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Impacts of firm performance on chief executive officers' overconfidence

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Abstract

This research investigates the intricate relationship between firm performance and chief executive officer (CEO) overconfidence, drawing on data obtained from a comprehensive analysis of 733 publicly listed U.S. companies from 2015 to 2021. The study employs stock-option data, as inspired by the seminal work of Malmendier and Tate (2005), a robust metric to gauge CEO overconfidence. The empirical findings contribute significantly by establishing a positive correlation between firm performance and the manifestation of CEO overconfidence. This discerned pattern suggests that as firm performance improves, there is an accompanying increase in the likelihood of CEOs exhibiting overconfident behaviors in their decision-making processes. This insight significantly enriches our understanding of the complex interplay between organizational success and the psychological attributes of corporate leadership. Furthermore, the study unveils variations among different firm types, revealing that non-financial firms, particularly those exhibiting strong performance, are more prone to having overconfident CEOs compared to their counterparts in the financial sector. In addition to these insights, the research explores the impact of the COVID-19 pandemic

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on this dynamic relationship, underscoring an intensified influence of firm performance on CEO overconfidence during this period. This investigation unveils the nuanced dynamics introduced by external disruptions, shedding light on how executive decision-making adapts to unprecedented challenges posed by global events.

Keywords: CEO overconfidence, Managers, Firm performance

1. Introduction

The chief executive officer (CEO) is considered the business's core value, and the CEO's strategic importance in large corporations has been widely recognized (Lorange, 1980). Studying the influence of CEOs on corporate value has an important role in deepening insights into how businesses operate, thereby directly affecting the future prosperity of enterprises. Besides, Beatty and Zajac (1987) emphasized the importance of the CEO's potential impact on the performance of the business, thereby emphasizing the importance of a more complete understanding of ways a business can try to ensure that the CEO's behaviors maximize its performance. In the uncertain economic, political, and social context today, the role of CEOs is of great interest to researchers and policymakers.

Originating from studies of Beatty and Zajac (1987), Dalton and Kesner (1985), and Reinganum (1985) focus on the influence of CEO's behavioral psychology has developed a rich research background for later researchers to explore many different aspects of behavioral economics, such as the impact CEO narcissism behavior on firm performance through earnings (Rusydi, 2021) or CEO proactiveness, innovation, and firm performance (Kiss *et al.*, 2021). Previous studies have provided significant insights into the relationship between CEO behavior and firm performance. However, we believe that it is not simply a one-sided relationship between a CEO's behavior and firm value; the firm performance can also affect the psychology of the CEO.

Indeed, the current psychology literature asserts that human behavior is the product of many interrelated factors. Due to the complexity of the factors underlying behavior, it is impossible to describe exactly what is known about those factors and how they interact. Thus, to the best of our knowledge, studies on the direct impacts of corporate activities on the CEO's psychology and behavior are very limited. These ideas have only appeared in several studies on a specific psychological-behavioral aspect such as the study by Kaplan *et al.* (2022) on CEO overconfidence.

To fill this gap in the current literature, we investigate the impacts of firm performance on CEO overconfidence by using panel data including 733 companies in the U.S. from 2015 to 2021. Our sample firms operate in different sectors and consist of both financial and non-financial firms. Compared with non-financial enterprises, the group of enterprises operating in the financial industry is considered relatively specific and is often separated for separate observations in previous studies. In this paper, we investigate both financial and non-financial firms to provide a more comprehensive picture and to examine whether there are differences in the effects of

firm performance on CEO overconfidence in financial and non-financial sectors. Additionally, the research time (from 2015 to 2021) covers the period before and during the COVID-19 pandemic, in which 2020 and 2021 are years when the economy, politics, and society have the most fluctuations due to the COVID-19 pandemic. From this basis, our paper will also study the difference in the influence of performance on CEO overconfidence at financial firms and non-financial firms in the period before and during the COVID-19 pandemic and the moderating role of COVID-19 pandemic in the effect of firm performance on the CEO overconfidence.

Our study contributes significantly to the existing literature by unveiling a compelling relationship between firm performance and CEO overconfidence. It appears that when companies achieve enhanced performance, there is a corresponding rise in the likelihood of CEOs displaying overconfident behaviors. Successful firms tend to foster greater overconfidence in their leaders' decision-making processes.

A noteworthy finding emerges when we explore the impacts of CEO overconfidence in different types of firms, particularly within the financial and non-financial sectors. We discern a compelling pattern where non-financial firms, particularly those with robust performance, are more inclined to have CEOs who exhibit overconfident traits when compared to their counterparts in the financial industry.

Moreover, our investigation encompasses the periods before and during the COVID-19 pandemic. A consistent positive relationship between firm performance and CEO overconfidence is evident in both time frames. However, a particularly noteworthy observation indicates that firm performance has a more pronounced influence on CEO overconfidence during the COVID-19 pandemic than it did in the pre-pandemic era. This underscores the significance of economic context in shaping CEO behavior and the response to external challenges.

This study is organized in the following manner. Firstly, we examine the relevant studies on CEO overconfidence and its influence on firm performance as documented in the current body of literature. Subsequently, hypotheses are formulated in section 2. Section 3 explains our methodology for sample selection and the generation of variables. In section 4, a thorough analysis and discussion of our empirical findings are conducted. This study concludes with an extensive examination and final remarks in section 5.

2. Theoretical frameworks and hypotheses

2.1 Firm performance and CEO overconfidence

The analysis of the direct effects of corporate activities on the psychology and behavior of CEOs is an issue that has not been thoroughly studied in contemporary academic discussions. There is a lack of studies that thoroughly examine the complex relationships between organizational activities and the psychological reactions of CEOs. Existing research addressing this intersection primarily concentrates on psychological and behavioral aspects. As an illustration, Cronqvist *et al.* (2012) conducted a groundbreaking investigation, examining the degree of behavioral consistency in the corporate finance decisions made by overconfident CEOs. Their research

sheds light on how organizational activities can impact the cognitive processes that support financial decision-making. Similarly, Kaplan *et al.* (2022) made noteworthy advancements by examining the occurrence of CEO overconfidence and elucidating how business actions can potentially influence a CEO's cognitive biases, resulting in an inflated perception of their capabilities. Although these studies offer valuable insights into the relationship between corporate operations and the psychological aspects of executive leadership, the current body of literature is still restricted. The importance of these contributions highlights the urgent requirement for additional investigation in this captivating yet underexplored field.

In addition, Fich and Shivdasani (2006) discover that corporate governance structures are essential in mitigating the possible adverse effects of CEO overconfidence. They specifically concentrated on the impact of board monitoring as a crucial governance measure. The study discovered that strong board oversight serves as a vital corrective measure to mitigate the possible risks linked to CEO overconfidence. Boards that actively monitor and critically evaluate the decisions and actions made by CEOs who display excessive confidence can effectively operate as gatekeepers. They can prevent the CEOs from taking excessive risks and ensure that the strategic choices made by the CEOs align with the company's long-term interests. This study highlights the significance of well-functioning governance systems in preserving a harmonious equilibrium between promoting strategic innovation and mitigating the possible negative consequences of excessive self-assurance, thus ensuring the overall well-being and longevity of the business. The results emphasize the importance for firms to consistently improve and reinforce their governance structures to traverse the intricacies caused by CEO overconfidence in strategic decision-making.

On the other hand, our study is related to numerous studies on CEO overconfidence. In the current literature, CEO overconfidence has been shown to affect many aspects of economics. Fairchild (2009) found that an overconfident CEO can create more value by leading a company to take on more projects. Various studies have the same finding. Overconfident behavior by managers can overcome underinvestment and reduce the financial difficulties that firms face (Gervais *et al.*, 2003; Hackbarth, 2009). Overconfident CEOs are willing to participate in mergers and acquisitions that can drastically change value (Goel and Thakor, 2008). Moreover, CEOs who are overconfident are more likely to engage in higher levels of risk-taking and show a stronger readiness to pursue riskier ventures. They are also often seen as more innovative in industries focused on innovation. De Marchi (2012) suggests that CEOs who exhibit overconfidence are more inclined to excel as green innovators compared to those who do not display overconfidence (Galende, 2006).

However, the current research on behavioral finance has not thoroughly explored the influence of CEO overconfidence on firm value. Ye and Yuan (2008) provide one of the limited studies that experimentally investigate this connection in Chinese companies. They analyze the relationship by assessing the effect on firm value from investments. Their equation model considers firm value, CEO overconfidence, and investment as endogenous variables. The study shows a positive correlation between overconfident CEOs and company values, which later shifts to a

negative correlation. The authors propose that there exists an ideal level of overconfidence that can generate value for the firm. Their findings are consistent with previous studies suggesting that the relationship was U-shaped. Based on these above arguments, we propose a positive relationship between firm performance and CEO overconfidence in the following hypothesis:

H1: Better firm performance increases CEOs' likelihood of expressing overconfidence.

2.2 Firm performance and CEO overconfidence between financial and non-financial firms

Traditionally, theorists studying industry organizations have emphasized that the type of firm is a key factor in determining its effectiveness (Bain, 1954; Schmalensee, 1985). This viewpoint originates from the belief that various sorts of companies have a significant impact on enhancing business performance and influencing certain attributes inside the operational framework. Researchers such as Sakakibara (2002), Short *et al.* (2007), and Lee (2009) have highlighted that the effect of a company's type on its performance is not random. Instead, variations among different types of companies significantly impact the strategic choices made by these companies, ultimately influencing their overall performance.

Notably, financial institutions have frequently been regarded as separate entities requiring individual scrutiny. For instance, Foerster and Sapp (2005) conducted an extensive study encompassing both financial enterprises and non-financial firms in G7 countries, the Netherlands and Switzerland. The study covered the period from 1973 to 2000. Their study compared the consequences of excluding financial institutions from risk variables in different asset pricing models. Studies in the financial industry have explored the correlation between CEO overconfidence and risk issues. These studies have primarily focused on banks, insurance companies, and non-financial organizations. Ho *et al.* (2016) discovered that CEOs in banks who displayed excessive confidence were more prone to lowering lending requirements and increasing leverage during a crisis, in contrast to other CEOs. This made them more susceptible to shocks caused by the crisis. Mouna and Anis (2017) found that CEO overconfidence in non-financial enterprises has a notable adverse effect on future enterprise operations.

Given the divergent perspectives on industry effects and the unique considerations for financial institutions, this study aims to classify firms into financial and non-financial categories. This classification will comprehensively explore the moderating industry effect on the relationship between firm performance and CEO overconfidence. In doing so, we seek to contribute novel insights, being one of the first studies to investigate how disparities in the performance of financial and non-financial firms influence the overconfident behavior of their CEOs. The following hypothesis will be explored in this study:

H2: Firm performance has a different effect on CEO overconfidence across financial and non-financial firms.

2.3 CEO overconfidence and firm performance in the COVID-19 pandemic

The COVID-19 pandemic outbreak has triggered the worst global recession since 1930 (Vernengo and Nabar-Bhaduri, 2020). On the corporate level, the COVID-19 outbreak affects

the stock market (Iyke, 2020; Liu *et al.*, 2020), firm performance in the energy industry (Phan and Narayan, 2020), and other aspects (Hagerty and Williams, 2020). Previous studies have investigated the country response and stock market response to COVID-19 as a whole (Al-Awadhi *et al.*, 2020; He *et al.*, 2020; Liu *et al.*, 2020), thereby creating the limitation of studying the impact of the pandemic at the market level in general, that is, assuming COVID-19 has the same impact on all sectors. Narayan *et al.* (2013) argue that industries are heterogeneous and, therefore, can respond to market shocks differently. Phan *et al.* (2015) also found strong evidence that return predictability is associated with certain industry characteristics. Therefore, the supply-demand relationship changes according to the industry's characteristics during the pandemic outbreak.

In examining the role of CEO overconfidence amidst the challenges and opportunities presented by the COVID-19 pandemic, previous studies offer a comprehensive exploration (e.g., Hu *et al.*, 2020; Du, 2023; Karthaus and Strese, 2022). Commonalities among these studies include a central focus on CEO overconfidence and its pervasive influence on various aspects of firm behavior and performance. Recognizing the complexities within this relationship, each study delves into the nuanced aspects, considering factors such as ex-ante risk, gender differences, and environmental dynamism.

While the studies converge in their shared focus on CEO overconfidence, they diverge in the specific outcomes under scrutiny during COVID-19. Hu *et al.* (2020) concentrate on firm performance, particularly stock market returns, offering insights into the immediate impacts of CEO overconfidence. In contrast, Du (2023) navigates the intricacies of CEO overconfidence by examining its relationship with investment behavior during the pandemic, uncovering both overinvestment and the emergence of underinvestment as prevalent issues. Karthaus and Strese (2022) contribute a unique perspective by exploring CEO overconfidence in the context of digitalization efforts among small- and medium-sized enterprises (SMEs), thereby broadening the scope of outcomes studied.

Further distinctions arise in the studies' consideration of gender differences, industry-specific contexts, and temporal dynamics. Du's (2023) explicit investigation into potential gender distinctions in the effects of CEO overconfidence added a layer of complexity to the overall understanding. Karthaus and Strese (2022) focus on SMEs and provide insights into a specific industry and firm type, contributing to a more tailored comprehension of CEO overconfidence in diverse organizational settings. Temporal considerations further distinguish the studies, with Hu *et al.* (2020) and Du (2023) examining the immediate impact during the pandemic, while Karthaus and Strese (2022) extending their exploration into digitalization efforts during and beyond the crisis.

In summary, the collective exploration of CEO overconfidence within the context of the COVID-19 pandemic offers a nuanced understanding of its multifaceted impacts on organizational outcomes. While shared themes provide a foundational understanding, diverse outcomes, and contextual considerations contribute to a comprehensive perspective on the

role of CEO overconfidence in shaping firm behavior and performance during times of crisis. Taking all the above arguments and studies, the following hypothesis is suggested:

H3: The COVID-19 pandemic has a moderating effect on the link between firm performance and CEO overconfidence across financial and non-financial firms.

3. Research methodology

3.1 Sample selection

Our study exclusively focuses on a sample of 733 firms listed in the United States (U.S.) to investigate the relationship between firm performance and CEO overconfidence. By spanning the period from 2015 to 2021 and encompassing diverse industries, including both financial and non-financial sectors, our study aims for a comprehensive understanding that reflects the nuances of the U.S. business landscape. This deliberate selection ensures a rich dataset comprising 3,274 observations, which forms the robust foundation for our in-depth analysis.

A stringent criterion was meticulously applied to maintain the data reliability and integrity. Only companies that appeared in the list of the largest U.S. companies at least three times between 2015 and 2021, as recognized by Forbes, were included. This strategic criterion adds a layer of credibility to our dataset, providing a more nuanced perspective on the intricate relationship between firm performance and CEO overconfidence. By focusing exclusively on U.S. firms, we aim to capture the unique dynamics and contextual factors within the American business landscape, ensuring that our findings are rigorous, relevant, and applicable to the specific conditions of U.S.-based financial and non-financial firms.

The research data itself, a critical component of our study, was meticulously sourced from S&P Capital IQ. As a renowned financial information platform, S&P Capital IQ is celebrated for its precision in delivering financial data and conducting thorough industry analyses. This careful selection of data sources further enhances the credibility and accuracy of our study, reinforcing the reliability of the insights we aim to derive from this targeted sample of U.S. firms.

3.2 Variable construction

3.2.1 Measuring CEO overconfidence

Our study aligns with the methodology introduced by Malmendier and Tate (2005), adopting the Holder67 method as a key metric for assessing CEO overconfidence. Expanding upon this framework, we enhance the depth of our analysis by incorporating a broader range of options exercises into our study. As per Malmendier and Tate's criteria, the classification of a CEO as overconfident is contingent upon whether the average value of options held by the CEO reaches 67% or exceeds it. To implement this criterion, we establish a dummy variable, assigned a value of 1 when the average value surpasses the 67% threshold and 0 otherwise. This operationalization, drawing inspiration from Malmendier and Tate (2005), ensures consistency and facilitates a thorough and nuanced evaluation of CEO overconfidence, elevating our study's comprehensiveness and significance.

3.2.2 Measuring firm performance

In this paper, we use Tobin's Q as a measure of firm performance. There is consensus in the financial literature that Tobin's Q is often used as a market-based metric to assess a company's performance. Previous studies on the relationship between CEO overconfidence and firm performance have used this proxy (Yermack, 1995; Malmendier and Tate, 2005; Saeedi and Mahmoodi, 2011; Hirshleifer *et al.*, 2012). Brainard and Tobin (1968) define Tobin's Q as the market value of a stock divided by the replacement cost of the asset. Since it is difficult to accurately estimate the replacement cost of an asset because it requires many assumptions and all the necessary data are not always available, most studies use a simplified version of Tobin's Q and replace the cost with the book value of the asset. In this study, Tobin's Q is measured by the market value to the book value of a firm's total assets in a financial year. Table 1 below describes the variables in the study.

Table 1. Variable description

Variable	Explanation	Sources
CEO overconfidence	A dummy variable that takes the value 1 if it is above the threshold and 0 otherwise. The threshold is that the average value of options the CEO holds is at least 67% or higher (Malmendier and Tate, 2005).	Authors' calculation
Firm performance	Tobin's Q is measured by the market value to the book value of a firm's total assets in a fiscal year.	Authors' calculation
Total assets	Total assets	S&P Capital IQ
Cash flow	Cash flow to equity ratio	S&P Capital IQ
Financial firm	The dummy variable equals 1 if the company operates in the financial industry, and 0 otherwise.	Authors' calculation
CEO ownership	The proportion of a company's ownership stake held by its CEO (%).	S&P Capital IQ
Compensation	The annual compensation of the CEO comprises the sum of salary, bonus, nonequity incentive, stock awards and compensation, and other incentive compensation.	S&P Capital IQ
Tenure	CEO's working time in years.	S&P Capital IQ
Age	CEO's age in years	S&P Capital IQ
Founder	The dummy variable equals 1 if the CEO is the founder of the company and 0 otherwise.	Authors' calculation
Master degree	The dummy variable equals 1 if the CEO has a Master's degree and 0 otherwise.	Authors' calculation
Gender	The dummy variable equals 1 if the CEO is female and 0 otherwise.	S&P Capital IQ

Source: Authors' compilation

3.2.3 Variables related to CEO characteristics

CEO compensation

In many reputable studies such as Malmendier and Tate (2005), and Hirshleifer *et al.* (2012), CEO compensation is considered an important variable affecting CEO overconfidence. Chung and Pruitt (1994) find a positive and strong correlation between compensation and Tobin's Q. Therefore, in this study, we use CEO compensation, which is measured as the sum of salary, bonus, nonequity incentive, stock awards and compensation, and other incentive compensation, as a control variable. CEO compensation is expected to have a positive impact on firm value.

Age and tenure of CEO

According to Serfling (2014), who provides a comprehensive examination of how the age of the CEO affects business policy, younger CEOs are associated with a rise in the value of the company. A control variable that is frequently used to reflect managerial ownership or risk aversion is the length of time that a CEO has been in their position (Berger *et al.*, 1997; Coles *et al.*, 2006). Both of these studies demonstrate that CEOs who have been in their positions for a longer period are less likely to improve the value of the company. Jang (2020) comes to a similar conclusion, stating that CEOs tend to grow overconfident during their present term as CEOs, but they get less overconfident as they age. This could be due to the fact that people tend to become less optimistic and more realistic as they get older.

CEO education

The research conducted by Jang (2020) demonstrates that there is a correlation between the educational background of the CEO and their level of overconfidence. Managers who have a background in financial education tend to exhibit more overconfident behavior than those who have a background in engineering or other sorts of education. One possible explanation for this outcome is that chief executive officers who have a degree in finance tend to overestimate their capabilities as managers. CEOs with more financial training and longer management experience are found to be prone to overconfidence. This study speculates a positive relationship between CEO education and CEO overconfidence.

3.3 Models specification

Previous studies, such as Vitanova (2021) and Dittrich *et al.* (2005), have extensively examined the impact of firm performance on CEO overconfidence using logit or probit models. These analyses typically involve a binary dependent variable, coded as 1 for CEOs exhibiting overconfidence and 0 for those who do not. The underlying logic suggests that under the influence of firm performance, CEOs may either display overconfident behavior or not. The primary objective of these models is to predict the probability of a CEO, with a specific set of attributes, expressing overconfidence. In doing so, they aim to uncover how firm performance determines the likelihood of CEOs exhibiting overconfident behavior. The logit model relies on the logistic distribution function, while the probit model is grounded

in the normal cumulative distribution function. Consequently, we proceed with employing a series of Probit models in a general format, denoted as equation (1) and equation (2), in the subsequent analyses as follows:

$$CEO\ overconfidence_{it} = \alpha + \beta_1 firm\ performance_{it} + \beta_2 ln\_Totalasset_{it} + \beta_3 cashflow/equity_{it} + \beta_4 financial\ firm_{it} + \beta_5 financial\ firm_{it} * firm\ performance_{it} + \beta_6 CEO\ ownership_{it} + \beta_7 compensation_{it} + \beta_8 tenure_{it} + \beta_9 Age_{it} + \beta_{10} founder_{it} + \beta_{11} Master\ degree_{it} + \beta_{12} CEOownership_{it} + \beta_{13} Gender + \varepsilon_t, \quad (1)$$

$$CEO\ overconfidence_{it} = \alpha + \beta_1 firm\ performance_{it} + \beta_2 Covid\text{-}19 * firm\ performance_{it} + \beta_3 Covid\text{-}19 + \beta_4 ln\_Totalasset_{it} + \beta_5 cashflow/equity_{it} + \beta_6 financial\ firm_{it} + \beta_7 financial\ firm_{it} * Covid\text{-}19 + \beta_8 CEO\ ownership_{it} + \beta_9 compensation_{it} + \beta_{10} tenure_{it} + \beta_{11} Age_{it} + \beta_{12} founder_{it} + \beta_{13} Master\ degree_{it} + \beta_{14} CEOownership_{it} + \beta_{15} Gender + \varepsilon_t \quad (2)$$

where *CEO overconfidence* is a binary variable that signifies if a CEO displays overconfidence in a given year, denoted as year t; *Firm performance* is Tobin's Q ratio of firm *i* at year *t*, measured by the market value to the book value of a firm's total assets in a fiscal year; α is the intercept; ε_t is the error terms clustered by industry; β_1 come β_{12} are the estimated coefficients. The variables are denoted and explained in Table 1.

In addition, it is possible that standard errors are inflated as a result of interdependence at the company level in a pooled cross-section regression. Therefore, we utilize a clustering method to address the issues of heteroscedasticity and serial correlation in the standard errors.

4. Empirical results and discussion

4.1 Descriptive summary

Table 2 reports descriptive statistics of the main variables based on data from 2015 to 2021. The mean firm performance value of 1.53 suggests that the market valuations of the enterprises in our sample exceed the cost of replacing their capital stock. Put simply, our sample organizations are generally perceived as efficient in resource utilization. With an average of approximately 0.206, the number of financial firms accounted for about 21% of the observed firms.

When examining various variables associated with CEOs in our study, a notable finding is the mean level of CEO overconfidence, which stands at approximately 42%. This statistic suggests that, on average, CEOs in our sample are inclined towards displaying overconfident behaviors. Furthermore, the data reveals that our sample CEOs typically hold their positions for an average of 10.5 years, demonstrating a significant degree of stability and experience in their roles. In terms of age, the average age of these CEOs is 51 years. Moreover, a substantial 21.5% of the CEOs in our study possess master's degrees, underscoring the educational qualifications within this group. Finally, it is worth noting that female CEOs comprise 38.6%

of our sample, indicative of a growing trend towards gender diversity in executive leadership positions.

The correlation coefficients among variables are reported in Table 3. We observe that the correlation of the pairs of variables is always below 0.5. The variables "compensation" and "tenure", and the pair of variables "age" and "tenure" display the highest correlation of 0.333, and 0.286, respectively. This pattern of correlation coefficients across the various variables leads us to a preliminary conclusion that there is no significant autocorrelation present within the model. Besides, the results of Table 3 suggest that the impact of business activities, founders, total assets, and CEO ownership can be positively related to CEO overconfidence. Meanwhile, age, tenure, and gender have a negative correlation with the overconfident behavior of CEOs.

Table 2. Descriptive summary

Variable	Number of observations	Mean	Standard deviation
CEO overconfidence	2,419	0.418	0.493
Firm performance	3,424	1.527	1.984
Total assets	3,495	270,731	222,511
Cash flow/equity	3,394	0.206	0.344
Financial firm	3,588	0.206	0.406
CEO ownership	2,913	5.163	9.244
Compensation	3,515	13,506	11,583
Tenure	3,574	10.505	6.936
Age	3,552	51.523	48.515
Founder	3,552	0.361	0.480
Master degree	3,262	0.215	0.411
Gender	3,552	0.386	0.694

Source: Authors' calculation

Table 3. Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) CEO overconfidence	1											
(2) Firm performance	0.139***	1										
(3) Total assets	0.067***	-0.155***	1									
(4) Cash flow/equity	0.010	0.027	-0.055***	1								
(5) Financial firm	-0.275***	-0.092***	0.296***	-0.018	1							
(6) CEO ownership	0.052***	-0.053***	-0.256***	0.001	-0.091***	1						
(7) Compensation	-0.021	-0.011	-0.067***	-0.027	0.046**	-0.031*	1					
(8) Tenure	-0.038*	-0.001	0.011	0.019	0.083***	0.271***	0.340***	1				
(9) Age	-0.114***	0.023	0.038**	-0.059***	-0.091***	0.153***	0.075***	0.331***	1			
(10) Founder	0.069***	-0.062***	-0.193***	0.049***	-0.115***	0.196***	0.041**	0.092***	-0.104***	1		
(11) Master degree	0.122***	0.016	0.109***	-0.019	-0.042**	-0.102***	-0.023	-0.051***	-0.043**	-0.012	1	
(12) Gender	-0.034*	0.002	-0.032*	-0.009	-0.016	-0.012	0.011	0.03*	0.007	0.044***	-0.019	1

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculation

4.2 The effect of firm performance on CEO overconfidence

The findings from our probit regression analysis, with CEO overconfidence as the dependent variable, are presented in detail in Table 4. These results align with the expectations outlined in Hypothesis 1, revealing a clear and statistically significant relationship between firm performance and a CEO's likelihood of displaying overconfidence. Our analysis indicates a positive association with a substantial significance level of 1%. In other words, as firm performance improves, there is a heightened probability that the CEO will exhibit overconfident behavior. This outcome strongly supports the earlier work by Vitanova (2021), highlighting the pivotal role of firm power as a determinant in shaping leader overconfidence. It underscores the critical link between firm performance and the overconfidence tendencies of its CEOs, shedding light on the intricate dynamics at play within the corporate landscape.

We also find that CEO's overconfidence is affected by their ownership percentage. In particular, the -0.075 estimated coefficient on CEO ownership is negatively significant at the 10% level, suggesting that CEO ownership percentage has a negative impact on CEO overconfidence. The increase in CEO ownership reduces the CEO's probability of demonstrating overconfidence. According to Vitanova (2021), research on the relationship between overconfident behavior and power in corporate governance indicates that

CEO overconfidence is endogenous because it positively correlates with the amount of power a particular leader holds. Further, that negative relationship implies that conflict between managers and executives is reduced, so the CEO has to shoulder more responsibilities and become more cautious with his decision-making, thereby curbing the CEO's overconfidence.

Regarding CEO demographic variables, the estimated coefficient for a master's degree is about 0.269, indicating the positive effect of CEO education levels on their overconfidence. This result is in line with Jang's (2020) study that CEO overconfidence is correlated with educational background. A Master's degree partly shows the CEO's knowledge, professional skills, and vision, thereby increasing the CEO's confidence in business management. Therefore, the positive effect of education level on CEO overconfidence is quite reasonable.

Interestingly, the -0.019 estimated coefficient on the variable of age demonstrates that the higher the CEO age is, the lower their probability of exhibiting overconfidence. A potential explanation is that CEOs become more loss-averse and patient when they are older (Kim and Nguyen, 2022), which reduces their overconfidence. Furthermore, we also observe that female CEOs are less overconfident than their male counterparts. Female managers may be more risk and loss-averse than male managers (Kim, 2023).

Table 4. Probit estimations for the impact of firm performance on CEO overconfidence

CEO overconfidence	Coefficients	P-value
Firm performance	0.149***	0.000
Total assets	0.048	0.742
Cash flow/equity	-0.017	0.570
Financial firms	-0.097***	0.000
Financial firm * firm performance	0.194**	0.048
CEO ownership	-0.075*	0.067
Compensation	0.013***	0.000
Tenure	0.058*	0.097
Age	-0.019***	0.000
Founder	0.084	0.208
Master degree	0.269***	0.000
Gender	-0.310**	0.038
Intercept	0.621*	0.083
Industry dummies	Yes	
Year dummies	Yes	
No of observations	2,419	

Notes: Standard errors are clustered by industry. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculation

4.3 The impact of firm performance on CEO overconfidence by firm types

Within this section, we investigate the intricacies of CEO overconfidence and its relationship with firm performance, focusing on the potential variations across different types of firms, namely financial and non-financial organizations. To explore these dynamics, we generate interaction terms between financial firm indicators and firm performance within our subsequent Probit regression models in Table 4. This approach allows us to discern whether the influence of firm performance on CEO overconfidence differs between these distinct categories of firms.

Table 4 reveals distinctions in the effects of firm types on CEO overconfidence. The negative and statistically significant coefficient associated with the financial firm indicator suggests that CEOs in financial firms are less inclined to exhibit overconfidence than their counterparts in non-financial firms.

Furthermore, when we investigate the relationship between firm performance and CEO overconfidence within different firm types, we find a clear and consistent pattern that aligns with the insights discussed in the preceding section. Specifically, the impact of firm performance on the level of overconfidence exhibited by its CEO is greater in non-financial firms compared to financial firms. This difference is evidenced by the estimated coefficients of 0.149 on firm performance, and the coefficients of 0.097 on financial firms dummy and interaction terms between the financial firm indicator and firm performance.

These findings indicate that non-financial firms with better performance are more likely to have overconfident CEOs compared to CEOs in financial firms. This outcome supports hypothesis H2 and aligns with our earlier finding, emphasizing the significant influence of firm performance on CEO overconfidence. Significantly, this impact is particularly evident among CEOs in firms highly responsive to non-financial dynamics, strengthening the logical link between industry characteristics and the prevalence of overconfident behaviors among CEOs in the non-financial sector.

4.4 Impacts of firm performance on CEO overconfidence before and during the COVID-19 period

4.4.1 Univariate test

In this section, we explore potential differences in CEO overconfidence and firm performance between the pre-COVID-19 and the pandemic era. To do so, we employ t-tests to assess all relevant variables. Concerning CEO overconfidence, we observe a clear and noticeable change. The mean CEO overconfidence before the COVID-19 pandemic stood at 0.516, whereas the mean CEO overconfidence dropped to 0.345 during the pandemic. This change results in a significant mean difference of 0.171. The COVID-19 pandemic has significantly affected CEO overconfidence, with CEOs displaying a reduced tendency to exhibit overconfidence during the pandemic compared to the pre-COVID-19 period.

Regarding firm performance, it is evident that the COVID-19 pandemic, primarily attributed to operational inefficiencies, has had a widespread impact on businesses. The financial indicators, such as total assets and cash flow/equity, have shown notable declines compared to 2015-2019. Specifically, the mean value of firm performance has decreased from 1.654 in the pre-COVID-19 era to a mean value of 1.579 during the pandemic, resulting in a statistically significant mean difference of 0.075.

Table 5. Univariate test

Variable	Before the COVID-19 pandemic (2015-2019)			During the COVID-19 pandemic (2020-2021)			T test (mean before - during the COVID-19 pandemic)
	Number of observations	Mean	Standard deviation	Number of observations	Mean	Standard deviation	
CEO overconfidence	1,414	0.516	0.499	1073	0.345	0.475	0.171***
Firm performance	2,141	1.654	1.385	1283	1.579	1.842	0.075**
Total assets	2,161	5.823	2.529	1334	5.674	2.498	0.149*
Cash flow/equity	2,086	30.219	48.124	1308	12.298	72.103	17.921
CEO ownership	1,962	5.206	9.277	1300	5.133	9.223	0.073
Compensation	1,721	13.560	15.485	1192	13.467	16.059	0.092
Tenure	2,154	11.515	8.245	1361	14.331	8.154	-2.816***
Age	2,190	51.563	53.189	1384	51.460	49.171	-0.102
Founder	2,175	0.363	0.481	1377	0.358	0.479	0.004
Gender	2,175	0.386	0.192	1377	0.384	0.192	0.013
Master degree	2,175	0.215	0.411	1377	0.218	0.417	-0.003

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculation

4.4.2 Multivariate analysis

In this section, we extend our analysis by conducting a pooled probit regression, introducing interaction terms that incorporate a proxy for firm performance and a COVID-19 dummy variable. This analysis allows us to further explore the influence of firm performance on CEO overconfidence, both before and during the COVID-19 pandemic. Results are reported in Table 6.

Table 6. Probit regression estimates of the firm performance's effect on CEO overconfidence before and during the COVID-19 pandemic

CEO overconfidence	Coefficients	P-value
Firm performance	0.157***	0.002
COVID-19 * Firm performance	0.454***	0.000
COVID-19	-0.055*	0.080
Total assets	0.043	0.817
Cash flow/equity	-0.021	0.278
Financial firms	-0.868***	0.000
COVID-19 * Financial firms	-0.312***	0.000
CEO ownership	-0.072	0.248
Compensation	0.010	0.661
Tenure	0.016	0.802
Age	-0.018***	0.000
Founder	0.099	0.265
Female	-0.122	0.316
Master degree	0.262***	0.004
Gender	-0.308*	0.062
Intercept	0.400	0.445
Industry dummies	Yes	
Year dummies	Yes	
No of observations	2,419	

Notes: Standard errors are clustered by industry. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors' calculation

We observe that while the coefficient associated with the COVID-19 variable displays a significant negative impact on CEO overconfidence, the coefficients related to firm performance and the interaction between firm performance and COVID-19 exhibit high significance and positive values. This pattern suggests that, during the COVID-19 pandemic, firm performance had a greater effect on CEO overconfidence compared to the pre-pandemic period.

This empirical finding provides robust support for hypothesis H3, reinforcing the proposition that CEOs with overconfident behavior demonstrate an increased inclination for risk-taking. This alignment is consistent with existing literature, notably the works of Hu *et al.* (2020) and Karthaus and Strese (2022), which posit that overconfident CEOs view uncertainty not as a deterrent but as an avenue for seizing opportunities. Notably, the COVID-19 pandemic significantly disrupted production and business activities across enterprises, leading many businesses to suspend operations or even close. In this challenging context, any firm performing

better than the baseline can be seen as a remarkable achievement. Such accomplishments can serve as a powerful motivator, potentially contributing to an increase in CEO overconfidence during COVID-19 compared to the preceding period.

Our finding is in line with Hu *et al.* (2020); while it is true that CEO overconfidence can sometimes lead to misjudgments regarding returns and risks in investments, the presence of overconfidence in a CEO's behavior can have a notable impact during the COVID-19 crisis. Within this particular framework, CEOs who possess excessive confidence may have the capacity to effectively oversee investor perception and cultivate trust, especially in the face of unfavorable news or obstacles linked to a pandemic. This implies that the overconfidence of a CEO can work as a beneficial element in reducing the adverse consequences of such situations. Their confidence and assertiveness may reassure investors, potentially influencing the perception of the company and its stock performance. This alignment with investor sentiment can, in turn, result in abnormal corporate and stock returns that deviate from what might be expected in more uncertain times. Hence, CEO overconfidence, while carrying certain risks, can, in specific scenarios, act as a stabilizing force and a source of resilience in the face of economic and market challenges.

5. Conclusion

This study investigates whether firm performance has an impact on CEO overconfidence. Our sample consists of 733 listed US companies from 2015 to 2021. The empirical findings shed light on several key dynamics. Notably, we discover that enhanced firm performance positively correlates with an increased likelihood of CEOs exhibiting overconfident behavior. In other words, CEOs tend to become more overconfident in their decision-making when firms perform well. Additionally, we identify a positive relationship between CEO education levels and overconfidence, suggesting that CEOs with higher educational qualifications are more likely to display overconfident traits.

Moreover, our analysis reveals that CEO age plays a significant role in shaping their likelihood of overconfidence. Older CEOs are less likely to display overconfident behaviors, indicating that age is inversely related to overconfidence.

A compelling pattern also emerges when we explore the nuances of CEO overconfidence in the context of different types of firms, specifically financial and non-financial firms. We observe that non-financial firms with stronger performance are more likely to have CEOs who exhibit overconfident tendencies when compared to their counterparts in financial firms. This suggests that the relationship between firm performance and CEO overconfidence varies across different sectors, with non-financial firms showing a more pronounced link between performance and overconfident CEO behavior.

Furthermore, we explore the connection between firm performance and CEO overconfidence in both the pre-COVID-19 and during the COVID-19 pandemic periods. We identify a consistently positive association between firm performance and CEO overconfidence in both time frames. However, a noteworthy observation is the amplified impact of firm performance

on CEO overconfidence during the COVID-19 pandemic compared to the pre-pandemic period. Additionally, we uncover that firm performance has been significantly affected by the COVID-19 pandemic. This is evident from the declines in key financial indicators, including corporate activity, total assets, and cash flow. These reductions underscore the significant impact of the pandemic on the financial health and operations of companies.

Nevertheless, our study has some limitations as follows. Firstly, we use an indirect method to measure CEO overconfidence. Although this method is widely used, there are still some limitations: limitations on research subjects (applicable only to leaders of large public companies that are granted stock options, can be different from the leaders' true beliefs because observations are binary variables). Secondly, we do not have many theoretical frameworks to develop a stronger hypothesis about the relationship between the financial industry and CEO overconfidence in general. Finally, we support the relationship between overconfident CEO behavior and firm performance, but with different business contexts, we cannot conclude this is a co-positive, co-negative, or mixed relationship.

While acknowledging its limitations, this research opens up a fresh perspective for businesses when it comes to selecting and managing executive overconfidence. It suggests that understanding the dynamics of overconfidence in corporate decision-makers can be pivotal in maintaining a balanced level of overconfidence that aligns with an optimal threshold. Striking this balance can facilitate the achievement of maximum profits and sustained growth for a company. Furthermore, from a research standpoint, this study has illuminated numerous intriguing research gaps. These gaps serve as valuable entry points for future researchers, inspiring them to delve deeper into the subject matter. Exploring these gaps could lead to a richer understanding of the complex interplay between executive behavior, firm performance, and the broader business landscape. As such, this study contributes to the current discourse and paves the way for further exploration and discovery in the realm of executive overconfidence and its implications for the corporate world.

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