets
	ROE	Return on equity	Year t, net profit / shareholder equity balance
	SO	State-owned shareholding ratio	Ratio of state-owned shares to the total shares
	SHARE	Whether executives hold shares	The values take 1 in case there are state-owned shares, otherwise it takes 0.
	INDEP	Proportion of independent directors	By the end of year t, the number of independent directors/the total number of company directors
Firm governance control variables	TWO	CEO duality	The value takes 1 in case the chairman and the general manager are the same person, otherwise it takes 0.
	FIRMAGE	Firm's listing period	The year of the sample - the year the firm was founded
	SOE	Whether the enterprise is state-owned	The value takes 1 in case the firm is stated-owned, otherwise takes 0.
	YEAR	Year	The value takes 1 in case the sample belongs to a certain year; otherwise it takes 0; this variable controls the time-fixed effect.
	INDU	Industry	According to the industry classification standard of the CSRC (China Securities Regulatory Commission), the industries are divided into 12 categories, which are represented by 11 industry dummy variables to control the differences in the industry. The value takes 1 in case the sample belongs to the manufacturing industry, otherwise it takes 0.

Table 5. Statistics of overconfidence sample by year

Year	Total	Dgend		Dage		Dgegr		Dtenure	
		Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
2003	3	1	0	2.6667	0.5774	1.6667	0.5774	3.6667	0.5774
2004	4	1	0	2	0.8165	2.25	0.5	2.5	1.291
2005	356	0.9522	0.2135	1.9607	0.6827	1.7809	0.8606	1.941	1.2823
2006	408	0.9706	0.1692	1.951	0.6742	1.6299	0.8311	1.5735	1.4652
2007	435	0.9609	0.194	1.8736	0.6721	1.5724	0.8376	1.4529	1.5419
2008	464	0.9569	0.2033	1.8599	0.6892	1.5991	0.8562	1.5022	1.5287
2009	482	0.944	0.2302	1.8133	0.6689	1.6183	0.8624	1.417	1.5254
2010	520	0.95	0.2182	1.775	0.6491	1.6231	0.8846	1.3731	1.4857
2011	495	0.9414	0.2351	1.7677	0.6524	1.5535	0.8889	1.3556	1.4972
2012	744	0.953	0.2119	1.7204	0.6783	1.6008	0.8777	1.246	1.4684
2013	790	0.9392	0.239	1.681	0.6657	1.6	0.8674	1.3051	1.5286
2014	843	0.9407	0.2363	1.6026	0.6752	1.5753	0.8567	1.2432	1.5684
2015	919	0.9402	0.2373	1.5506	0.7043	1.543	0.8556	1.3689	1.5704
2016	1048	0.9456	0.2269	1.5487	0.6893	1.5258	0.8561	1.5601	1.5795
2017	1150	0.9365	0.2439	1.5374	0.7104	1.5104	0.8557	1.5591	1.5463

Finally, a model for the overconfidence, the scale of the company's external guarantees for subsidiaries, and the control variables is constructed:

$$SUBGUA = \alpha_i + \beta * OVERCONF + CONTROLS_{it} + \varepsilon_{it} \quad (3)$$

DATA DESCRIPTION AND RESULTS

Descriptive statistics

The personal traits of the CEO

A descriptive statistical analysis of the personal traits of the CEOs in all sample companies (including companies with external guarantees and without external guarantees) was conducted and the results are shown in Table 5. By comparing the changes in the mean and variance of different years we can know the trends of personal traits of CEOs in Chinese listed companies in the sample spacing.

Table 5 shows the personal traits of the sample company executives. We made a descriptive statistical analysis of the personal traits of CEOs in all sample companies, the list in above table shows the changes in the mean and variance of different years, from this we can see the trends in the personal traits of CEOs in Chinese listed companies in recent 15 years. Table 5 shows that the proportion of male CEOs in Chinese listed companies was 100% in 2003 and now this number is 93.65%, and the decrease of this number in the past 15 years indicates that females are gradually joining the ranks of company CEOs. The average age of CEOs

is between 40 and 50 years old, and there is a gradual increase in this data. The average education level is higher than bachelor and is increasing year by year, indicating that the companies are paying more attention to the academic qualifications of CEOs when selecting or promoting CEOs. The average office term of directors is about three and a half years, and the mobility is relatively low.

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Table 6. Descriptive statistics of main variables

Variable	Obs	Mean	Std. Dev.	Min	Max
OVERCONF	8,661	1.3840	0.4174	0.5506	2.3397
TMTGAP2	8,661	11.9293	1.1603	8.6305	14.8591
TMTGAP1	8,661	1.6533	0.5929	1.0294	4.4689
SUBGUA	8,661	0.4394	0.0653	0.0101	0.6287
LEV	8,661	0.5019	0.1820	0.1051	0.8855
LNSIZE	8,661	22.1580	1.1740	19.9606	25.8100
ROE	8,661	0.0381	0.0659	-0.2233	0.2639
INDEP	8,661	0.3694	0.0530	0.2941	0.5714
SHARE	8,661	0.0450	0.1056	0.0000	0.5126
SO	8,661	0.0793	0.1654	0.0000	0.6630
FIRMAGE	8,661	9.3814	5.8280	1.0000	23.0000
TWO	8,661	0.2266	0.4187	0.0000	1.0000
SOE	8,661	0.2112	0.4082	0.0000	1.0000

Table 7. Main regression results

	Pay gap			External guarantee		
	Total	State-owned	Non-state-owned	Total	State-owned	Non-state-owned
OVERCONF	-0.286*** [0.0404]	-0.328*** [0.0889]	-0.289*** [0.0478]	-0.00000797* [0.0000]	-0.00000228** [0.0000]	-6.59E-07 [0.0000]
TWO	0.104 [0.0533]			0.000000199 [0.0000]		
LEV	-0.482*** [0.1223]	-1.144*** [0.2716]	-0.443** [0.1457]	0.00000873*** [0.0000]	0.000000727 [0.0000]	0.0000104*** [0.0000]
LNSIZE	0.223*** [0.0339]	0.233** [0.0708]	0.208*** [0.0416]	0.000000992* [0.0000]	0.000000224 [0.0000]	0.00000132** [0.0000]
ROE	0.807*** [0.1656]	0.926** [0.2975]	0.697*** [0.1962]	-1.94E-07 [0.0000]	-0.00000241 [0.0000]	0.000000482 [0.0000]
_cons	6.612*** [0.8843]	6.240*** [1.5839]	8.209*** [0.9385]	-0.0000244** [0.0000]	-0.0000115 [0.0000]	-0.0000266* [0.0000]
frim	control	control	control	control	control	control
year	control	control	control	control	control	control
N	8661	1829	6832	8661	1829	6832
adj. R-sq	0.1892	0.234	0.1471	0.0401	0.028	0.0508
AIC	15851.3	2598	12387.6	-187733	-40405.7	-148216
BIC	15985.6	2697.2	12496.9	-187591.7	-40306.4	-148106.7

Descriptive statistics of main variables

Table 6 shows the results of descriptive statistics of main variables. In the total sample, for the dependent variable the internal pay gap, the mean of absolute pay gap was 11.9293 and the mean of relative pay gap was 1.6533; and the values of the standard deviation of the two were 1.1603 and 0.5929 respectively, this indicates that the gap between the CEO's salary and the management's average salary is relatively large; the mean of the overconfidence score was 1.384 and the maximum was 2.3397, and this indicates that there are large differences in the personal traits of Chinese CEOs and overconfident CEOs are quite common; the mean of the score of the guarantees of subsidiaries was 0.4394, and the standard deviation was 0.0653, indicating that listed companies that would guarantee for their

subsidiaries are not common. In general, the conditions reflected by Table 6 has provided a preliminary verification for the hypotheses in this paper.

Results of empirical analysis

The structure of the relationship between manager overconfidence, pay gap, and corporate external guarantee behavior is shown in Table 7, which contains research hypotheses for the two questions of this paper. Due to different nature of the company, the research conclusions might be different as well. The overall test result of the impact of overconfidence on the pay gap shows that the p value was 0.000, indicating that the model has a good fitting degree and its ability to interpret the variables is relatively good. In general, model 1

examines the relationship between CEO overconfidence and internal pay gap, CEO overconfidence has a significant inhibitory effect on the pay gap, that is, the two exhibits a negative correlation ($\beta = -0.286$, $p < 0.001$), so hypothesis 1 has been verified to be valid. This shows that the characteristics of overconfident CEOs of overestimating benefits and underestimating risks might not be able to achieve high returns for the company, and therefore it cannot bring extra high salary for the CEOs, which is in line with the pay ceiling policy of the central government. Compared to CEOs with higher-level overconfidence, CEOs with lower-level overconfidence are more likely to receive a higher payment. Taking into account the nature of state-owned and non-state-owned enterprises, the results show that both support the argument of hypothesis 1. Model 2 examines the relationship between CEO overconfidence and corporate external guarantee behavior. Overconfidence has a significant inhibitory effect on the scale of corporate external guarantees ($\beta = -0.00000797$, $p < 0.05$), and hypothesis 2 has been verified to be valid. This may be because overconfident CEOs are more adventurous in investment behavior and they are not willing to take on additional risks for the development of subsidiaries. In the test of the nature of subsidiaries, the research results of state-owned enterprises support hypothesis 2, but private-owned enterprises do not support it, this might be because that in private enterprises, the decision-making power of the board of shareholders is obviously higher than that of the CEO when making external guarantee decisions, so the external guarantee behavior is not affected by the personal traits of the CEO.

ROBUSTNESS TEST

The robustness test mainly considers the alternatives of the measurement methods of pay gap and external guarantee behavior indicators. At present, there is no unified standard for the measurement method of the internal pay gap of executives, there are mainly the relative pay gap and the absolute pay gap. Based on previous paragraph, the relative pay gap was adopted in the panel data test, the absolute pay gap was adopted in the robustness test, and the empirical test results are consistent with the conclusions of this paper, as shown in Table 8. The external guarantee behavior indicator was

replaced by high-risk guarantee, including “the amount of guarantee provided to shareholders, actual controllers and their related parties”, “the amount of debt guarantee provided directly or indirectly to the guaranteed object whose asset-liability ratio exceeds 70%”, and the “amount of the total guarantee exceeds 50% of the net assets”, as long as any of the above-mentioned situation exists, it is considered a high-risk guarantee. The empirical test result is not consistent with the hypothesis, a possible reason is that the overconfident CEOs themselves would prefer projects with high-risks and high-returns, they lay stress on the returns, and will deliberately avoid the guarantee risks.

Table 8. Robustness test

	Salary	High-risk guarantee
OVERCONF	-0.111*** [0.0244]	-0.00776 [0.0050]
TWO	0.106** [0.0339]	0.00774 [0.0060]
LEV	-0.0518 [0.0706]	0.0590*** [0.0171]
LNSIZE	0.00487 [0.0207]	0.0148** [0.0047]
INDEP	0.0247 [0.1940]	-0.0423 [0.0368]
SHARE	-0.172 [0.1952]	-0.0334 [0.0513]
SO	0.0379 [0.0613]	-0.0227 [0.0144]
FIRMAGE	0.0193 [0.0242]	-0.00932 [0.0111]
_cons	1.458** [0.4925]	0.149 [0.3616]
N	8661	8661
adj. R-sq	0.0116	0.0327
AIC	7217.5	-16868.5
BIC	7373	-16713

Standard errors in brackets, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CONCLUSION

Based on the principal-agent theory, this paper adopted the personal traits of CEOs to measure their overconfidence. Through empirical research, it is found that CEO overconfidence has a negative correlation with the internal pay gap; this negative correlation indicates that the behavioral decisions of current CEOs gradually become rational, and the consequences of this rationality are manifested in the external guarantee behavior, they attach great importance to the risk of the company, so overconfident CEOs are more reluctant to

provide guarantees to the subsidiaries. This further indicates that overconfident CEOs pay more attention to the high returns brought by the high-risk decisions to the enterprise, in contrast, in terms of the subsidiary guarantee behavior with higher-risk and fewer potential returns, the CEOs tend to be more rational. This paper not only enriches the research on the manager overconfidence in the field of company financial behavior, but also fills the studies on the manager pay gap in the field of corporate governance. In particular, it also has certain enlightening significance in perfecting the internal governance mechanism of Chinese enterprises. Future research can be appropriately extended to explore issues such as whether there are certain correlations between the salary-performance sensitivity of entrepreneurs with overconfidence or low-confidence and the company risks.

Acknowledgements

The work of the paper is supported by the natural science fund NO.2018A030313470 in Guangdong and research platform and projects of Guangdong education department NO.2018GWTSCX053.

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