



The Battle for Market Share: How Product Market Competition Shapes the Effect of CEO Overconfidence on Firm Risk

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Abstract: This study uses a sample of Chinese listed firms to examine how overconfident CEOs influence firm risk, with product market competitiveness serving as a moderator. The findings of this investigation reveal that firms led by overconfident CEOs are more likely to have very volatile stock returns and cash flows, which runs counter to the predictions of traditional agency theories that assume agents are rational and risk averse. The results also demonstrate that non-state-owned firms are particularly susceptible to the unfavorable effects of overconfidence. Furthermore, except for state-owned firms, a competitive industrial environment may mitigate the negative consequences of CEO overconfidence. These outcomes suggest policy makers and regulators to formulate strategies for promoting stronger competition in the industry.

Key words: Overconfidence, Firm risk, External governance, Product market competition, China

1. Introduction

The fundamental tenet of conventional corporate finance theories is that all agents are completely rational and capable of maximizing utility. However, recent advancements in the field of behavioral sciences have revealed that managers frequently develop irrational ideas and subsequently act in unreasonable and erratic ways by putting those ideas into effect. It implies that executives' choice of action may be influenced by their cognitive qualities. Behavioral studies in corporate finance have identified overconfidence as one of the most pervasive forms of executive cognitive bias. The literature has identified four ways this psychological bias manifests. First is miscalibration or, more commonly, over precision. It describes executives' propensity to have unwarranted faith in the accuracy and precision of their judgments. Miscalibrated executives tend to provide overly narrow confidence intervals for their predictions, indicating a lack of awareness of the uncertainty surrounding their estimates (Dunning et al., 1990; Fabricius & Büttgen, 2013; Griffin et al., 1990). The Second form of overconfidence is overestimation. It arises when those making choices overstate their competence and act as though they had complete command over exceedingly improbable circumstances (Bollaert & Petit, 2010; Moore & Healy, 2008; Moores & Chang, 2009; Vancouver et al., 2002). Third form of overconfidence is called over placement, where executives believe that they possess superior skills and qualities as compared their competitors (Brown, 1986; Camerer & Lovallo, 1999; Kahneman & Lovallo, 1993; Merkle & Weber, 2011). The fourth form of

overconfidence is over optimism. It entails underestimating the likelihood of adverse events and overestimating the probability of positive outcomes (Taylor & Brown, 1988).

A number of corporate decisions including mergers (Malmendier & Tate, 2008), overinvestment (Park & Chung, 2016), managerial forecasts (Hribar & Yang, 2016), maturity of debt (Huang et al., 2016), innovation ambidexterity (Wong et al., 2017), and cash concentrates (Aktas et al., 2019), have been linked to CEO overconfidence in prior studies. Despite the importance of risk to decision making and the dire consequences it may have on a company's lifespan and performance, only a handful of investigations (e.g. Ali & Tauni, 2021; Kim et al., 2016; Li & Tang, 2010) examine the function of overconfidence in determining corporate risk level. In the corporate world, where upholding the rights of shareholders is a top priority, risk taking is an issue of prime importance. Taking risks is essential but decisions that expose the company to unnecessary risk might eventually cause financial difficulties or even lead to bankruptcy. Overconfident CEOs are more likely to ignore warning signs of impending failure and overestimate their chances of success when making investments, according to studies of cognitive biases among corporate leaders. Consequently, they have a greater predisposition to engage in risky projects. (Bass & Stogdill, 1990; Bollaert & Petit, 2010; Goel & Thakor, 2008; Hackbarth, 2008; Hiller & Hambrick, 2005). The stock market performance of firms led by overconfident CEOs is more prone to fluctuations (Hirshleifer et al., 2012). Overconfident bank CEOs are a significant contributor to bank fragility (Suntheim & Sironi, 2012).

Corporate governance must be powerful and effective to prevent CEO's illogical conduct from lowering the value of their firms. Additionally, CEOs who are susceptible to psychological biases may not be a good fit for incentive systems designed to solve the common agency difficulties. While this doesn't imply incentives don't matter, it does indicate they have a limited effect. Conventional agency conflicts are irrelevant when overconfident CEOs feel they are serving the firm's best interest by striving to increase its value, which eliminates the need for incentive systems to be used in this context (Baker & Wurgler, 2011). The monitoring function served by product market competition has been largely effective in the past. Strong competition in the industry is one of the most sophisticated governance mechanisms (Gilson & Roe, 1993). Intense competition requires top managers to formulate optimal strategies related to future events in order to obtain better outcomes and performance, while failure in doing so might result in top managers losing their jobs. Intense competition in the industry may cause management of a firm to distribute surplus funds among stockholders rather than investing in negative NPV projects (Grullon & Michaely, 2007). Intense competition in product market is beneficial for management if they take optimal decisions and work in the best interest of stockholders (Guadalupe & Pérez-González, 2010). Giroud and Mueller (2011) indicate that fierce competition can act as an alternative to corporate governance and can significantly boost managerial efficiency.

The findings of this research provide evidence against the conventional theories that assume agents act rationally. Our findings show that when a CEO is overconfident, the firm faces heightened market and operational risk. Further investigation suggests that Chinese NSOEs (Non-State-Owned Enterprises) are more susceptible to the negative effects of overconfidence than SOEs (State-Owned Enterprises). Regarding the effects of competitive industry pressure as an external governance tool, this research demonstrates that it has the potential to lessen the impact of overconfidence on firm risk. This moderation effect, though, was only exhibited in NSOEs. These results remain unaffected despite measuring CEO overconfidence and firm risk with various proxies and using alternative estimation models. This study presents substantial contributions to the existing literature. To begin, it attempts to investigate how an overconfident CEO might impact a firm's risk profile. The extant literature that examines this relationship is quite scant and not in agreement. Second, this study uses a more appropriate measure of firm risk. The majority of prior research has used the standard deviation of either historical cash flow from operations or historical stock returns as a proxy for firm risk. However, we measure firm risk as the standard deviation of cash flow from operations over the four years following the present year and the standard deviation of stock returns over one year following the present year. This is because it takes time for the effects of a CEO's actions to be reflected in stock prices or financial reports, therefore an accurate evaluation of their actions can only be made in later years. Several earlier studies have employed similar method to measure firm risk (e.g. Ali & Tauni, 2021; Haider & Fang, 2016; Huang & Wang, 2015; Wang, 2012). Third, this study divides company risk into market risk and operational risk and analyses the impact that overconfidence has on both, as opposed to most prior studies focusing on only one facet of risk. Fourth, there is a considerable dearth of research on the role of external governance tools in preventing and addressing bias in human behavior. To fill this gap, this research analyses how the degree of competitiveness in the product market influences the overconfidence-induced firm risk. Lastly, this study explores how the link between CEO overconfidence and firm risk differs across Chinese SOEs and NSOEs, taking into account China's

institutional structure which is highly distinctive and unusual in comparison to the rest of the world. The rest of the paper proceeds as follows. Section 2 contains the hypotheses derivation using the theoretical foundation and assessment of literature. Sample description and analysis procedures are included in section 3. Section 4 contains the study's findings and associated discussions. We put our results through another round of rigorous testing in section 5. Finally, we conclude the study and provide its implications in section 6.

2. Hypotheses Development

2.1 Overconfident CEOs and Firm Risk

The way management makes decisions may be heavily influenced by their personalities or other behavioral characteristics, as suggested by the upper echelons theory and the behavioral decision theory. Since CEOs are the highest-ranking employees and are in charge of all critical firm's decisions (Goel & Thakor, 2008; Shapira, 1995), their behavioral characteristics can have a large influence on the survival and growth of the firm. Researchers have identified various ways in which CEO overconfidence might affect the risk profile of a firm. Overconfidence causes CEOs to overestimate their capabilities and expertise in directing outcomes (Bollaert & Petit, 2010; Hayward et al., 2006). This characteristic leads them to feel that they already have the recipe for success in their possession (Hiller & Hambrick, 2005). They take decisions relatively quickly because they believe they have a thorough and faultless comprehension of the situation and opportunities. They rarely invest much effort in coming up with fresh tactics because they often base their decisions on previously successful experiences. This pattern prevents them from adjusting their preferences in light of new information or developments (Picone et al., 2014).

As a result of their inflated sense of self-assurance, overconfident CEOs often fail to adequately consider the possibility that their initiatives may fail (Malmendier & Tate, 2005). Perception of control is a term used by researchers to describe CEOs' erroneous conviction that they are in possession of high-quality information, implying that CEOs' overconfidence causes them to feel that they alone have complete control over the results of a project and that external factors have no impact (Hiller & Hambrick, 2005). Heightened perceptions of self-competence and control result into initiation of venturesome projects which raise the likelihood of uncertainties and risks (Durand, 2003). Miscalibration is yet another manner in which the overconfidence of a CEO can affect the risk level of a firm. Miscalibration has been equated with overestimation in several previous investigations (Moore & Healy, 2008). In certain ways, though, it differs from overestimation. Miscalibrated individuals are more inclined towards the underestimation of variance instead of overestimation of mean (Hribar & Yang, 2016). Miscalibrated CEOs overestimate the accuracy of their projections and feel that the likelihood of their projections being accurate is quite high. They consider themselves as more knowledgeable, although reality often contradicts this notion (Bernardo & Welch, 2001). They set unrealistically small confidence ranges in their predictions and fail to account for the inherent uncertainty in predicting a company's performance or returns (Ben-David et al., 2013).

Furthermore, overconfident CEOs tend to view themselves as better than their counterparts. As a result, they feel that their existence in the firm will boost the firm's performance. These CEOs favor centralized decision-making and take personal accountability (Hiller & Hambrick, 2005; Picone et al., 2014). As a result of this tendency, they disregard other people's feedback and knowledge (Owen, 2007). Furthermore, the employees who report to them concur with their conduct, since individuals tend to favor the judgments of authority (Padilla et al., 2007). Because of these issues, CEOs are unable to identify any risks associated with their investments and new initiatives. Collectively, the theoretical and empirical evidence from the past suggests that overconfidence, in all of its manifestations, influences CEO decision-making in ways that are fallible and paradoxical, which may significantly raise a firm's riskiness.

Hypothesis 1: An overconfident CEO raises the firm's exposure to risk.

Comparing China to other rising economies, the institutional structure is considerably different due to the government's continued ownership of a significant portion of many Chinese companies (Memon et al., 2018). The largest shareholding by state enables it to prohibit CEOs from taking excessive risks and to compel them for conservative investment choices (Boubakri et al., 2013; Haider & Fang, 2016). It suggests that, compared to NSOEs, CEOs in SOEs may have differing levels of flexibility when it comes to making decisions and creating policies. It is common for SOEs to have alternative aims that do not prioritize profit maximization, in contrast to the primary purpose of NSOEs, which is to enhance shareholders' wealth. Objectives like public good, employment creation or preservation, and industrial dominance are often at the forefront of SOEs' operations. Since the state

ultimately takes all major decisions about SOEs, the CEOs of these companies are typically chosen for political rather than professional grounds (Clarke, 2003), and as a result, they have very little say in the matter. In addition, SOEs rely heavily on the state for funding, staff, and other necessities. This reliance provides the state with more power and authority, allowing it to greatly influence the firm's operations and decisions. Consequently, this constrains the CEOs' discretion over the company's operations and strategies (Li & Tang, 2010).

Hypothesis 2: CEO overconfidence has a greater impact on the risk profile of NSOEs than SOEs.

2.2 Moderating Role of Product Market Competition

According to Shleifer and Vishny (1997), competitive environment in the product market is the best instrument for alleviating the inefficiency of management. For the firms that are facing tough competition, the chances are very rare that the firm will use their precious resources towards risky decisions because the margin of error is very narrow, and the competitors may take immediate advantage of any irrational or value-destroying decision taken by the executives. The study by Kolasinski and Li (2013) suggests that executives can take optimal decisions regarding acquisitions if the corporate governance is strong. Giroud and Mueller (2011) establish that competition in the industry is an alternative for corporate governance and has the capability to limit executives' slack. When the level of competition rises, any irrational decision by CEO, for example undertaking a negative NPV project, will minimize the firm's capability to compete, and the likelihood of being driven out of the market will increase (Abdoh & Varela, 2017; Grullon & Michaely, 2007). This pressure from competitive markets may thus resist an overconfident CEO from taking value-destroying decisions. Furthermore, Ho (2016) also documents evidence regarding the role of competitive product market in the association between CEO overconfidence and overinvestment, which shows that intense competition urges CEOs to work on their psychological biases. This in turn leads CEOs to take optimal decisions beneficial for the firm and stockholders. Thus, both theoretical and empirical evidence demonstrate that competition may serve as an alternative to corporate governance. The disciplinary effects of competition are experienced by the firms in highly competitive markets. This consequently influences the attitude of CEOs towards risk taking.

Hypothesis 3: Intense competition in product market mitigates the impact of CEO overconfidence on firm risk.

State intervention is common for China's publicly traded companies, especially SOEs. Therefore, the influence of competitive environment may exhibit different outcomes in these firms. Social and political objectives of SOEs may interrupt the disciplinary effect of competitive pressure. Since the state controls the policies and decisions of SOEs, it devises strategies that restrict SOEs from being involved in a competitive environment. Additionally, SOEs are normally supposed to perform some administrative tasks assigned to them by the state, which means that the disclosure and validity of information provided by these firms may be compromised. This further interrupts the information effects of competitive environment (Huang, 2016). NSOEs, on the other hand, with their growth over the past three decades have experienced significant progress and have become an essential part of the economy. Due to the absence of state's interference and control, these firms survive under the heavy pressure of competition and ultimately exhibit better performance due to enhanced governance. Overall, these assertions imply that the disciplinary role of competitive environment is expected to work normally in NSOEs by enhancing management's efficiency and alleviating agency problems. However, the SOEs may not benefit as much from the competition's disciplinary impact.

Hypothesis 4: A competitive product market is more effective for NSOEs in mitigating the risks associated with overconfidence.

3. Research Design

3.1 Sample

This analysis is based on the Chinese firms that issued A shares and were traded on the Shanghai and Shenzhen Stock Exchanges between 2003 and 2022. The RESSET Database has been used to collect the data about the firms' projected earnings; the China Stock Market and Accounting Research (CSMAR) Database has been used for all other data. Both sets of data have been integrated based on a unique code assigned to each company. The Actual Controller data for companies, that helps in differentiating between SOE and NSOE, is not included in the CSMAR

database before 2003, hence that is the major rationale for using the period 2003-2022. Due to their distinct performance and risk-taking characteristics, ST firms and financial firms have been omitted from the sample. Firms with missing or negative total assets, total liabilities, or total equity figures are also eliminated. Following these steps, a final sample of 2,534 firms with 27,296 firm-year observations is produced. All variables have been winsorized at the 1st and 99th percentile, as recommended by Kale and Shahrur (2007), which helps to reduce the impact of extreme values.

3.2 Measurement of CEO Overconfidence

We determine whether or not a CEO is overconfident by comparing the predicted and actual profits of the company, as done by Ali and Tauni (2021) & Huang et al. (2011). If the actual profit ends up being less than the predicted profit, it indicates that the profit was over predicted. Overconfidence can be attributed to a CEO if profits are over predicted consistently for a significant period throughout the CEO's tenure. A static measure of CEO overconfidence is provided by this method; we call it "CEO_overC1", and its value is 1 if the CEO is overconfident and 0 otherwise. We utilize the annual and quarterly earnings projections released by the Chinese listed companies for measuring overconfidence through this approach. The existing literature has a strong foundation for this overconfidence measure. Overconfidence among a group of Taiwanese corporations was evaluated using this method by Lin et al. (2005). Numerous tests were run to ensure the validity of this proxy, and the results demonstrated that it had the potential to serve as a meaningful measure of overconfidence. This proxy was also adopted by Li and Tang (2010) for assessing CEO overconfidence in Chinese companies. Validity of this measure was also established by Hribar and Yang (2010), who used it to a sample of U.S. companies and concluded that overconfident CEOs over forecasted their companies' profitability. Recently, Wang et al. (2016) & Ali and Tauni (2021) also used the similar approach.

We use two additional CEO overconfidence measures from earlier literature to test the robustness of our main overconfidence measure. For the first robustness measure, we compare the firm's yearly profit estimates with the mean of analysts' yearly profit estimates. If a company's estimates are higher than analysts' forecasts consistently for a significant period throughout the CEO's tenure, the firm's CEO is said to be overconfident (Wang et al., 2016). With this method, a measure of overconfidence called "CEO_OverC2" is created, and its value is 1 if CEO is overconfident and 0 otherwise. Overconfident CEOs have a propensity to over forecast the cash flows that their investment initiatives will provide (Heaton, 2002). As a result, they either postpone executing their stock options or acquire additional company shares in an effort to further their own financial interests (Malmendier & Tate, 2005). The lack of employee stock options in China leads us to label CEOs as overconfident if they increase their shareholding in the company. This strategy offers a third indicator of CEO overconfidence called "CEO_OverC3," and its value is 1 if the CEOs is overconfident and 0 otherwise.

For all of the above indicators of overconfidence, we only consider profit estimates that have been released by the companies before the conclusion of the reporting period. For example, the financial report's release for the year ended in December 2021 is finalized by April 30, 2022. We do not consider a firm's forecast that is released after December 31, 2021, as the management of the firm may have more up-to-date knowledge of the performance of the firm at that point. Wang et al. (2016) contend that post-reporting period forecasts are not a proper depiction of overconfidence. Furthermore, if the CEOs have been in their position for less than three years, we discard those firm-year observations too (Hirshleifer et al., 2012).

3.3 Measurement of Firm Risk

Our study categorizes firm risk as either market risk or operational risk. We follow Wang (2012), Huang and Wang (2015) & Haider and Fang (2016) for measuring these two categories of risk. The standard deviation of stock returns over the subsequent year is used to determine market risk (Mark_R). The standard deviation of quarterly operating cash flow, scaled by total assets, over the four subsequent years is used to determine operational risk (Oper_R). To further assure robustness, we also incorporate other measurements of market and operational risks. Standard deviation of market-adjusted daily stock returns over the subsequent year is used to determine market risk (Mark_R2). Standard deviation of industry-adjusted cash flow from operations scaled by total assets over the four subsequent years is what we use to determine operational risk (Oper_R2) ((Ali & Tauni, 2021; Huang & Wang, 2015).

3.4 Measurement of Product Market Competition

The HHI (Herfindahl-Hirschman Index) is used to evaluate the degree of product market competitiveness. HHI, defined as the industry-year sum of the squared market shares of the businesses in that industry, is widely accepted as a proxy for market competition (Gaspar & Massa, 2006; Jiang et al., 2015; Kordestani & Mohammadi, 2016). A company's market share is calculated by dividing its sales by the industry's sales. Large values of HHI represent the concentration of the market share with only a small number of big firms, consequently weakening industry competitiveness. For the convenience of interpretation, we multiply HHI with negative one (Majeed & Zhang, 2016). This action generates a new measure (Pro_MC), where large values represent stronger competition in product market due to the market share being divided among various firms, and vice versa.

3.5 Estimation Models

Following Qiao et al. (2022) and Hirshleifer et al. (2012), we apply Ordinary Least Square (OLS) regression and incorporate the effects of year and industry fixed effects in all our estimation models. We also re-estimate the OLS results using firm fixed effects regression, which has the benefit of addressing endogeneity concerns such as omitted variable bias and time-invariant unobserved heterogeneity bias. The robustness section of this study presents and discusses the estimates produced using fixed effects regression. The regression models provided by equations (1) and (2) are used to test our first hypothesis. Both equations (1) and (2) include market risk and operational risk as their dependent variables, respectively. Using the interaction term of CEO overconfidence with SOE (CEO_OverC1*SOE) in equations (3) and (4), we evaluate our second hypothesis, which states that market and operational risks are more prevalent in NSOEs than SOEs due to CEO overconfidence.

$$Mark_R_{i,t+1} = \beta_0 + B_1CEO_OverC1_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (1)$$

$$Oper_R_{i,t+4} = \beta_0 + B_1CEO_OverC1_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (2)$$

$$Mark_R_{i,t+1} = \beta_0 + B_1CEO_OverC1_{i,t} + B_2SOE_{i,t} + B_3CEO_OverC1_{i,t} * SOE_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (3)$$

$$Oper_R_{i,t+4} = \beta_0 + B_1CEO_OverC1_{i,t} + B_2SOE_{i,t} + B_3CEO_OverC1_{i,t} * SOE_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (4)$$

By introducing an interaction term CEO_OverC1*Pro_MC into equations (5) and (6), we test our third hypothesis and determine the extent to which the impact of CEO overconfidence is tempered by competitive pressure in the product market. Fourth hypotheses testing involves estimating the moderating impact of product market competitiveness in SOEs relative to NSOEs via a three-way interaction (CEO_OverC1*Pro_MC*SOE) in equations (7) and (8).

$$Mark_R_{i,t+1} = \beta_0 + B_1CEO_OverC1_{i,t} + B_2Pro_MC_{i,t} + B_3CEO_OverC1_{i,t} * Pro_MC_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (5)$$

$$Oper_R_{i,t+4} = \beta_0 + B_1CEO_OverC1_{i,t} + B_2Pro_MC_{i,t} + B_3CEO_OverC1_{i,t} * Pro_MC_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (6)$$

$$Mark_R_{i,t+1} = \beta_0 + B_1CEO_OverC1_{i,t} + B_2SOE_{i,t} + B_3CEO_OverC1_{i,t} * SOE_{i,t} + B_4Pro_MC_{i,t} + B_5CEO_OverC1_{i,t} * Pro_MC_{i,t} + B_5Pro_MC_{i,t} * SOE_{i,t} + B_5CEO_OverC1_{i,t} * Pro_MC_{i,t} * SOE_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (7)$$

$$Oper_R_{i,t+4} = \beta_0 + B_1CEO_OverC1_{i,t} + B_2SOE_{i,t} + B_3CEO_OverC1_{i,t} * SOE_{i,t} + B_4Pro_MC_{i,t} + B_5CEO_OverC1_{i,t} * Pro_MC_{i,t} + B_5Pro_MC_{i,t} * SOE_{i,t} + B_5CEO_OverC1_{i,t} * Pro_MC_{i,t} * SOE_{i,t} + \gamma.Ccontrols_{i,t} + Industry_{j,t} + Year_t + \varepsilon_{i,t} \quad (8)$$

The symbols i , t , j , and ε denote firm, year, industry and error term, respectively; and *Controls* refers to the control variables included in this analysis. All variables and their respective measures are listed in Table 1.

Table 1: Variable definition

Variable	Abbreviation	Measurement
CEO Overconfidence	CEO_overC1	1 if profit is overestimated consistently for majority of the time over the CEO's term, 0 otherwise
	CEO_overC2	1 if company's profit estimates are higher than analysts' forecasts for majority of the time over the CEO's term, 0 otherwise
	CEO_overC3	1 if the CEOs' holdings of their companies' stock increase, 0 otherwise
Market Risk	Mark_R	Standard deviation of daily stock returns over the course of one year following the current year
	Mark_R2	Standard deviation of market-adjusted daily stock returns over the one-year period following the current year
Operational Risk	Oper_R	Standard deviation of the firm's quarterly operating cash flow, scaled by total assets, over the four years that follow the present year
	Oper_R2	Standard deviation of industry-adjusted cash flow from operations, scaled by total assets, over the four years following the current year
Product Market Competition	Pro_MC	HHI multiplied with negative one
Growth Opportunities	G_opp	Market value of assets divided by the book value of assets
Leverage	Levg	Firm's total debt to total assets
Firm Age	FiAg	Difference between the current year and the year in which firm was incorporated
Firm Size	FiSi	Natural logarithm of firm's market value of equity
Profitability	Prof	Earnings before interest and taxes scaled by firm's total assets
Internal Funds	In_Fu	Cash flow from operations divided by total assets
Past Stock Returns Volatility	PSRV	Standard deviation of daily stock returns over the year preceding the current year
Past Cash Flow Volatility	PCFV	Standard deviation of quarterly cash flow from operations over the three years preceding the current year

4 Results and Discussion

4.1 Descriptive Statistics

Table 2 contains the descriptive statistics for all variables considered in this analysis. Stock return volatility (Mark_R) is 3.023% on average, while stock return volatility adjusted for industry (Mark_R2) is 2.342%. The mean values for Oper_R (volatility of operating cash flow) and Oper_R2 (volatility of operating cash flow adjusted for industry) are 0.0538 and 0.0814, respectively. CEO_OverC2, which accounts for the the CEO's increased ownership in the firm, has a lower mean value than CEO_OverC1. The mean value of product market competition (Pro_MC) is -0.1534. G_opp, with a mean value of 1.9076, indicates that the market value of the firm's assets exceeds the book value. The mean ratio of debt to total assets is 22.179%. The mean age of a company is 13.4 years. The averages for internal funds (In_Fu), profitability (Prof), and size (FiSi) are 0.0257, 0.0555, and 22.1919, respectively. Historical market returns have shown an average volatility of 3.676 percent, compared to the average volatility of operational cash flow of 5.398 percent.

Table 2: Descriptive Statistics

Variables	Obs.	Mean	St.Dev	p25	p75	min	max
Mark_R	27296	0.03023	0.00991	0.02324	0.03556	0.01330	0.05752
Mark_R2	27296	0.02342	0.00721	0.01813	0.02782	0.01022	0.04493
Oper_R	18232	0.05377	0.03050	0.03219	0.06612	0.01163	0.18674
Oper_R2	18232	0.08141	0.11564	0.03543	0.08322	0.01301	0.87968
CEO_OverC1	27296	0.29002	0.45805	0	1	0	1
CEO_OverC2	24433	0.18947	0.41214	0	0	0	1
Pro_MC	27296	-0.15335	0.17343	-0.16852	-0.05538	-1.02104	-0.02092
G_opp	27296	1.90760	1.38215	1.03771	2.24454	0.55865	8.63711
Levg	27296	0.22179	0.16076	0.07879	0.33955	0	0.62253
FiAg	27296	13.43448	5.23146	9	16	2	27
FiSi	27296	22.19185	1.24707	21.30122	23.03987	19.43806	25.50726
Prof	27296	0.05547	0.06160	0.02884	0.08297	-0.21101	0.25432
In_Fu	27296	0.02577	0.06576	-0.01163	0.06133	-0.16612	0.23242
PSRV	27296	0.03676	0.02328	0.02545	0.03862	0.01706	0.18555
PCFV	18232	0.05398	0.03303	0.03063	0.06726	0.00810	0.19274

4.2 Correlation Matrix

The correlation matrix for all variables in this study is displayed in Table 3. Overconfident CEOs are connected with higher exposure to operational and market risks. There is an adverse correlation between product market competitiveness and firm risk. The majority of the correlation coefficients are consistent with our proposed associations. None of the independent variables have very high correlation coefficients with one another; and their VIF values were found to be less than 10. The highest VIF score was 2.3, implying that there is no significant multicollinearity issue.

Table 3: Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Mark_R	1											
(2) Oper_R	0.4109*	1										
CEO_OverC												
(3)	0.0028*	0.0418*	1									
(4) Pro_MC	0.0255*	0.0005*	0.0487*	1								
(5) G_opp	0.0223*	0.0811*	-0.0088	0.0005*	1							
(6) Levg	0.0369*	0.1462*	0.1021*	0.0228*	0.2290*	1						
(7) FiAg	0.0993*	0.1581*	0.0917*	0.0519*	0.1759*	0.0009	1					
(8) FiSi	0.1619*	0.4503*	0.0671*	-0.0207	0.3463*	0.0537*	0.2809*	1				
(9) Prof	0.0590*	0.1377*	0.1008*	0.0109	0.0685*	0.1786*	0.0277*	0.1512*	1			
(10) In_Fu	0.0379*	0.0127*	0.0053	0.0011	0.0113	0.0841*	0.0252*	0.0477*	0.2669*	1		
(11) PSRV	0.1669*	0.2622*	0.0475*	0.0238*	0.0148	0.0595*	0.1445*	0.1154*	0.0275*	0.0302*	1	
(12) PCFV	0.0839*	0.2807*	0.0216*	-	-	0.1639*	0.2639*	0.381*	0.1071*	0.0104*	0.2683*	1

0.0286* 0.1937*

4.3 Overconfident CEOs and Firm Risk

CEO overconfidence has been found to raise a firm’s riskiness, as evidenced by the OLS estimates in Table 4. Overconfident CEOs make their companies more vulnerable to market and operational volatility, as observed in columns (1) and (3), where the effect of overconfidence is positive and statistically significant at the 1% level. These results corroborate our first premise. In columns (2) and (4) of Table 4, we introduce an interaction term of CEO overconfidence and state ownership (CEO_overC1*SOE). Overconfidence appears to have less of an impact on firm risk in SOEs compared to NSOEs, as demonstrated by the negative and statistically significant coefficients of this interaction term in both columns. This is further supported by plotting the graphs with prediction margins. NSOEs experience a bigger increase in market risk due to CEO overconfidence than SOEs, as shown in Figure 1’s slope being steeper when SOE=0. Figure 2 shows a similar pattern, with NSOE firms experiencing greater levels of overconfidence-induced operational risk than SOE firms. These estimations lead us to accept the study's second hypothesis, which suggests that CEO overconfidence has a reduced impact on firm risk when it comes to SOEs. These estimates convince us to agree with the study's second premise, which contends that in the case of SOEs, CEO overconfidence has a diminished impact on firm risk.

Table 4: Impact of CEO overconfidence on firm risk

VARIABLES	(1) Mark_R	(2) Mark_R	(3) Oper_R	(4) Oper_R
CEO_OverC1	0.02830*** (0.00347)	0.03736*** (0.00564)	0.11736*** (0.02040)	0.05943** (0.02600)
SOE		-0.01017*** (0.00264)		-0.02181* (0.01276)
CEO_OverC1*SOE		-0.01082*** (0.00376)		-0.04204** (0.01587)
G_opp	0.02241*** (0.00135)	0.04059*** (0.00219)	-0.16656*** (0.01496)	-0.16807*** (0.01692)
Levg	0.06286*** (0.00962)	0.06950*** (0.01409)	0.80014*** (0.08669)	0.81632*** (0.08509)
FiAg	-0.00071* (0.00034)	-0.00352*** (0.00049)	-0.01012*** (0.00218)	-0.01001*** (0.00270)
FiSi	-0.05395*** (0.00206)	-0.04775*** (0.00202)	0.53757*** (0.01670)	0.52571*** (0.01581)
Prof	-0.18695*** (0.03139)	-0.24499*** (0.03307)	1.78706*** (0.14609)	1.68514*** (0.17054)
In_Fu	0.09007*** (0.01915)	0.19458*** (0.02973)	-0.11771 (0.12288)	-0.13766 (0.12204)
PSRV	0.02248*** (0.00372)	0.08825*** (0.00410)		
PCFV			0.34965*** (0.01549)	0.42849*** (0.01728)
Constant	-2.22482*** (0.04323)	-2.32938*** (0.04120)	1.50341*** (0.27123)	1.32403*** (0.32068)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Observations	27,296	27,296	18,232	18,232
R-squared	0.701	0.686	0.659	0.690

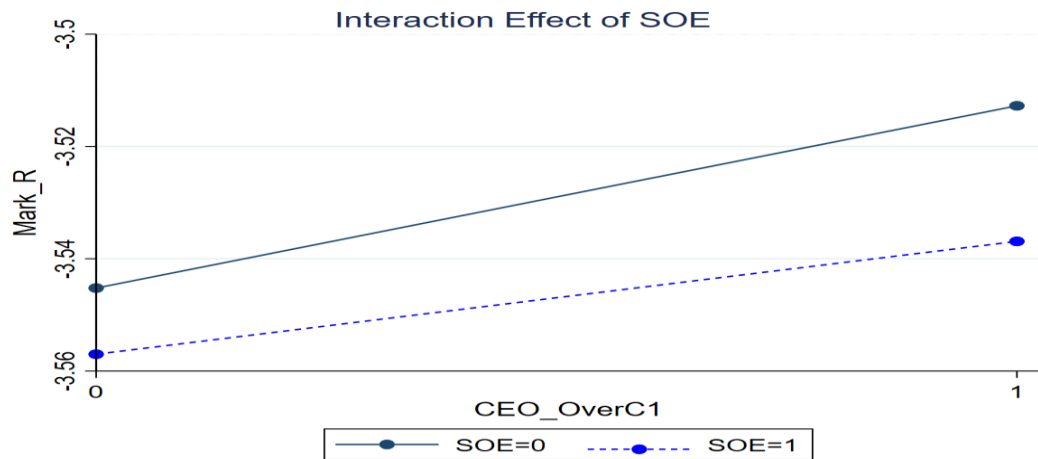


Figure 1: CEO overconfidence and market risk in SOEs vs NSOEs

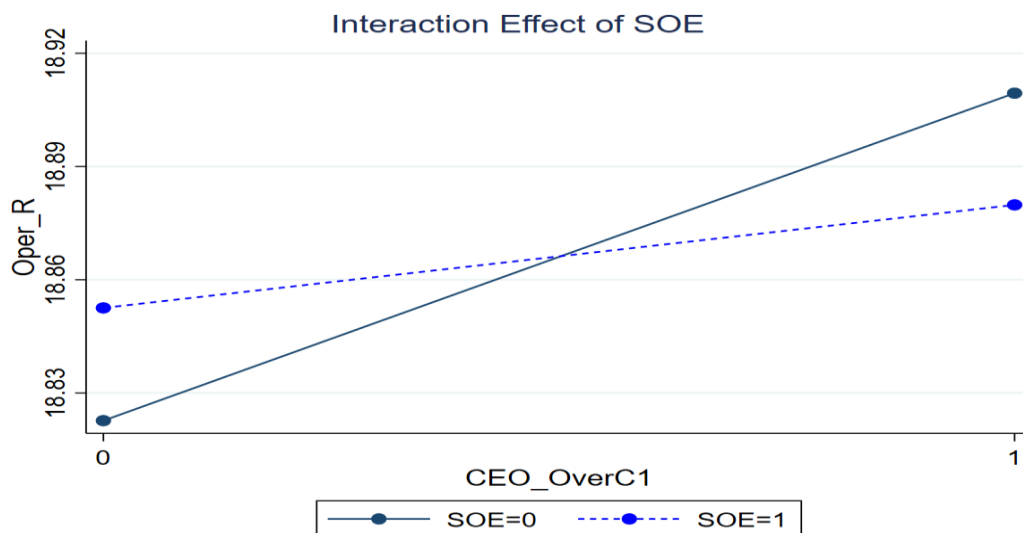


Figure 2: CEO overconfidence and operational risk in SOEs vs NSOEs

4.4 Moderating Effect of Product Market Competition

The effects of CEO overconfidence on company risk in the face of competitive pressure in the product market are presented in Table 5. Negative and statistically significant coefficients can be observed in both columns (1) and (3) for the interaction term CEO_OverC1*Pro MC. This advocates that the impact of CEO overconfidence on firm risk is mitigated by the competitive nature of the product market. Interaction plots are created using predicted margins to confirm the presence of this negative moderation. Figure 3 demonstrates that when competition is low (at mean minus one standard deviation of product market competitiveness), CEO overconfidence has a bigger impact on market risk. However, when the industry competitiveness is substantial (at mean plus one standard deviation of product market competition), overconfidence-caused market risk decreases. Figure 4 shows similar results for operational risk. These findings lend support to our third premise, which claims that product market competitiveness dampens the impact of CEO overconfidence on firm risk.

To determine if the moderating influence of industry competitiveness varies across SOEs and NSOEs, we add a three-way interaction term CEO_OverC1*Pro_MC*SOE to Table 5, columns (2) and (4). There is no statistically significant influence of industry competitiveness on overconfidence-caused firm risk in the case of SOEs, as indicated by the coefficients of the three-way interaction term in both columns. Our fourth premise, which holds that the impact of product market competitiveness in diminishing overconfidence-associated firm risk is less pronounced in SOEs, is thus rejected. One possible explanation for the lack of a statistically significant moderating

effect is that the SOEs operate under different social or political objectives which restrict market competition from exerting its influence on these firms.

Table 5: Moderating effect of product market competition

VARIABLES	(1) Mark_R	(2) Mark_R	(3) Oper_R	(4) Oper_R
CEO_OverC1	0.0141*** (0.00445)	0.0279*** (0.00575)	0.1388*** (0.02777)	0.1318*** (0.03806)
Pro_MC	-0.0035*** (0.00072)	-0.0101** (0.00471)	-0.0716** (0.03544)	-0.1354*** (0.02401)
CEO_OverC1*Pro_MC	-0.0122* (0.00690)	-0.0133** (0.00648)	-0.0490* (0.02677)	-0.0692** (0.03145)
SOE		-0.0098* (0.00510)		-0.0357 (0.03510)
CEO_OverC1*SOE		-0.0196** (0.00975)		-0.0467* (0.02552)
Pro_MC*SOE		0.0205 (0.02288)		-0.1213 (0.19213)
CEO_OverC1*Pro_MC*SOE		0.0285 (0.03886)		-0.1958 (0.28798)
G_opp	0.0240*** (0.00156)	0.0241*** (0.00155)	-0.1518*** (0.01439)	-0.1525*** (0.01446)
Levg	0.0602*** (0.01091)	0.0602*** (0.01090)	0.7863*** (0.07541)	0.7876*** (0.07524)
FiAg	-0.0007* (0.00039)	-0.0005 (0.00039)	-0.0108*** (0.00257)	-0.0109*** (0.00259)
FiSi	-0.0549*** (0.00207)	-0.0546*** (0.00212)	0.4778*** (0.01778)	0.4789*** (0.01794)
Prof	-0.1849*** (0.02920)	-0.1866*** (0.02940)	1.5704*** (0.16529)	1.5600*** (0.16644)
In_Fu	0.0976*** (0.02053)	0.0966*** (0.02050)	-0.1195 (0.11164)	-0.1207 (0.11150)
PSRV	0.0243*** (0.00389)	0.0238*** (0.00388)		
PCFV			0.3801*** (0.01500)	0.3797*** (0.01503)
Constant	-2.5625*** (0.04221)	-2.5765*** (0.04326)	1.5415*** (0.26497)	1.5506*** (0.26893)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Observations	27,296	27,296	18,232	18,232
R-squared	0.688	0.689	0.682	0.678

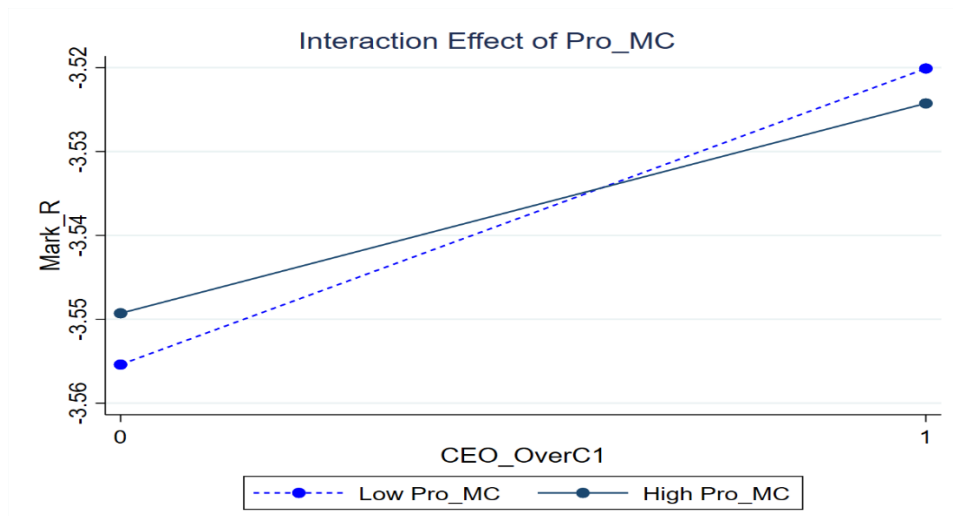


Figure 3: Moderating effect of product market competition on the association between overconfidence and market risk

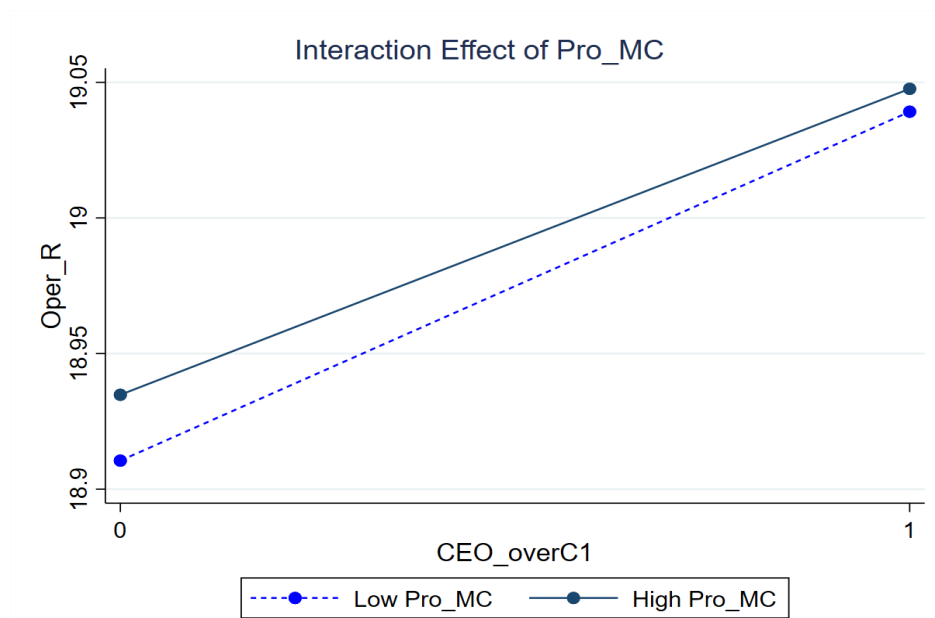


Figure 4: Moderating effect of product market competition on the association between overconfidence and operational risk

4.5 Robustness Tests

Estimates of multiple robustness tests are displayed in Table 6, where Panel A provides the regression results for our second CEO overconfidence indicator. The difference between the firm’s and analysts’ expected earnings determines this measure. Panel B provides the estimates from our third indicator of CEO overconfidence. CEOs’ additional investment into their firms determines this measure. Fixed effects regression results are provided in Panel C. Panel D provides estimates for alternative indicators of firm risk. The estimates derived from the robustness tests are mostly consistent across all the panels in Table 6. Overconfident CEOs are putting their companies at greater risk, as evidenced by the positive and statistically significant coefficients of the overconfidence variable across all panels. In addition, CEO overconfidence has a mitigated impact on the firm risk of SOEs, as shown by the negative interaction coefficients between CEO overconfidence and state ownership in each panel. Further, the negative interaction coefficients between CEO overconfidence and product market competitiveness across all panels suggest that a competitive industry environment may reduce the impact of overconfident CEO on company risk. Finally, the three-way interaction coefficients in each panel are statistically

insignificant, signaling that SOEs lack the moderating role of competitive industry in alleviating overconfidence-associated firm risk. Overall, our main findings are robust, since the estimates generated by different model specifications and alternative variable proxies are qualitatively similar to our earlier estimates.

Table 6: Robustness checks

VARIABLES	(1) Mark_R	(2) Mark_R	(3) Mark_R	(4) Mark_R	(5) Oper_R	(6) Oper_R	(7) Oper_R	(8) Oper_R
Panel A: OLS results obtained by using second measure of CEO overconfidence (CEO_OverC2)								
CEO_OverC2	0.011*** (0.0041)	0.022*** (0.0054)	0.017*** (0.0052)	0.020*** (0.0069)	0.124*** (0.0246)	0.108*** (0.0341)	0.122*** (0.0315)	0.122*** (0.0436)
CEO_OverC2*SOE		- 0.012*** (0.0030)		-0.026** (0.0104)		-0.026** (0.0131)		-0.017** (0.0081)
CEO_OverC2*Pro_MC			-0.027** (0.0136)	-0.043** (0.0219)			-0.015** (0.0062)	-0.067* (0.0350)
CEO_OverC2*Pro_MC*SOE				-0.034 (0.0466)				0.290 (0.3229)
Observations	14,692	14,692	15,187	15,187	9,763	9,763	9,944	9,944
Panel B: OLS results obtained by using third measure of CEO overconfidence (CEO_OverC3)								
VARIABLES	Mark_R	Mark_R	Mark_R	Mark_R	Oper_R	Oper_R	Oper_R	Oper_R
CEO_OverC3	0.008** (0.0034)	0.012*** (0.0041)	0.016** (0.0080)	0.012** (0.0051)	0.054*** (0.0201)	0.058** (0.0268)	0.068*** (0.0259)	0.061* (0.0341)
CEO_OverC3*SOE		-0.010** (0.0046)		-0.020** (0.0092)		-0.014** (0.0064)		-0.014* (0.0074)
CEO_OverC3*Pro_MC			-0.013** (0.0054)	- 0.012*** (0.0015)			-0.094* (0.0495)	-0.015** (0.0066)
CEO_OverC3* Pro_MC*SOE				0.040 (0.0387)				0.131 (0.2342)
Observations	24,433	24,433	24,430	24,430	16,262	16,262	16,259	16,259
Panel C: Results obtained by using alternative estimation regression model (Fixed Effect Regression)								
VARIABLES	Mark_R	Mark_R	Mark_R	Mark_R	Oper_R	Oper_R	Oper_R	Oper_R
CEO_OverC1	0.218*** (0.0242)	0.081** (0.0356)	0.225*** (0.0291)	0.067** (0.0289)	0.068** (0.0293)	0.088* (0.0459)	0.075** (0.0374)	0.140** (0.0578)
CEO_OverC1*SOE		- 0.210*** (0.0427)		-0.240* (0.1271)		-0.030* (0.0163)		-0.099 (0.0720)
CEO_OverC1*Pro_MC			-0.048* (0.0281)	-0.087** (0.0395)			-0.072** (0.0312)	-0.450** (0.1884)
CEO_OverC1* Pro_MC*SOE				0.210 (0.1657)				-0.595 (0.4575)
Observations	27,296	27,296	27,296	27,296	18,232	18,232	18,229	18,229
Panel D: OLS results obtained by using alternative measures of market (Mark_R2) and operational risks (Oper_R2)								
VARIABLES	Mark_R2	Mark_R2	Mark_R2	Mark_R2	Oper_R2	Oper_R2	Oper_R2	Oper_R2
CEO_OverC1	0.006*** (0.0021)	0.023*** (0.0067)	0.002** (0.0009)	0.022** (0.0099)	0.061*** (0.0233)	0.025*** (0.0083)	0.059* (0.0313)	0.075* (0.0448)
CEO_OverC1*SOE		- 0.032*** (0.0098)		- 0.040*** (0.0127)		-0.059*** (0.0210)		-0.037* (0.0215)

CEO_OverC1*Pro_MC			-0.024*** (0.0057)	-0.002* (0.0011)			-0.018** (0.0085)	0.382** (0.1744)
CEO_OverC1* Pro_MC*SOE				-0.055 (0.0554)				-0.735 (0.5047)
Observations	27,296	27,296	27,296	27,296	18,232	18,232	18,229	18,229

5. Conclusion

Our analysis spans from 2003 to 2022, and it is based on data related to Chinese publicly traded companies. Contrary to conventional agency theories that trust in agent's rationality and risk-aversion, the findings of this study exhibit that firms with overconfident CEOs are more likely to experience highly volatile stock returns and cash flows. The results further show that NSOEs are more vulnerable to the negative consequences of overconfidence in this situation. Since the state has the final say in all the important policies and initiatives of the SOEs, the limited autonomy of CEOs in decision-making may account for the diminished impact of overconfidence on SOEs (Li & Tang, 2010). Further investigation reveals that competitive industry environment might limit the detrimental effects of CEO overconfidence in NSOEs by serving as an external governance mechanism. When it comes to SOEs, however, competition may not serve as a disciplinary mechanism. The varied aims under which SOEs operate may be the reason why competition does not play a disciplinary function in these firms. Instead of seeking maximum profit, SOEs are driven by other, more altruistic, or even political objectives. SOEs provide less discretion to CEOs in decision making. Furthermore, CEOs' appointment in SOEs is based on political reasons (Clarke, 2003) rather than efficiency or competency, and the probability of CEOs losing their jobs due to the negative consequences of behavioral biases is extremely low. As a result, competitive pressure may be ineffective in restraining the choices of overconfident CEOs in SOEs.

The ramifications of our findings extend to management, regulators, and policymakers. The obtained estimates suggest that executives' behavioral attributes greatly contribute to the firm's risk level. It's important for business leaders to have self-confidence when making important decisions, which may lead to positive outcomes like more innovation and, in turn, economic development. On the other hand, overconfidence may lead to disastrous outcomes like increased risk-taking and failure. Therefore, the CEOs need to exercise extreme caution when making judgments, making sure their convictions are grounded on data rather than any sort of irrational optimism. It's feasible that they can prevent the company's downfall caused by overconfidence if they approach with prudence. Our study also finds that intense competition in the industry dampens the effect that an overconfident CEO has on firm risk. This necessitates that regulatory bodies and policymakers craft sound policies and take concrete measures to foster a competitive environment for businesses.

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