

CEO Overconfidence and its Relationship with Overinvestment in the Context of the COVID-19 Pandemic

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Abstract

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This paper primarily focuses on examining the correlation between CEO overconfidence and firm investment. Initially, I aimed to investigate whether there are any differences in confidence levels between male and female CEOs. The outcome of my research was that I was unable to identify any notable differences in the effects of CEO overconfidence on investment between male and female executives. This implies that regardless of gender, when a CEO displays overconfidence, they are likely to exhibit a similar inclination towards overinvestment. Additionally, my research focuses on the impact of the COVID-19 pandemic on CEO overconfidence and its subsequent influence on firm investment behavior. My study successfully establishes this connection. Specifically, in the current context of the COVID-19 pandemic, the relationship between CEO overconfidence and investment ratios is expected to weaken. However, the primary reason for this weakening effect is the volatile economic climate brought about by the COVID-19 era. The pandemic has significantly influenced companies to reduce their investments, resulting in the emergence of underinvestment as a prevalent issue, irrespective of the level of CEO confidence. In addition, my research reveals that a high level of CEO confidence is not able to substantially augment investment levels or adequately mitigate the problem of underinvestment in light of the substantial disruptions caused by the pandemic.

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Chapter 1 Introduction

In the realm of behavioral finance, experts have made significant strides in pinpointing a range of behavioral biases that individuals tend to fall prey to when navigating their financial choices. These biases, known as behavioral biases, can be described as consistent mistakes that people make when confronted with uncertain situations, resulting in the creation of less-than-ideal decisions (Chen et al., 2007). Overconfidence is a commonly studied cognitive bias that occurs when people have an inflated perception of their own abilities, expertise, and predictions. This bias can be influenced by an individual's previous triumphs, leading them to believe they are more capable than they actually are. Additionally, overconfidence can also stem from a misguided sense of competence without any substantial evidence to back it up. In its most basic form, overconfidence can be defined as having excessive faith in one's own cognitive abilities, intuitive reasoning, and judgments, without any valid justification (Pompian, 2012). This mindset often leads individuals to underestimate the risks involved in a situation and overestimate their ability to control it or make accurate predictions. However, it should be noted that overconfidence can have both positive and negative consequences, acting as a double-edged sword. On one hand, it can propel individuals to attain powerful positions within an organization (Lubit, 2002). On the other hand, it can also serve as the root cause for corporate investment failures within the same organization (Malmedier & Tate, 2005).

In order to address the limitations imposed by traditional financial theories, it is essential to delve into approaches that take into account the behavioral aspects of individuals during a financial decision-making process (Bernstein, 1998). By doing so, a more comprehensive understanding of the decision-making process can be achieved. Companies are now faced with the formidable task of considering behavioral aspects, such as overconfidence, when making corporate investment decisions. One prominent form of overconfidence that has been extensively researched in the fields of strategic management and psychology is CEO overconfidence. This is primarily due to the fact that CEOs often exhibit a significant degree of overconfidence in their personalities, which enables them to ascend to influential decision-making positions within an organization (Lubit, 2002). Given the significant significance of corporate investment decision making, I am of the opinion that the level of overconfidence exhibited by CEOs is a key factor in elucidating the reasons behind corporate investment motivations and subsequent investment effectiveness. Conducting research in this realm will undoubtedly enhance our comprehension of the tangible outcomes stemming from CEO overconfidence.

In contrast to previous studies, my research stands out due to its incorporation of the unique context of the ongoing COVID-19 pandemic. The COVID-19 pandemic has resulted in an unparalleled global health crisis that has affected countries across the globe. In addition to the severe impact on public health, this unprecedented situation has also caused significant economic disruptions on a magnitude and rapidity that have never been witnessed before (Abadi et al., 2020; Baker et al., 2020). This sudden and unexpected shock has disrupted numerous business operations, resulting in a significant decline in revenues and cashflows. According to the US Bureau of Economic Analysis, corporate profits in the United States experienced a sharp decline of 11.8% to USD 1,569.2 billion in the second half of 2020, marking the steepest drop in profits since the last quarter of 2008 during the global financial crisis caused by the coronavirus. Given the unpredictability of this crisis, companies have been forced to reduce their investments and instead focus on building up precautionary savings. The investment behavior of corporations reflects their willingness to actively engage in new investment activities in order to promote organizational growth. Several factors unique to each firm, such as the rate of cash inflow, availability of bank loans, and cash holdings, play a significant role in determining their investment behavior. These factors are crucial in making decisions about new investments. The behavior of corporate investments is influenced by the prevailing social and economic conditions, as it is a situation-sensitive phenomenon. Any changes in the current economic or social conditions have a direct impact on managerial decisions regarding new investments. Additionally, the current pandemic situation has had a

significant impact on the way managers think (Ratten, 2020), and research has also shown that the personality traits of managers play a crucial role in influencing the investment decisions made by their firms (Sharma & Tarp, 2018). Based on these ideas, it can be argued that corporate firms may experience fluctuations in their investment patterns as a result of the current pandemic's impact.

During times of unprecedented challenges, the CEO of a company plays a crucial and indispensable role in effectively managing crises and safeguarding the long-term sustainability and success of the business. In relation to the issue of CEO overconfidence discussed in this paper, numerous studies have consistently revealed that CEOs who exhibit overconfidence tend to overlook potential risks and overinflate potential returns (e.g., Banjeree et al., 2015; Cain & McKeon, 2013; Goel & Thakor, 2008; Hirshleifer et al., 2012; Malmendier & Tate, 2008). Consequently, their decision-making processes may be less than optimal and have the potential to adversely impact their companies (Hiller & Hambrick, 2005). In light of the unparalleled and uncertain circumstances brought about by the ongoing pandemic, which have the potential to profoundly affect the economic landscape and even the mindset of chief executive officers (CEOs), I am deeply intrigued by the possibility of uncovering unforeseen advantages stemming from CEO overconfidence amidst this period of economic upheaval. The potential benefits, such as increased confidence and enthusiasm, deserve careful investigation and analysis during the pandemic.

It is a commonly held belief that CEOs who possess an abundance of confidence tend to downplay the potential risks associated with their decisions and overinflate the anticipated returns. However, it is crucial to acknowledge the fact that dispositional optimism, or the tendency to maintain a positive outlook, can wield a substantial influence on attaining success in various settings (Puri & Robinson, 2007). Specifically, I suggest that the excessive self-assurance displayed by chief executive officers could potentially offer significant benefits to a company amidst challenging circumstances, such as the persisting global health crisis caused by the coronavirus. According to Hillary et al. (2016), CEO overconfidence, which shares similarities with excessive optimism, can provide CEOs with certain advantages when it comes to developing effective strategies and taking decisive actions, especially in the face of challenging and intricate business environments. This is because a higher level of optimism can result in improved decision-making in economic matters, as demonstrated by Puri and Robinson (2007). In addition, CEOs who possess confidence may possess the ability to mitigate their risks by implementing swift and resolute operational or financial strategies, thereby safeguarding their exposure to potential challenges (Robert Baum & Wally, 2003). In addition to the aforementioned findings, Johnson and Fowler (2011) elaborate on the notion that in situations where resources are limited, the perception of overconfidence actually becomes beneficial. This idea is further substantiated by a number of empirical studies conducted within the corporate realm, which demonstrate that leaders who possess a positive outlook and a high perception of the likelihood of success are more likely to successfully compete for and eventually secure external funding (Dai et al., 2017; Eckhardt et al., 2006).

The findings mentioned above hold significant implications for reevaluating the relationship between CEO overconfidence and firm investment strategies within the framework of the COVID-19 pandemic. This implies that the COVID pandemic represents an extraordinary occurrence that can potentially reshape the interplay between CEO overconfidence and firm investment due to the ever-changing economic environment. Moreover, CEO overconfidence could also act as a unique element that helps alleviate the negative consequences of the pandemic.

When investigating the phenomenon of CEO overconfidence, I also consider the impact of gender differences. This is because numerous studies have consistently revealed that men generally exhibit greater levels of confidence in comparison to women.

The central theme of my research paper revolves around conducting a comprehensive analysis of the profound effects that an excessively self-assured chief executive officer (CEO) can have on a company's investment choices. Furthermore, I aim to shed light on the potential distinctions in behavior between male and female CEOs and delve into how these divergences may shape investment strategies. Additionally, I will thoroughly investigate how the prevailing

economic climate, especially the unprecedented COVID-19 pandemic, exerts its influence on investment decisions. Consequently, my study will offer a meticulous evaluation of the intricate interplay between CEO confidence, gender disparities, and the broader economic landscape. The study confirms that when CEOs are overconfident, firms tend to have a higher investment ratio. However, this does not necessarily mean they are overinvesting. The gender of the CEO does not significantly affect their inclination towards overinvestment. When it comes to overconfidence, male CEOs and female CEOs are equally likely to engage in overinvestment. The influence of CEO overconfidence on investment ratios depends on economic conditions, and during the COVID-19 pandemic, this influence is expected to decrease. The COVID-19 pandemic serves as a crucial factor causing companies to reduce their investments, which in turn leads to the problem of underinvestment regardless of the CEO's level of confidence. I also investigated whether CEO overconfidence could mitigate the negative impact of the COVID-19 pandemic on firm investment efficiency. However, the results showed that CEO overconfidence was not successful in addressing the problem of underinvestment during the pandemic. The paper I have written makes significant contributions to the existing research in two important ways. Firstly, I go beyond just examining the influence of CEO overconfidence on firm investment levels and also delve into the assessment of investment efficiency. Previous studies have largely neglected the exploration of firm investment efficiency, thus my research fills this gap in the literature. Secondly, I specifically situate my study within the context of the COVID-19 pandemic, which provides us with a unique and natural environment to understand the intricate relationship between CEO overconfidence, the broader economic landscape, and investment strategies. By conducting my analysis during such unprecedented times, I am able to gain valuable insights into how CEO overconfidence affects investment decision-making in the face of a global crisis. The paper is structured in the following manner. Firstly, a thorough literature review is conducted, which is divided into five sections: investment efficiency, the relationship between CEO overconfidence and corporate investment, the impact of gender on confidence, the effects of COVID on investment, and the influence of COVID on CEO overconfidence. Secondly, the methodology employed in this study is outlined, with a specific focus on the measurement of firm investment efficiency and CEO overconfidence. Following that, four hypotheses related to CEO overconfidence, CEO gender, investment level, investment efficiency, and the COVID-19 pandemic are put forward. Finally, the explanation of the process of collecting pertinent data on firms and CEOs is provided, along with the construction of regression models used to analyze the four hypotheses. In conclusion, I have executed the regression model, discussed the results, and drawn conclusions pertaining to the matter of CEO overconfidence and excessive firm investment.

Chapter 2 Literature review

2.1 Investment efficiency

According to the Modigliani and Miller (1958) framework, the primary determinant of a firm's investment decisions is the availability of profitable investment opportunities. In this paradigm, any investment project that generates a positive net present value (NPV) should be pursued by the firm. The theory posits that firms are inclined to secure funding for all projects that promise positive NPVs and to persist in investing until the additional benefit gained from each investment matches the corresponding cost incurred, as demonstrated by Hayashi (1982) and other researchers. In practical application, companies may encounter certain limitations on their ability to secure funding, thereby restricting managers from executing all projects with a positive net present value (e.g., Hubbard 1997). Previous research has indicated that certain elements, such as obstacles in the capital market, can potentially cause firms to deviate from their optimal investment strategies (Chen et al., 2017). Consequently, this deviation can lead to either an excessive investment or an insufficient investment. The overinvestment phenomenon is observed when managers deliberately make poor project choices to exploit and take control of resources belonging to certain firms. On the other hand, the

underinvestment phenomenon arises when companies, constrained by limited financial resources, opt out of potentially profitable projects with positive net present value due to the excessive expenses associated with accessing capital (e.g., Biddle et al., 2009).

2.2 CEO overconfidence and corporate investment

Psychologists have accumulated a vast amount of evidence which supports the notion that individuals tend to exaggerate and have an inflated perception of their own abilities. In the research conducted by Svenson (1981), individuals were surveyed regarding their proficiency as drivers compared to a specific group of drivers. The outcomes revealed that a majority of participants believed themselves to be more capable and less prone to taking risks compared to the average driver within their respective group. These findings were then compared to similar recent discoveries in various domains. Lastly, Svenson (1981) delved into the various potential consequences that can arise when individuals perceive themselves to be more competent than their peers. This perception of superiority can significantly impact decision-making processes, strategic planning efforts, and even one's inclination towards taking risks. In addition, it has been noted that CEOs and other high-ranking executives are more likely to display a heightened vulnerability to this bias. This could be attributed to the fact that individuals with significant expertise tend to exhibit a greater degree of overconfidence (Camerer & Lovallo, 1999) and this tendency becomes even more pronounced in circumstances where the link between actions and consequences is complex and intricately intertwined (Moore & Kim, 2003).

Studying corporate investment decision making is a highly significant topic in finance, and there is a vast body of research that investigates the influence of CEO overconfidence on both long-term and short-term corporate investment outcomes. According to the literature, the investments made by large corporations have often experienced various problems and shortcomings, which can mostly be attributed to the overconfidence of the CEOs. The connection between CEO overconfidence and corporate investments has developed through the observation of how CEOs make decisions regarding corporate investments. Current research on this connection allows for the direct measurement of their thoughts and emotions, enabling an interpretation of the reasons behind these decisions. This knowledge can aid in understanding the presence of biased behaviors in the decision-making process for corporate investments.

The hubris hypothesis, which was put forth by Roll (1986), serves as a potential explanation for corporate takeovers. According to this hypothesis, the excessive pride and overconfidence exhibited by decision makers within bidding firms can account for their willingness to make bids that surpass the current market price, resulting in a positive valuation error. In essence, this theory suggests that bidding firms, driven by hubris, end up paying an inflated price for their targeted companies.

The research conducted by Hayward and Hambrick in 1997 also provides evidence of the comparable occurrence of overpayment in acquisitions. The study conducted by Hayward and Hambrick (1997) focuses on examining how a chief executive officer's excessive self-confidence, also known as hubris, affects the substantial premiums paid for acquisitions. Through the analysis of 106 large-scale acquisitions, they have discovered that there are four key indicators of CEO hubris that have a strong correlation with the amount of premiums paid. These indicators include the acquiring company's recent performance, the positive media attention received by the CEO, a measurement of the CEO's inflated sense of importance, and a combined factor incorporating all three variables. On average, they have observed a decline in shareholder wealth for acquiring firms subsequent to acquisitions, and the level of CEO hubris and acquisition premiums directly align with the extent of these shareholder losses.

Eichholtz and Yönder (2015) examine the impact of CEO overconfidence on investment behavior and specifically analyze the acquisition and disposal of properties. The study reveals that REITs led by overconfident CEOs exhibit a higher tendency to invest, acquiring more assets and showing a decreased likelihood of selling assets, as long as they possess sufficient discretionary cash. Furthermore, it is discovered that managers who display overconfidence exhibit lower property investment performance, as evidenced by decreased net operating income and gains from real estate sales.

In conclusion, based on the findings of previous studies conducted by scholars, it has been observed that companies led by CEOs who demonstrate excessive confidence have a tendency to make bigger investments when faced with significant investment decisions within the organization. However, these substantial investments may not always align with the most optimal investment strategy.

2.3 Gender and confidence

Men demonstrate higher levels of overconfidence compared to women, as supported by research findings (Lundeberg et al., 1994). The degree of gender differences in overconfidence varies depending on the specific task being evaluated (Lundeberg et al., 1994). Several studies have provided evidence that the greatest disparities in self-assurance occur in tasks that are perceived to be more aligned with masculinity (Deaux & Emswiller, 1974; Lenney, 1977; Beyer & Bowden, 1997). According to Prince (1993), there is a notable disparity between men and women when it comes to their level of confidence in their financial knowledge and skills, with men generally displaying a higher degree of certainty in this domain. Upon casual observation, it becomes evident that there is a notable overrepresentation of men within the financial industry. It is anticipated that men will, in most cases, possess a higher level of overconfidence when it comes to their aptitude for making financial decisions in comparison to women.

2.4 COVID and investment

The economic effects of the COVID-19 pandemic have received considerable attention in academic research. The global economy has been profoundly impacted by the virus, leading to abrupt drops in consumer demand (Goodell, 2020; Hassan et al., 2020), substantial decreases in oil prices (Mensi et al., 2020; Rajput et al., 2021), a surge in unemployment rates (Campello et al., 2020; Coibion et al., 2020), and stringent social restrictions that have had significant repercussions on economic activities. At the level of individual companies, businesses have faced substantial declines in their stock prices and revenues (Fahlenbrach et al., 2021), depletion of their corporate cash reserves (Vito & Gómez, 2020), and an increased likelihood of bankruptcy for large corporations (Wang et al., 2020). Researchers have dedicated significant effort to thoroughly investigate the impact of the COVID pandemic on corporate investment.

The research conducted by Farooq et al. (2021) delves into the examination of how the COVID-19 pandemic has impacted the investment behavior of non-financial publicly listed companies in Pakistan. In order to achieve this objective, the authors utilize a comprehensive dataset spanning from 2010 to 2020 and employ the difference-in-differences (DID) model to quantitatively analyze the empirical relationship. The results obtained from the DID model reveal that the pandemic and the various measures implemented in response to it have had a notable and detrimental effect on corporate investment in capital. Throughout the course of the pandemic, firms have significantly scaled back their investment in fixed assets, largely due to a decline in productivity. Moreover, industries situated in heavily affected regions have experienced a decline in investment growth as a result of quarantine policies, restricted social activity, and the increased costs associated with acquiring new machinery. However, it is worth noting that this negative impact is somewhat alleviated for firms that possess a higher rate of cash inflow and greater access to bank loans. These financial factors serve as a protective mechanism against the challenges posed by the pandemic.

In a recent study conducted by Tawiah and O'Connor Keefe (2022), the impact of cash reserves on corporate investment in the midst of the COVID-19 pandemic was examined. The results of the study indicate a significant decrease in both Capital Expenditure and M&A levels, with declines of 37% and 71% respectively during this challenging period. However, it was observed that companies with substantial cash reserves were able to withstand the impact of the pandemic on their investment activities to a lesser extent. Specifically, companies that ranked in the 81st percentile in terms of cash holdings were able to maintain their capital expenditure and acquisition levels at rates similar to those before the pandemic. These findings highlight the adverse effect of the COVID-19 pandemic on corporate investment, but also emphasize the importance of accumulated cash reserves in mitigating this impact.

In the study of Hoang et al. (2022), they aim to examine how the actions taken by the US government in response to the COVID-19 pandemic, such as implementing strict social measures and providing economic support packages, have impacted corporate investment. Through their analysis of empirical data, they have discovered that while the overall level of investment has decreased due to the economic consequences of the pandemic, the government's response and economic support measures have actually had a positive effect on corporate investment when they account for the pandemic's impact on individual firms. Interestingly, they have found that the impact of economic support packages on corporate investment is more significant than that of health containment policies. Additionally, their research reveals that the influence of these government measures is weaker in companies with higher levels of political risk and investment irreversibility, but stronger in firms that have a higher degree of technological intensity. These findings offer valuable insights into how businesses have responded to government policies during the pandemic and highlight the importance of both social measures and economic support in revitalizing corporate investment and facilitating the overall economic recovery process.

In conclusion, numerous researchers have observed that the emergence and widespread effects of the COVID-19 pandemic have had a negative influence on corporate investment, leading to a reduction in investment levels by firms.

2.5 COVID and CEO overconfidence

As previously evidenced, there is a notable tendency for CEOs to exhibit overconfidence. Therefore, it is perplexing as to why CEO overconfidence persists as a prevailing phenomenon, despite the numerous adverse outcomes associated with it. Nonetheless, a growing body of research suggests that CEOs with excessive confidence can actually enhance the performance of companies and garner positive responses from the financial market. This is especially true when certain circumstances and efficient governance mechanisms are present.

In a study conducted by Reyes et al. (2020), it was discovered that there exists a positive relationship between CEO overconfidence and the performance of a firm. Additionally, the researchers also delved into the influence of the business cycle on this positive relationship between CEO overconfidence and firm performance. Their research suggests that during periods of economic expansion, overconfident CEOs have a greater positive impact on firms' performance. However, this effect is diminished during economic recessions. To investigate this relationship, they examined the Return on Equity of publicly listed US firms between 1992 and 2015, which includes significant events such as the bursting of the dot-com bubble in 2001 and the Great Recession of 2008-2009. Their analysis confirms that during expansion periods, the relationship between overconfident CEOs and firms' performance becomes stronger, but this effect is weakened during recessions.

In the study conducted by Hu et al. (2020), the researchers delve into the effects of CEO overconfidence on the performance of firms amidst the COVID-19 pandemic. The findings of their study highlight a noteworthy correlation between overconfident CEOs and significantly higher stock market returns, indicating that CEO overconfidence may have a pivotal role in bolstering investor confidence during times of crisis. To evaluate a firm's specific exposure to the pandemic, the authors employ a measure based on textual analysis, and their results demonstrate that CEO overconfidence effectively mitigates the adverse impact of such exposure. Furthermore, the authors shed light on how overconfident CEOs manage to instill confidence by actively promoting positive public sentiment and selectively withholding negative news during the pandemic. Nevertheless, it is important to note that the influence of CEO overconfidence diminishes when firms confront higher levels of pre-existing risk and weaker fundamentals. Overall, this study provides valuable insights into the positive aspects of CEO overconfidence during times of crisis.

The initial study conducted by Reyes et al. (2020) posits that there exists a positive correlation between CEO overconfidence and firm performance, although this association is contingent upon the macroeconomic conditions. The second study conducted by Hu et al. (2020) indicates that CEO overconfidence might mitigate the adverse effects of COVID-19 on firm performance. Based on my analysis, it can be inferred that COVID-19 has the potential to

act as a moderating factor in the association between CEO overconfidence and firm activity. Furthermore, CEO overconfidence can also potentially function as a moderating variable in the connection between the impacts of COVID-19 and firm outcomes.

Chapter 3 Methodology

3.1 Investment efficiency measurement

Investment efficiency is defined as the company's ability to undertake all projects that have a positive net present value (Gomariz & Ballesta 2014). Previous studies have not provided any clear indicators of the company's investment efficiency but Biddle et al. (2009) and Chen et al. (2011) have made some pioneering attempts. They first forecast the normal level of investment. After calculating the anticipated ideal investment, the authors proceed to determine the discrepancy between this expected value and the actual investment made, which is represented by the error term in the investment model. This comparison allows them to evaluate the extent of inefficiency present. In both of these two studies, the amount of investment anticipated for the upcoming year is predicted based on the level of growth opportunities available in the current year, which is measured by the rate of sales growth.

$$investment_{i,t} = \beta_0 + \beta_1 sales\ growth_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

I utilize the identical investment efficiency measurement as they do. First, I gather sales growth and investment data and construct the above regression analysis. Afterwards, I proceed to categorize companies according to the extent of the discrepancies observed in the residuals, which signify deviations from the anticipated level of investment. These groups serve as the dependent variable for further analysis and examination. To be more precise, I categorize companies on an annual basis by arranging them into four groups, known as quartiles, according to the residuals obtained from Equation (1). Firm-year observations that fall within the bottom quartile, which means they have the most negative residuals, are labeled as under-investing. On the other hand, observations that belong to the top quartile, indicating the most positive residuals, are categorized as over-investing. Lastly, observations that fall within the middle two quartiles are classified as the benchmark group. I assign three numerical values to the dependent variable (y) to indicate the respective investment efficiency scenarios: 0 denotes normal efficiency, 1 signifies underinvestment, and 2 represents overinvestment. In the section of the regression results that focuses on investment efficiency, I utilize a multinomial logit model to make predictions about the probability of a company falling within the top or bottom quartiles, as opposed to the middle two quartiles.

3.2 CEO overconfidence measurement

In my research, I primarily rely on an options-based measure of overconfidence, which is consistent with the existing literature on the subject. This particular metric is considered suitable because CEOs typically have a restricted range of investment diversification. As a result, it is reasonable for them to swiftly exercise their options as soon as they become highly profitable. As a result, when a CEO decides to hold onto these options even after they have become fully available for exercise, it signifies a level of excessive self-assurance or unwarranted optimism. In order to obtain a precise evaluation of overconfidence, I gather data that is accessible to the public and create a measure of overconfidence that is in line with the approach used by Humphery et al. (2016). To begin with, I initiate the process by conducting a thorough analysis of multiple factors that are instrumental in evaluating the level of confidence displayed by the CEO. Through this comprehensive examination, I am able to calculate a continuous measure of confidence.

$$confidence = \frac{average\ value\ per\ vested\ option}{average\ strike\ price}$$

where,

$$\text{average value per vested option} = \frac{\text{value of vested unexercised options}}{\text{number of vested unexercised options}}$$
$$\text{average strike price} = \text{stock price} - \text{average value per vested option}$$

Next, I proceed to establish the Overconfidence measure as a parameter that holds a value of one only if the Confidence measure reaches or surpasses 67% for two or more consecutive years. In such instances, I categorize the CEO as overconfident starting from the initial occurrence when the Confidence measure first attains or exceeds 67%.

3.3 Hypothesis development

Drawing upon a comprehensive examination and synthesis of scholarly literature pertaining to the interplay among CEO overconfidence, CEO gender, corporate investment, and the ramifications of the COVID pandemic, I propose the ensuing hypotheses.

First, based on the literature review, I have discovered that CEOs who are overconfident tend to invest more. Consequently, this investment level deviates from the optimal level of investment, which can be considered a form of investment inefficiency. An excessive investment amount can result in an overinvestment issue concerning investment efficiency. Therefore, I propose hypothesis 1.

Hypothesis 1: When a CEO is characterized as overconfident, they have a tendency to lead the company towards increased investment, resulting in inefficient investment efficiency, which can be referred to as overinvestment.

Additionally, I take into account the gender difference in CEO overconfidence. Numerous studies indicate that men tend to be more overconfident than women. Therefore, I believe that the impact of CEO overconfidence on firm investment will be more positive for male CEOs compared to female CEOs. Therefore, I propose hypothesis 2.

Hypothesis 2: Male CEOs tend to show a stronger connection between CEO overconfidence and both the amount and inefficiency of firm investments.

Additionally, I believe that the macroeconomic environment will impact the causal relationship between CEO overconfidence and firm investment. COVID is a global health crisis that also inflicts significant economic damage worldwide. In this highly uncertain environment, a lot of firms need to reduce their investment spending in order to save money for the stability of the firm. Therefore, it is logical to assume that the link between CEO overconfidence and firm investment will decrease during the COVID-19 pandemic, as firm investment is greatly impacted by it. Therefore, I propose hypothesis 3.

Hypothesis 3: The correlation between CEO overconfidence and investment amount as well as investment inefficiency may potentially be diminished by the COVID-19 pandemic.

Furthermore, I am interested in the advantages that CEO overconfidence can bring during the special time of COVID. Scholars primarily concentrate on the adverse consequences of CEO overconfidence, as it can affect managers' ability to make optimal decisions. However, overconfidence can also bring benefits, such as empowering managers, especially during COVID when a strong leader is needed by the firm. Therefore, I propose hypothesis 4.

Hypothesis 4: The overconfidence of CEOs during COVID-19 has the potential to reduce the negative impact of the pandemic on excessive investment and investment inefficiency.

3.4 Data

The company and CEO that I investigate in my dataset are from all of North America in the Compustat database. I gather data every year on personal information for CEOs and fundamental information for companies from the fundamentals annual section in Compustat. The range of data that I have selected spans from 2010 to 2022. I also collected annual compensation information from the annual compensation section of Execucomp in Compustat for CEOs. I collect data on the value of vested unexercised options and the number of vested unexercised options. Using this data, I calculate the average value per vested option by dividing the value of vested unexercised options by the number of vested unexercised options. Afterwards, I use the monthly stock files section in the CRSP database to obtain the monthly stock prices for these companies. Next, I start the calculation of the CEO overconfidence index

using the previously mentioned method. To begin, I find the average strike price by subtracting the stock price of the company at the end of the fiscal year from the average value per vested option of the CEO. Subsequently, the confidence percentage is calculated by dividing the average value per vested option by the average strike price. Afterwards, I proceed to establish the measure of Overconfidence using the previously mentioned method. I also collect data on the gender, tenure, age of CEOs, whether the fiscal year falls within the COVID period, and the industry of the firm from the fundamentals annual section in Compustat.

Afterwards, I collect information on Return on Assets (ROA) and Leverage (LEV) metrics from the Financial Ratios Suite by WRDS. I also gather data on the total assets and net cash flow of these companies from the fundamentals annual in Compustat. To represent the size of the company's assets, I calculate the natural logarithm of the total asset value. Furthermore, I determine the cash flow availability by dividing the net cash flow by the total asset value.

In addition, I gather sales information from the fundamentals annual section in Compustat and calculate the growth rate by dividing the difference between the current year's sales and the previous year's sales by the previous year's sales. Additionally, I obtain the total investment amount for each company by combining the values of Cash and Short-Term Investments, Equity, and Fixed Income categories from the fundamentals annual section in Compustat. After excluding data from banking and utility companies, the above mentioned regression analysis is conducted to study the relationship between firm investment amount and firm growth rate. Thus, I am able to obtain data regarding the efficiency of firm investments. I also calculate the investment ratio by dividing the investment amount by the total assets. This ratio is used to indicate the level of corporate investment, making it easier to compare firms of different sizes.

So far, I have gathered information on firm investment amount (Investment ratio), firm investment efficiency (Investment dummy), CEO overconfidence (Overconfidence), the gender of the CEO (Gender), and whether the current year is during the COVID-19 period (COVID), CEO tenure (Tenure), CEO age (Age), Return on Assets (ROA), Leverage (LEV), company size (Size), cash flow availability (Cash flow) and the industry of the firm (Industry). Explanations for the variables are provided in table 1. After removing all companies that do not have available data for the aforementioned variables, the final dataset I have consists of 2681 data entries from 41 different industries covering from 2011 to 2022. However, in order to meet the minimum number of data points required for regression analysis, I have excluded industry codes 1 and 20. Therefore, I am left with a total of 2678 data entries from 39 different industries covering from 2011 to 2022. Table 2 displays the distribution of these Fama French industries across fiscal years. Table 3 provides the descriptive statistics for the above variables. Firstly, I present descriptive statistics for the primary variables in regression equations (2)-(10) in panel A. Additionally, I am providing the distribution table that compares the levels of overconfidence during the COVID-19 pandemic with non-pandemic periods in panel B. When looking at panel B, it is evident that both during the COVID period and otherwise, the number of CEOs without overconfidence surpasses those with an overconfidence problem. However, the percentage of CEOs exhibiting overconfidence remains consistent. This implies that during the COVID period, there will not be a significant rise in the proportion of CEOs facing an overconfidence problem. This eliminates the distribution bias of the overconfidence variable.

3.5 Regression model

Afterwards, I begin creating regression models using the variables mentioned above. The primary independent variables investigated in this study comprise CEO overconfidence, gender, and the impact of the COVID-19 pandemic. The investment ratio and investment dummy are the two main dependent variables. Two variables that serve as control measures for CEO personal characteristics are the length of their tenure and their age. Four control variables at the firm level that can influence the firm's investment ratio include return on assets, leverage, firm size, cash flow adequacy and firm industry.

Based on the scholarly literature I have examined and the hypothesis I have proposed, my initial assessment focuses on determining the individual impacts of CEO overconfidence, CEO gender, and the existence of the COVID-19 pandemic on corporate investment. I am interested in examining the potential impact of three distinct factors on corporate investment:

CEO overconfidence, CEO gender, and the COVID-19 pandemic. I would like to investigate each of these factors separately to determine their individual effects.

$$Investmentratio = \beta_1 Overconfidence + \beta_2 Tenure + \beta_3 Age + \beta_4 Roa + \beta_5 Lev + \beta_6 Size + \beta_7 Caf + Industry\ fixed\ effects + \varepsilon \quad (2)$$

$$Investmentratio = \beta_1 Gender + \beta_2 Tenure + \beta_3 Age + \beta_4 Roa + \beta_5 Lev + \beta_6 Size + \beta_7 Caf + Industry\ fixed\ effects + \varepsilon \quad (3)$$

$$Investmentratio = \beta_1 Covid + \beta_2 Tenure + \beta_3 Age + \beta_4 Roa + \beta_5 Lev + \beta_6 Size + \beta_7 Caf + Industry\ fixed\ effects + \varepsilon \quad (4)$$

Afterward, I am interested in determining whether the correlation between CEO overconfidence and investment ratio will be influenced by gender and COVID-19.

$$Investmentratio = \beta_1 Overconfidence + \beta_2 Overconfidence * Gender + \beta_3 Gender + \beta_4 Tenure + \beta_5 Age + \beta_6 Roa + \beta_7 Lev + \beta_8 Size + \beta_9 Caf + Industry\ fixed\ effects + \varepsilon \quad (5)$$

$$Investmentratio = \beta_1 Overconfidence + \beta_2 Overconfidence * Covid + \beta_3 Covid + \beta_4 Tenure + \beta_5 Age + \beta_6 Roa + \beta_7 Lev + \beta_8 Size + \beta_9 Caf + Industry\ fixed\ effects + \varepsilon \quad (6)$$

Finally, I substitute the investment ratio with investment efficiency indicators and utilize a multiple logit model to evaluate the influence of investment efficiency employing a similar analytical approach as mentioned earlier.

$$Investmentdummy = \beta_1 Overconfidence + \beta_2 Tenure + \beta_3 Age + \beta_4 Roa + \beta_5 Lev + \beta_6 Size + \beta_7 Caf + Industry\ fixed\ effects + \varepsilon \quad (7)$$

$$Investmentdummy = \beta_1 Gender + \beta_2 Tenure + \beta_3 Age + \beta_4 Roa + \beta_5 Lev + \beta_6 Size + \beta_7 Caf + Industry\ fixed\ effects + \varepsilon \quad (8)$$

$$Investmentdummy = \beta_1 Covid + \beta_2 Tenure + \beta_3 Age + \beta_4 Roa + \beta_5 Lev + \beta_6 Size + \beta_7 Caf + Industry\ fixed\ effects + \varepsilon \quad (9)$$

$$Investmentdummy = \beta_1 Covid + \beta_2 Overconfidence + \beta_3 Covid * Overconfidence + \beta_4 Tenure + \beta_5 Age + \beta_6 Roa + \beta_7 Lev + \beta_8 Size + \beta_9 Caf + Industry\ fixed\ effects + \varepsilon \quad (10)$$

Chapter 4 Result

From table 4, it is evident that overconfidence and four firm level control variables hold significant value at 1% in equation (2). This indicates that even after considering personal and firm variables, overconfidence remains a statistically significant factor in determining the firm's investment ratio. There exists a positive correlation between overconfidence and the investment ratio of firms. Specifically, if the CEO of the firm is considered to be overconfident, the investment ratio of this firm will increase by 3%. In addition, I examine the impact of the gender of the Chief Executive Officer (CEO) and the occurrence of the COVID period on the investment ratio of firms. According to equations (3) and (4) in table 4, neither gender nor COVID has a significant influence on the investment ratio. Additionally, I explore the potential moderating impact of CEO gender on the association between CEO overconfidence and firm investment ratio. It is plausible that I may observe a stronger positive correlation between CEO overconfidence and firm investment ratio within the male CEO cohort compared to the female

CEO cohort. Nevertheless, the significance of the interaction¹ term was not detected in my analysis, as evidenced by equation (5) in table 4. Furthermore, I examine the role of the COVID-19 pandemic as a moderator in the correlation between CEO overconfidence and the firm's investment ratio. My objective is to determine if the association between overconfidence and investment ratio differs during the COVID-19 period compared to a typical economic environment. My analysis demonstrates that the presence of COVID has a substantial detrimental moderating impact on the correlation between CEO overconfidence and the firm's investment ratio, as determined at a significance level of 5%. This can be observed from the coefficient in equation (6) in table 4. Within the regression models (2)-(6), the utilization of clustered standard errors in both the company and fiscal year dimensions is employed with the aim of augmenting the accuracy of the p value.

Furthermore, in addition to the examination of investment ratio, I also take into account investment efficiency using the same regression methodology. First, I observed from panel A in table 5 that neither overconfidence nor gender will lead to the underinvestment problem; only COVID can cause it. Additionally, there is no moderating effect of overconfidence on the relationship between COVID and underinvestment. Then I examine panel B regarding overinvestment. I discover that none of CEO overconfidence, CEO gender, or COVID will have any impact on the overinvestment problem in companies. To sum up, the COVID-19 pandemic has greatly contributed to underinvestment in firms. However, I do not observe any positive influence resulting from CEO overconfidence. In simpler terms, CEO overconfidence does not significantly positively contribute to the relationship between the underinvestment problem and its underlying cause, CEO overconfidence. The CEO's overconfidence cannot solve the problem of underinvestment during the COVID-19 pandemic.

Chapter 5 Discussion

I have observed that CEO overconfidence modestly boosts the firm's investment ratio, but it does not lead to excessive investment. This means that hypothesis 1 is not fully supported. The impact of gender on CEO overconfidence is not significant, as there is no noteworthy difference in the link between male CEO overconfidence and firm investment ratio compared to female CEO overconfidence and firm investment ratio. Therefore, hypothesis 2 is incorrect. However, I do notice a noticeable moderating effect of the COVID-19 pandemic on the relationship between CEO overconfidence and investment ratio. It is expected that overconfident CEOs will contribute less to an excessive investment ratio during the COVID-19 pandemic. However, another issue arises as a consequence of the COVID-19 pandemic, which is the underinvestment in firms. And the detrimental effects of COVID-19 on a company's investment efficiency cannot be alleviated by the presence of overconfident CEOs. Therefore, it can be concluded that hypothesis 3 is accurate, whereas hypothesis 4 is incorrect.

Chapter 6 Conclusion

My study provides confirmation that when CEOs are overconfident, there is a tendency for firms to have a higher investment ratio. However, it is important to note that this does not necessarily result in overinvestment as defined in existing literature. In relation to the influence of CEO overconfidence on the issue of CEO overinvestment, there is no significant gender difference. When faced with the same problem of overconfidence, male CEOs do not exhibit a greater inclination towards overinvestment compared to their female counterparts. Furthermore, my research reveals that the influence of CEO overconfidence on corporate investment ratios is contingent upon the prevailing economic conditions. Specifically, during the current COVID-19 pandemic, the strength of the association between CEO overconfidence and investment ratios is anticipated to diminish. Nevertheless, the primary driver of this

diminishing impact arises from the turbulent climate brought about by the COVID-19 era. The COVID-19 pandemic acts as a significant factor leading companies to decrease their investments, resulting in the emergence of underinvestment as an issue, regardless of the CEO's level of confidence. In light of the observed negative effects of the COVID-19 pandemic on firm investment efficiency, I sought to explore the potential moderating role of CEO overconfidence in this relationship. However, my findings indicate that CEO overconfidence did not effectively address the issue of underinvestment amidst the significant disruptions caused by the pandemic.

The findings and implications of this research indicate the importance of being cautious when evaluating the suitability of a company's investment strategy. It is crucial to take into account the issue of CEO overconfidence when assessing whether a corporate investment strategy is appropriate or not. Put simply, in companies where the CEO demonstrates overconfidence, it may be necessary to reassess whether their investment decisions genuinely contribute to the firm's success, as these CEOs may overestimate the likelihood of success and result in excessive investments. Furthermore, this study reveals that both male and female CEOs who display overconfidence tend to exhibit a similar inclination towards making excessive investments. This study also highlights that the COVID-19 pandemic has created a unique situation for businesses, where many have been compelled to reduce their investment spending. As a result, this has had a substantial impact on the underinvestment problem faced by these firms.

One of the potential limitations of this study is its reliance on options as a measurement of CEO overconfidence. This approach may not be suitable for smaller and mid-sized companies, as they often lack detailed data on the value and number of vested unexercised options held by their CEOs. As a result, the sample size may be significantly reduced in this analysis. Furthermore, there may be some issues with the overconfidence measurement method. This is because I classify CEOs as overconfident once their confidence measure reaches or surpasses 67% for the first time, but it is possible for some of them to no longer be overconfident after being labeled as such. Nonetheless, I have noticed that this option-related method is commonly employed in the majority of studies on CEO overconfidence. In order to tackle the problem present in the aforementioned CEO overconfidence measurement method and strengthen the reliability of my results, it would be beneficial to investigate alternative approaches that can offer a more thorough comprehension of the impact of CEO overconfidence. If alternative methods of measuring CEO overconfidence are being used, it would be beneficial to enlarge the sample size and thoroughly reassess the hypothesis. However, the majority of papers in the field of CEO overconfidence primarily rely on the option measurement method. There are only a few studies that have ventured into employing innovative methods for assessing this phenomenon. It is my belief that future research should place greater emphasis on developing more concise and efficient ways to measure CEO overconfidence. In addition, my research concentrates exclusively on the COVID pandemic, which is a health crisis that is leading to significant economic losses and damage simultaneously. So how does the COVID pandemic differ from traditional economic crises such as the 2008 financial crisis? Will the differences have an impact on my study results when utilizing the COVID pandemic or financial crisis as the economic backdrop for my study? In my opinion, it would be advantageous for future research to expand the scope of this study by examining different economic backgrounds and analyzing the variations in disparities observed during multiple economic crises. By doing so, there is a strong likelihood that additional intriguing and insightful findings will emerge.

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Appendix

Table 1

Variable description.

Variable	Description	Compustat or Financial Ratios by WRDS
Investment ratio	$\frac{\text{Total Investment}}{\text{Total asset}}$	total investment = (CHE)cash and short -term investment + (ISEQ)investment securities equity + (ISFXM)investment securities fixed income total asset = (AT)assets total
Investment dummy	Dummy variable: 0 for normal investment efficiency, 1 for underinvestment, 2 for overinvestment	
Overconfidence	Dummy variable: 1 for overconfidence, 0 for no overconfidence	
Gender	Dummy variable: 1 for male, 0 for female	(GENDER)gender
COVID	Dummy variable: 1 for during COVID period (2020-2022). 0 for not during COVID	
Tenure	CEO tenure	
Age	CEO age	(AGE)age

ROA	Return on Assets	(roa)return on assets
LEV	Total Debt/Total Assets	(debt_at)total debt/total assets
Size	Natural logarithm of total asset	total assets = (AT)assets total
Cash flow	$\frac{\text{Net Cash Flow}}{\text{Total asset}}$	Net Cash Flow = (OANCF)operating activities net cash flow total assets = (AT)assets total
Industry	Fama French industry classification	

This table provides an explanation for the primary variables. It also provides the name of the Compustat item or Financial Ratios Suite by WRDS item that is used to calculate a variable.

Table 2**Table of FF_IND by fiscal year.**

FF_IND	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
FOOD	1	9	10	7	8	11	7	4	8	10	7	1	83
BEER	0	2	1	1	1	0	1	0	0	0	0	0	6
TOYS	0	5	4	4	3	3	2	5	3	5	5	1	40
FUN	0	5	5	5	5	4	4	4	3	4	3	0	42
BOOKS	0	2	3	3	2	2	2	1	2	1	3	0	21
HSGLD	1	11	10	9	8	9	10	9	5	4	4	1	81
CLTHS	3	4	2	4	3	1	1	2	2	2	3	1	28
HLTH	0	3	3	4	6	6	6	2	3	1	2	0	36
MEDEQ	2	16	19	14	13	8	11	8	14	17	12	1	135
DRUGS	2	17	19	20	21	25	24	21	21	19	26	1	216
CHEM	0	12	13	10	9	10	4	5	8	7	8	0	86
RUBBR	0	4	2	4	3	2	2	2	1	1	0	0	21
TXTLS	0	2	2	2	2	1	0	1	0	0	1	1	12
BLDMT	2	4	6	5	6	3	5	3	3	3	3	1	44
CNSTR	0	8	8	7	6	9	8	6	8	7	6	1	74
STEEL	0	5	7	8	5	5	7	9	7	5	5	1	64
MACH	0	20	16	18	17	15	10	9	10	8	9	2	134
ELCEQ	0	5	5	3	3	0	1	1	0	1	1	0	20
AUTOS	1	8	11	11	9	10	13	10	9	8	8	0	98
AERO	0	2	3	3	4	2	2	2	2	3	2	1	26
SHIPS	0	1	1	1	1	1	0	0	0	1	0	0	6
GUNS	0	0	0	0	1	0	1	1	1	1	1	0	6
MINES	0	3	2	0	2	0	0	0	1	1	0	0	9

OIL	0	7	8	9	7	7	5	5	7	1	6	0	62
TELCM	0	1	4	4	5	3	3	2	2	2	1	0	27
PERSV	1	2	5	4	3	4	3	4	3	2	4	1	36
BUSSV	7	39	39	38	38	29	27	26	22	20	18	1	304
COMPS	3	15	15	13	13	16	9	9	7	6	5	4	115
CHIPS	8	32	35	32	25	24	16	17	20	16	10	2	237
LABEQ	0	12	18	14	10	16	11	12	5	3	3	1	105
PAPER	0	4	3	3	0	1	0	0	0	2	4	0	17
BOXES	0	3	3	1	1	2	2	1	3	2	2	0	20
TRANS	0	12	12	9	11	7	5	5	6	5	3	0	75
WHLSL	3	17	11	13	12	8	9	8	8	7	10	5	111
RTAIL	18	17	14	15	17	10	9	9	6	7	7	1	130
MEALS	2	8	8	8	9	9	9	5	7	4	1	0	70
RLEST	0	0	0	1	1	1	1	0	1	1	0	0	6
FIN	1	5	6	9	8	6	4	3	6	4	3	0	55
OTHER	0	2	2	2	3	3	2	1	2	2	1	0	20
Total	55	324	335	318	301	273	236	212	216	193	187	28	2678

This table presents the distribution of fiscal years across these 39 industries.

Table 3**Descriptive statistics for variables in the equations.**

Panel A: Descriptive statistics for variables in the equations (2)-(10)					
Variables	N	Mean	SD	Min	Max
Investment ratio	2,678	0.18	0.18	0.00	0.98
Investment dummy	2,678	0.74	0.81	0.00	2.00
Overconfidence	2,678	0.37	0.48	0.00	1.00
Gender	2,678	0.95	0.22	0.00	1.00
COVID	2,678	0.15	0.36	0.00	1.00
Tenure	2,678	7.88	7.29	0.00	45.00
Age	2,678	63.34	7.38	38.00	88.00
ROA	2,678	0.13	0.12	-1.53	1.13
LEV	2,678	0.52	0.28	0.00	2.92
Size	2,678	7.67	1.70	2.50	12.41
Cash flow	2,678	0.09	0.10	-1.60	0.87
Industry	2,678	26.28	12.62	2.00	48.00

Panel B: The distribution of CEO overconfidence during COVID compared to non-COVID times

	COVID	No COVID	
Overconfidence	143	853	996
No overconfidence	265	1417	1682
Total	408	2270	2678

This table presents the descriptive statistics and the CEO overconfidence distribution. Panel A presents descriptive statistics for variables in the equations (2)-(10). Panel B presents the distribution of CEO overconfidence during COVID compared to non-COVID times.

Table 4**Correlation matrix for variables in the equations.**

	Investment ratio	Investment dummy	Overconfidence	Gender	Covid	Tenure	Age	ROA	Lev	Size	Cash flow	Industry
Investment ratio	1.00											
Investment dummy	0.14	1.00										
Overconfidence	-0.06	0.13	1.00									
Gender	-0.02	-0.03	0.01	1.00								
Covid	0.07	-0.01	-0.02	-0.05	1.00							
Tenure	-0.07	0.09	0.07	0.06	-0.01	1.00						
Age	-0.02	-0.03	-0.07	0.07	-0.25	0.44	1.00					
ROA	-0.02	-0.29	0.09	0.05	-0.07	-0.06	0.08	1.00				
Lev	0.11	-0.32	-0.03	0.04	0.07	-0.18	-0.06	0.08	1.00			
Size	0.40	-0.39	-0.13	0.01	0.08	-0.18	-0.04	0.17	0.36	1.00		
Cash flow	-0.00	-0.15	0.07	0.04	-0.04	-0.03	0.04	0.81	-0.03	0.13	1.00	
Industry	0.02	-0.01	-0.02	0.03	-0.07	-0.02	0.01	0.09	0.05	0.06	0.12	1.00

This table provides the correlation coefficients for the variables in equations (2)-(10).

Table 5

The regression results focus on the relationship between CEO overconfidence, CEO gender, the COVID pandemic, and their combined impact on the firm's investment ratio.

Variable	(2)	(3)	(4)	(5)	(6)
Overconfidence	0.03 (3.04***)			0.07 (1.64*)	0.03 (3.48***)
Gender		-0.00 (-0.06)		0.01 (0.43)	
COVID			-0.00 (-0.36)		0.01 (1.49)
Interaction1				-0.04 (-1.00)	
Interaction2					-0.03 (-2.00***)
Tenure	-0.00 (-0.27)	0.00 (0.05)	0.00 (0.07)	-0.00 (-0.30)	-0.00 (-0.20)
Age	-0.00 (-0.01)	-0.00 (-0.33)	-0.00 (-0.37)	-0.00 (-0.00)	-0.00 (0.00)
ROA	-0.63 (-7.94***)	-0.61 (-7.67***)	-0.61 (-7.59***)	-0.63 (-8.00***)	-0.63 (-8.00***)
LEV	-0.12 (-4.63***)	-0.12 (-4.63***)	-0.12 (-4.62***)	-0.11 (-4.60***)	-0.12 (-4.60***)
Size	-0.02 (-4.88***)	-0.02 (-4.95***)	-0.02 (-5.23***)	-0.02 (-4.90***)	-0.02 (-5.00***)
Cash flow	0.47 (4.96***)	0.47 (4.90***)	0.47 (4.90***)	0.47 (4.96***)	0.47 (5.00***)

N	2678	2678	2678	2678	2678
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This table presents the regression results of equations (2)-(6). The results show the relationship between CEO overconfidence, CEO gender, the COVID pandemic, and their combined impact on the firm's investment ratio. Interaction1=Overconfidence*Gender, Interaction2=Overconfidence*COVID. * means significance at 10%; ** means significance at 5%; *** means significance at 1%.

Table 6

The regression results focus on the relationship between CEO overconfidence, CEO gender, the COVID pandemic, and their combined impact on the firm's investment efficiency.

Panel A: The regression results focus on the relationship between CEO overconfidence, CEO gender, the COVID pandemic, and their combined impact on the firm's underinvestment.

Variable	(7)	(8)	(9)	(10)
Overconfidence	-0.22 (-1.54)			-0.23 (1.46)
Gender		-0.17 (-0.56)		
COVID			1.30 (6.43***)	1.30 (5.03***)
Interaction2				0.02 (0.05)
Tenure	0.00 (0.39)	0.00 (0.20)	-0.00 (-0.42)	-0.00 (-0.16)
Age	-0.01 (-0.79)	-0.01 (-0.56)	0.01 (0.96)	0.01 (0.72)
ROA	0.65 (0.59)	0.60 (0.55)	1.03 (0.93)	1.09 (0.99)
LEV	0.12 (0.35)	0.12 (0.36)	0.09 (0.28)	0.10 (0.30)
Size	-0.35 (-6.23***)	-0.35 (-6.09***)	-0.39 (-6.74***)	-0.40 (-6.82***)
Cash flow	-2.51	-2.66	-2.91	-2.78

(-1.91**) (-2.02***) (-2.19***) (-2.09***)

Panel A: The regression results focus on the relationship between CEO overconfidence, CEO gender, the COVID pandemic, and their combined impact on the firm's overinvestment.

Variable	(7)	(8)	(9)	(10)
Overconfidence	0.07 (0.53)			0.05 (0.37)
Gender		-0.24 (-0.71)		
COVID			0.06 (0.35)	0.03 (0.16)
Interaction2				0.11 (0.29)
Tenure	0.00 (0.13)	0.00 (0.25)	0.00 (0.24)	0.00 (0.15)
Age	-0.00 (-0.45)	-0.00 (-0.46)	-0.01 (-0.49)	-0.01 (-0.46)
ROA	-3.30 (-2.49***)	-3.16 (-2.39***)	-3.24 (-2.46***)	-3.35 (-2.53***)
LEV	-0.78 (-2.21***)	-0.78 (-2.19***)	-0.79 (-2.23***)	-0.78 (-2.20***)
Size	1.37 (19.81***)	1.37 (19.80***)	1.36 (19.70***)	1.36 (19.71***)
Cash flow	4.62 (2.96***)	4.61 (2.94***)	4.71 (3.01***)	4.71 (3.02***)
N	2678	2678	2678	2678
Pseudo R^2	0.4541	0.4537	0.4615	0.4621

This table represents the regression results of equations (7)-(10). The four equations represent multi-logic regression models. As a result, the two end-line N and R^2 are applied to both panel A underinvestment and panel B overinvestment. Regarding investment efficiency, it is a categorical variable with three values. 0 represents the normal investment condition, 1 represents underinvestment, 2 represents overinvestment; Interaction1=Overconfidence*Gender, Interaction2=Overconfidence*COVID. * means significance at 10%; ** means significance at 5%; *** means significance at 1%.