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The Effect of CEO Overconfidence on Overinvestment: An Analysis of the Role of Inflation Uncertainty in the Capital Market

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Abstract
Investment is seen as one of the most important and influential factors in economic growth and development. It is directly affected by managers' approaches to decision-making because identifying the best investment opportunities to achieve ideal returns is one of the expectations that shareholders and stakeholders have of managers to reduce agency gaps. However, the emergence of managers' overconfident behavior as a foundation for psychological bias can deepen the agency gap due to overestimating project cash flows compared to their real values under inflationary conditions. This study aims to examine the effect of inflation uncertainty on the impact managerial overconfidence has on overinvestment. The statistical population consists of companies listed on the Tehran Stock Exchange (TSE). One hundred five companies were selected as the sample size by systematic removal sampling reviewed in 2011-2018. Due to its dichotomous dependent variable, this study uses probit regression to test the research hypotheses. The results indicated the significant positive effect of CEO overconfidence on overinvestment. It was also noted that inflation uncertainty strengthens the positive effect of CEO overconfidence on overinvestment. Based on these results, the CEO's decisions as a decision-maker in charge of any company, especially under inflationary conditions, can play a substantial role in future corporate investment levels. Thus, with an increase in behavioral bias, it can be assumed that the company will confront grave competitive challenges under economic conditions.

Keywords: CEO Overconfidence, Overinvestment, Inflation Uncertainty.

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Introduction

Investment is seen as one of the most important and influential factors in economic growth and development, the development of which can increase confidence in the capital market considering the company's competitive conditions (Liang et al., 2019). Investment practices are studied mainly because finding out about investment biases such as overinvestment of companies, and their CEOs can contribute to improving the decision-making capabilities of stakeholders such as shareholders. On the other side, at the macro level, inflation volatility is considered as one of the most crucial external factors faced by companies when investment decisions are made. A stable price level allows companies to seize the best investment opportunities as well as invest in high-yield projects (Beaudry et al., 2001). Nevertheless, detecting the best investment opportunities to reach ideal returns is one of the expectations that shareholders and stakeholders have of managers. This is because managers, as company steersmen, need to reduce the gap between them and shareholders.investors in the form of information symmetry and agency approaches and take steps to maximize their benefits (Alinejad Saroukalaei et al., 2018).

Furthermore, price changes in the economy can influence managers' decisions. Organizational managers, as key decision-makers, are exposed to cognitive biases and irrational behaviors. This can lead to the overlooked role of inflation in their decisions, as well as perceptual errors in investment, such as overinvestment (Ting et al., 2016). Hence, detecting irrational behaviors and psychological effects and their impact on managers' performance, as the steersmen of companies, is one of the topics that can contribute to the development of both the interactions and the functions of investment throughout the capital market. Overconfidence is one of these perceptual errors or so-called fluctuating behavioral decisions. An overconfident manager decides on the unit he.she supports based on his.her mental inclinations and motivations away from reality and involves personal tastes, feelings, and beliefs in corporate decision-making. Therefore, when faced with realities, he.she acts inefficiently as he.she is not prepared to confront the status quo (Shamsi and Jahanshad, 2019). As one of the most critical factors, decisions made by an overconfident manager based on his.her personal desires far from reality always endanger the future of the company.

Furthermore, overconfidence leads managers to be optimistic about the expected future income and cash flows of the business entity and the positive outlook for the company's future risk and return (Guo and Ding, 2019). Due to

their optimistic outlook for the expected future income, overconfident managers are more likely to make mistakes in forecasting (Scherand & Zechman, 2011). Hence, given the role played by price volatility in corporate investment behavior, leading to somehow influenced managers' decisions, managers can play an influential and decisive role in the relationship between investment decisions and inflation (Alinejad Saroukalaei et al., 2018). Thus, with an increase in overconfidence under inflationary fluctuations, they are expected to be more productive due to rising prices and, at the same time, more willing to invest in various dimensions, which can affect the company's risk and return (Faridnia and Eskandarpour, 2019). The results of experimental research indicate a positive relationship between managerial overconfidence and overinvestment under inflationary conditions (Huang et al., 2011). Therefore, due to its effects on inflation and overinvestment of companies, the need to address CEO overconfidence can be considered as a theoretical and practical necessity for two reasons. On the one hand, the study of the relationships between these variables in the theoretical and conceptual fields requires further study and analysis.

On the other hand, although the existence of a relationship between research variables has been hypothesized to be conscious and conceptually sufficient, its applications have not been widely studied. Thus, the relationship between CEO overconfidence in Iran with inflation uncertainty and overinvestment must be increasingly studied and interpreted due to its effects on the risk-taking and productivity of corporate capital. Accordingly, this study aims to examine the effect of the mediating role of inflation uncertainty on the impact managerial overconfidence has on overinvestment.

Literature Review

Behavioral finance theories

The school of behavioral finance, as a result of the combination of psychology and finance is founded on the view that psychology plays an essential role in financial decision-making. As cognitive errors and deviations affect investment theories, they also exert the same effect on financial alternatives (Hirscheifier, 2001). Behavioral finance is the science of studying how individuals analyze and interpret information to make informed investment decisions. To put it another way, behavioral finance seeks to examine the effect of psychological processes on decision-making. Nowadays, the perception of investors' fully rational behavior in pursuit of maximizing their benefits proves insufficient to justify market reaction and behavior. Therefore, behavioral finance is counted as a paradigm according to which financial markets are studied given certain

models which, in turn, refute two fundamental and circumscribing assumptions of the traditional paradigms, namely maximization of the expected tendencies and full rationality. The theoretical underpinnings of behavioral finance lend support to the claim that experimental puzzles in the domain of finance are sometimes hard to solve as certain economic factors are likely to demonstrate less rational behavior (Karimi and Rahnamayroodposhti, 2015). However, Robert Olsen is inclined to believe that behavioral finance does not aim at propagating the idea of the inaccuracy of rational behavior, but tries to encourage discussions on the role of psychological decision-making processes in recognizing and predicting financial markets. The proponents of behavioral finance develop the claim that the subject of psychological tendencies within the realm of investment requires extensive research. Taking psychology into consideration as a fundamental factor influencing the financial knowledge of investors in stock exchanges makes it difficult to accept the presence of uncertainty towards the behavioral finance creditability (Suresh, 2013; Shafer and Wang, 2011).

Overconfidence

Overconfidence is one of the essential findings of psychology in judgment and decision-making. It is a personality trait that can be defined as behavioral personality traits and unrealistic (positive) beliefs about various aspects of a consequence under uncertainty conditions. In this sense, the average estimate will be exaggerated (Skala, 2008). Managers are among the top-ranking individuals in organizations with more authority and decision-making power, whose personal desires can affect the organization's selected policies and procedures. Hence, managers' perspectives affect the organization, procedures, and policies, as well as employees and related issues. One of the primary applications of the concept of overconfidence in financial literature was made by May (1986). He argues that management overconfidence is one of the factors that cause managers to involve in the appropriate acquisition processes and overpayments for target companies. The majority of managers believe that their company is more likely to succeed than other companies (Moores & Chang, 2009). Such managers are called overconfident managers.

Optimism

Optimism is regarded to be one of the significant findings of psychology in judgment and decision-making. Overconfident individuals believe that they have more capabilities than others, can control risks beyond their reach, and have much more precise predictive power than expected (Chen et al., 2017; Ramsheh and Mollanazari, 2014). Two behavioral factors linked to managerial

overconfidence result in increased expectations of future demand:

≠ **Incorrect Grading (Lower-Variance Effect):** It indicates very low confidence in the expected results. The most common type of overconfidence is mentioned in the financial literature, sometimes referred to as overconfidence in forecasting. Here, people usually overestimate their knowledge accuracy and underestimate the risk and variance of random variables, with very narrow confidence intervals in their forecasting (Libby & Rennekamp, 2012). For example, when estimating the value of a share, they consider a very low deviation for the expected yield spectrum.

≠ **Extreme or Unrealistic Optimism (Above-Average Effect):** This concept is adapted from the financial literature derived from the concepts of psychology and delusional optimism. In this type of overconfidence, people overestimate their skills (Hribar & Yang, 2012). Extreme optimism leads to the expected future income leading managers to make decisions based on their predictions (Ghaderi et al., 2018). According to psychological research, people generally tend to have an unrealistic positive view of themselves and their skills. When compared to a group (e.g., colleagues), many people overestimate their capabilities and skills above the average capabilities and skills of other members.

The explanation provided for managerial overconfidence is distinct from the economic explanations presented in previous studies. From an economic point of view, it is assumed that managers are reluctant to meet future expectations, while overconfidence implies that managers have positive attitudes toward future expectations. Moreover, overconfidence is distinct from the explanations given for the agency theory mentioned in the previous literature (Kama & Weiss, 2013). According to Gervais et al. (2010), overconfident managers tend to operate in companies with risky growth.

Hypothesis Development

According to the cognitive bias theory, overconfidence refers to a personality trait based on overrating an issue or overconfidence in a decision and achieve a positive outcome in the future (Rayfield & Unsal, 2019). Overconfidence is considered to be a behavioral bias in financial affairs that has its roots in an individual's optimism about their knowledge and ability to predict (Wen et al., 2007). It enables people to overestimate expected future returns from investment projects and overlook its potential adverse effects in a process based on subjective reasoning. Accordingly, overconfidence in the CEO's perceptual beliefs is expected to lead to an increase in the company's capital expenditures and overinvestment in investment projects (Malmendier & Tate, 2005). Research by Chollet et al. (2015), De Franco et al. (2011), and Malmendier et al. (2011), to name a few, confirms that CEO overconfidence

causes a person to turn to biased financial reporting with intentional distortion by focusing on individual capabilities and biased personal analysis to achieve greater future returns to cover the adverse effects of perceptual biases. On the other hand, the results of various studies such as those conducted by Heaton (2002), Malmendier & Tate (2005), and Lin et al. (2008), to name a few, confirm that overconfident managers are more inclined to invest in cash within the company rather than cash dividend distribution. Regarding the financing of investment projects, overconfident managers prefer in-house financing over out-of-company financing. With sufficient internal cash resources, CEOs tend to overinvestment; Otherwise, they will often have little inclination to invest (Hassani and Zeighami, 2015). Accordingly, relying on the theoretical and experimental support of the mentioned research, H1 is presented as follows:

H1) CEO overconfidence has a significant impact on overinvestment in TSE listed companies.

One of the issues raised in financial economics and essential factors in solving economic problems is the development of investment (Johnson & Fowler, 2011). Business entities are always faced with many investment opportunities and have to make decisions about an optimal investment logically. One of the factors facing companies when making investment decisions is inflation volatility, which has dramatic effects on the amount of production and investment projects (Poensgen & Straub, 1976). Therefore, the higher the general level of price predictability, the easier it will be to choose profitable investment opportunities (Beaudry et al., 2001). Inflation volatility reduces the effectiveness of the price mechanism in resource allocation and will lead to economic inefficiency (Bredin & Fountas, 2009). Besides, increased inflation volatility leads to increasingly distorted market signals and managers' changing expectations of future price changes (Friedman, 1977). Inflation volatility also affects managers' ability to predict price changes accurately.

Managers are incapable of predicting the price of their products and similar products, as well as choosing between producing more or postponing new investments (Wang et al., 2016). The CEO plays an influential and decisive role in the relationship between investment decisions and inflation. Managers act as final decision-makers in investing in a similar macroeconomic environment and are affected by the factors involved. In other words, managerial overconfidence depends not only on the attributes of managers such as overconfidence but also on external environmental factors such as inflation volatility. In uncertain environments, managers often tend to be opinionated (self-centered) and therefore perform poorly in making investment decisions

(Deaves et al., 2010). However, in sustainable environments, managers tend to be optimistic and therefore perform well as successful entrepreneurs in a dynamic environment.

Furthermore, managers' self-confidence declines under the conditions of the economic crisis because managers change their behavior about economic pressures without any connection to their intrinsic traits (Klayman et al., 1999). Therefore, there is a potential interaction between investment decisions made by overconfident managers and external factors and their intrinsic behavioral tendencies because the economic pressures imposed on the company's investment depend on the decisions of managers and the optimism of managers not independent of the external environment. Inflation uncertainty is one of the most important external factors facing companies when making investment decisions. Therefore, uncertainty is seen as one of the economic dimensions, including primary monetary objectives, in the form of the reserve fund that the central bank is trying to minimize. Inflation can sometimes lead to a change in managers' expectations about future inflation uncertainty. As a result, such uncertainty affects managers' ability to predict price changes accurately. When product prices change, managers cannot predict the prices of their own products, complementary products, and competitive products. Therefore, they cannot decide whether or not to delay production, postpone investment, or sign short-term contracts to reduce investment altogether. Thus, inflation uncertainty can lead to a decline in corporate investment. However, it is unclear whether companies will consider it when making investment decisions because it has a significant impact on the scale of production and large-scale projects (De Gregorio, 1993). Therefore, due to the presentation of explanations related to the relationship between CEO overconfidence and inflation uncertainty in theory and the lack of empirical review of the past by other studies, H2 can be presented as follows:

H2) Inflation uncertainty exacerbates the impact of CEO overconfidence on overinvestment in stock exchanges.

Research Background

Experimentally, the relationship between individual behavioral biases and perceptual errors has a long history in psychological literature. However, it has become more consistent in financial discussions since the beginning of the present century through the fusion of behavioral and financial theories. The upward trend of research in this regard shows its importance in the performance of companies and even the capital market. On the other hand, as an elected representative of shareholders, the CEO should strive to improve the

quality of financial reporting because it is crucial for decision-making by shareholders and investors. If behavioral biases are combined with the quality of financial reporting, shareholder decision-making will be disrupted, and the capital market will lose its functionality. In this regard, Sauerwald & Su (2019) conducted a study entitled "CEO overconfidence on the degeneration of social responsibility disclosure." This study examined 500 companies in the period 2006-2014. The results showed declining social responsibility disclosure reports as a result of CEO overconfidence and the company's exposure to uncertainty by shareholders, investors, and analysts in a competitive market.

On the other hand, in their study, Ma et al. (2019) introduced the CEO's behavioral biases as one of the reasons for the disproportionate specialized knowledge of managerial position with a negative impact on the quality of financial reporting. Ulupinar (2018) examined the effect of managerial stability on the CEO's behavioral biases. This study was conducted in the period 1994-2006, in which managerial stability was measured using three criteria: CEO tenure, managerial ownership, and CEO duality, as well as perceptual biases based on overconfidence and optimism. The results showed a positive effect of all three of the above criteria on the CEO's perceptual biases, which led to biased CEO behavior more as a stable management position at the top of companies. Wang et al. (2016) conducted a study entitled "Overinvestment, inflation uncertainty, and managerial overconfidence: A firm-level analysis of Chinese companies. The study was conducted in the period 2003-2012, during which 113 companies active in the Chinese capital market were examined. The results showed an increased overinvestment as a result of lower inflation uncertainty, exacerbated by managerial overconfidence. Analysis of overinvestment was primarily driven by managerial overconfidence in state-owned enterprises, as well as a negative correlation between inflation uncertainty and managerial overconfidence overinvestment. Managerial overconfidence is mute in non-state-owned enterprises.

Additionally, they are witnessing an asymmetric impact of inflation uncertainty on corporate overinvestment during various economic cycles. Shamsi et al. (2019) conducted a study entitled "The impact of managerial overconfidence based on investment and capital expenditures on risk and capital productivity indicators." In this study, 132 companies were examined in the period 2011-2016. The panel regression model was used to test the hypotheses. The findings indicate the notorious effect of managerial overconfidence based on capital expenditures on the deviation of stock returns and, at the same time, the significant positive effect of managerial overconfidence based on investment on the latter. This means that companies

with overconfident investment-based managers are exposed to significant risk and invest more in high-risk projects.

Furthermore, managerial overconfidence has no significant effect on the deviation of operating cash flow and capital productivity. Alinejad Sarokolaei et al. (2018) conducted a study entitled "inflation volatility and overinvestment test with an emphasis on managerial overconfidence." The study looked at investing in companies by considering inflation volatility as well as the effect of managerial overconfidence on the intensity or weakness of this relationship in companies listed on the TSE. The statistical population consists of 193 companies in the period 2011-2015. In this study, the model by Biddle et al. (2009) was used to test overinvestment. The results indicate the lack of effect of inflation volatility on overinvestment and the direct and significant effect of managerial overconfidence on overinvestment. On the other hand, managerial overconfidence affects the relationship between inflation volatility and overinvestment.

Methodology

This is an applied research project in the objective and retrospective quasi-experimental method of data collection in positive accounting research, performed using the probit regression method and econometric models. The statistical population consists of companies listed on TSE for the period 2011-2018. The sample of choice is the companies that meet the following conditions:

1. The company must be listed on the stock exchange before 2012 and be listed on the stock exchange companies until the end of March 2019.
2. The company's fiscal year ends on March 20.
3. The activity or fiscal year has not changed during the mentioned years.
4. Not be part of the investment and financial intermediation companies (investment companies were not included in the statistical population because they are different from other companies in terms of the nature of their activity).
5. The duration of the transaction during the mentioned period should not be more than six months.

Following the above restrictions, 105 companies were selected as examples. The data were extracted from the compressed tablets of the TSE statistical and video archive, the TSE website, and other related databases, as well as the Rahavard Novin software. The final analysis of the collected data was performed using EViews 9 econometric software.

Introducing variables and patterns

To analyze the hypotheses proposed, based on the research conducted by He et al (2019) and Wang et al. (2016), the following probit models were designed:

- Nonlinear probit model for H1:

$$\text{Overinvestment}(Y_{it}=1|X'_{it}) = \Pr(Y_{it}=1|Y^*_{it}>0) =$$
$$\Phi\Big(\delta_0+\delta_1\text{Over\_Confidence}_{it}+\delta_2\text{Sales}_{it}+\delta_3\text{Constraint}_{it}+\delta_4\text{Cash}_{it}+\delta_5\text{Lev}_{it}+$$
$$\delta_6\text{BM}_{it}+\delta_7\text{ROA}_{it}+\delta_8\text{Agency Cost}_{it}+\delta_9\text{Tangibility}_{it}+$$
$$\delta_{10}\text{Invest\_Oppertunity}_{it}+\delta_{11}\text{Own\_Concenteration}_{it}+$$
$$\int_{-\infty}^{X'_{it}\infty}\left[\frac{1}{\sqrt{2\Pi\Pi}}\right]\text{Exp}\left[\frac{1}{2}\left(\frac{s-\mu}{\sigma}\right)^2\right]\Big)\,ds \qquad (1)$$

In Model 1, if the coefficient δ_1 is detected as significant, H1 will be confirmed.

- Nonlinear probit model for H2:

$$\text{Overinvestment}(Y_{it}=1|X'_{it}) = \Pr(Y_{it}=1|Y^*_{it}>0) =$$
$$\Phi\Big(\delta_0+\delta_1\text{Over\_Confidence}_{it}+\delta_2\text{Over\_Confidence}_{it}\times\text{Inflation Uncertainty}_{it}+$$
$$\delta_3\text{Sales}_{it}+\delta_4\text{Constraint}_{it}+\delta_5\text{Cash}_{it}+\delta_6\text{Lev}_{it}+\delta_7\text{BM}_{it}+\delta_8\text{ROA}_{it}+$$
$$\delta_9\text{Agency Cost}_{it}+\delta_{10}\text{Tangibility}_{it}+\delta_{11}\text{Invest\_Oppertunity}_{it}+$$
$$\delta_{12}\text{Own\_Concenteration}_{it}+\int_{-\infty}^{X'_{it}\infty}\left[\frac{1}{\sqrt{2\Pi\Pi}}\right]\text{Exp}\left[\frac{1}{2}\left(\frac{s-\mu}{\sigma}\right)^2\right]\Big)\,ds \qquad (2)$$

In Model 2, if the coefficient δ_1 is detected as significant, H2 will be confirmed.

Table 1. Definition of variables

Variable	Definition
Dependent Variable	
Overinvestment or Underinvestment	Overinvestment or underinvestment is calculated by the absolute value of the negative residuals $-\lvert\varepsilon_{it}\rvert>0, -\lvert\varepsilon_{it}\rvert<0$ of the difference between the total investment in financial and capital assets [4].
Independent Variables	
Inflation Uncertainty	How to measure inflation uncertainty: To calculate the uncertainty (probability) of inflation, first, the inflation rate is calculated each year based on the price index, followed by determining the average general price index that year based on the consumer price index for three consecutive years based on geometric mean. Finally, inflation uncertainty is obtained from the standard three-year inflation deviation equation. To calculate the geometric mean of the inflation rate based on the consumer price index, the following process takes place:

	$\bar{r}_{inf,t} = \left[\prod_{t-1}^{3}\left(1 + r_{inf,t-4}\right)\right]^{\frac{1}{3}} - 1$ $r_{inf,t} = \frac{1}{CPI_{t-1}}(CPI_t - CPI_{t-1})$ $r_{inf,t-1} = \frac{1}{CPI_{t-2}}(CPI_{t-1} - CPI_{t-2})$ $r_{inf,t-2} = \frac{1}{CPI_{t-3}}(CPI_{t-2} - CPI_{t-3})$ $\text{Inflation Uncertainty}_{it} = \text{Sqrt}\left[\frac{1}{n}\sum_{i-1}^{n} r_{inf,t}^2 - \langle\frac{1}{n}\sum_{i-1}^{n} r_{inf,t}\rangle\right]$ $\text{SIGMA}(r_{inf,t}) = \text{Inflation Uncertainty}_{it}$ $= \text{Sqrt}\left[\frac{1}{n}\sum_{i-1}^{n} r_{inf,t}^2 - \langle\frac{1}{n}\sum_{i-1}^{n} r_{inf,t}\rangle\right]$
$\text{Over\_Confidence}_{it}$	A variable is a function of the two-valued logic that takes 1 if the deviation between ($PEPS_{it}$) Predicated Earnings Per Share and ($REPS_{it}$) Real Earnings Per Share is positive; otherwise, ($\varepsilon_{it} < 0$) is zero [36]
Control Variables	
Sales	Sales divided by total assets or financial turnover ratio of assets as a measure of the efficiency of management performance in using resources to maximize revenue.
Constraint	Representing financing restrictions (Hadlock et al., 2010), $SA - \text{Index} = 0.737\ (SIZE_{it}) + 0.043\ (SIZE_{it}^2) + 0.040\ (AGE_{it})$ Where Size is the company's natural asset logarithm, and Age refers to the years it has been listed on the stock exchange.
Opt(Cash)	Turnover of operating cash is divided by the total assets of the previous period
Leverage	Financial leverage: debt divided by total assets
BM	The ratio of book value to the market value of property rights
ROA	The return on assets equals the net profit of the company divided by the assets of the last period
Agency cost	Operating cost divided by the total assets of the last period
Tangibility	Fixed assets divided by the total assets of the last period
Investment opportunities	Future investment opportunities are measured by Tobin's Q ratio or the ratio of market value to book value of total assets. $q - \text{tobin} = \frac{(\text{Market Value of Equity})_{it} + (\text{Present Value of Debts})_{it}}{(\text{Book Value of Total Asstes})_{it}}$
Ownership concentration	The number of Single Owner Equity holders in a shareholding structure of the sample companies selected in the study, who own at least one share, or the sole proprietor of the unit alone own at least 5% of the shares.

Research Findings

Descriptive Statistics

To examine the general characteristics of the variables, to estimate the model, and to analyze them accurately, it is necessary to get acquainted with the descriptive statistics of the variables. Table 2 presents the descriptive statistics of the variables being tested, including some central and scatter indices for a sample of 840 observational companies in the period 2011-2018.

Table 2. Descriptive statistics of research variables

Variable	Mean	Median	Max	Min	SD	Skewness	Kurtosis
OVER_INVESTMENT	0.127475	0	1	0	0.333608	2.234001	5.990759
$Over\_Confidence_{it}$	0.294554	0	1	0	0.455983	0.901389	1.812502
INF_UNCERTAINTY	-4.86298	-4.39851	-1.24989	-9.99077	2.786446	-0.58022	2.160941
SALE	0.498928	0.376483	7.374587	-0.00115	0.527258	5.544133	54.38486
CONSTRAINT	19.79851	19.09622	31.3867	11.93716	3.363987	0.829181	3.523349
CASH	0.129156	0.111093	0.642432	-0.46009	0.131745	0.500376	4.153894
LEVERAGE	0.569026	0.583429	0.997751	0.012734	0.225688	0.288575	4.943143
BM	1.468015	1.019442	22.60137	0.050937	1.526885	4.546362	42.17867
ROA	0.072896	0.049073	0.67914	-0.40446	0.107817	1.492602	7.836729
AGENCYCOST	0.386327	0.265431	7.105432	0	0.496113	5.983727	61.30699
TANGIBILITY	0.262816	0.222565	0.932981	0	0.189368	0.784977	2.940814
INV_OPPORTUNITIS	1.311231	0.980931	19.632	0.044245	1.269618	4.64978	46.09687
OWNERSHIP_CONSTRANTION	3.529703	3	8	1	1.837109	0.318901	2.155384

The mean, standard deviation, skewness, kurtosis, and Jarque-Bera test statistic are shown in Table 2. Among the research data, the highest mean of book value is the market value, which indicates this issue the market value of corporate stocks is approximately 1.5 times higher than the book value of corporate stocks. Also, the largest standard deviation is related to the variable INF_UNCERTAINTY, which shows that the level of inflation uncertainty has a large dispersion that the existence of fluctuations in inflation has caused the stability of this economically important variable to be disrupted. The highest skewness is related to operating costs with 5/98. Finally, most kurtosis is related to operating costs, clearly indicating its very scattered distribution. The rest of the

variables have concentrated distribution with low skewness and kurtosis. The growth in sales of companies funded by investment funds with kurtosis and skewness is roughly scattered and noticeable. The reliability test of the variables was performed before using the regression method, with the results presented in Table 3:

Table 3. Variable reliability test results

Variable	Unit Root Test	χ2 statistic	P – Value	Result
$\text{Over\_Confidence}_{it}$	Augmented Dickey-Fuller	355.895	0.0000	static– I(1)
INF_UNCERTAINTY	Augmented Dickey-Fuller	483.328	0.004	static– I(0)
SALE	Augmented Dickey-Fuller	1092.51	0.0000	static– I(1)
CASH	Augmented Dickey-Fuller	2111.27	0.0000	static– I(1)
CONSTRAINT	Augmented Dickey-Fuller	882.869	0.0000	static– I(1)
LEVERAGE	Augmented Dickey-Fuller	1627.13	0.0000	static– I(1)
BM	Augmented Dickey-Fuller	1854.74	0.0000	static– I(1)
AGENCYCOST	Augmented Dickey-Fuller	492.88	0.0004	static– I(0)
ROA	Augmented Dickey-Fuller	576.738	0.0000	static– I(1)
TANGIBILITY	Augmented Dickey-Fuller	1329.49	0.0000	static– I(1)
INV_OPPORTUNITIS	Augmented Dickey-Fuller	1318.87	0.0000	static– I(1)
Over_Investment	Augmented Dickey-Fuller	62.1536	0.0000	static– I(1)

As can be seen, all variables are stable either at the surface or with a single differentiation. Therefore, it can be concluded that the use of the regression method is unrestricted. According to the methodology, according to the procedure of calculation and classification of companies into two types, companies with overinvestment (1) and companies without overinvestment (0), probit regression has been used. Based on the results, the research hypotheses were tested.

First Hypothesis

H1: CEO overconfidence has a significant impact on investment bias in companies listed on TSE. The following model is used to measure it:

$$\text{Overinvestment}(Y_{it}=1|X'_{it}) = \Pr(Y_{it}=1|Y^{*}_{it}>0)$$
$$= \Phi\Bigg(\delta_0 + \delta_1 \text{Over\_Confidence}_{it} + \delta_2 \text{Sales}_{it} + \delta_3 \text{Constraint}_{it} + \delta_4 \text{Cash}_{it} + \delta_5 \text{Lev}_{it}$$
$$+ \delta_6 \text{BM}_{it} + \delta_7 \text{ROA}_{it} + \delta_8 \text{Agency Cost}_{it} + \delta_9 \text{Tangibility}_{it} + \delta_{10} \text{Invest\_Oppertunity}_{it}$$
$$+ \delta_{11} \text{Own\_Concenteration}_{it}$$
$$+ \int_{-\infty}^{X'_{it}\infty} \left[\frac{1}{\sqrt{2\Pi\Pi}}\right] \text{Exp}\left[\frac{1}{2}\left(\frac{s-\mu}{\sigma}\right)^2\right]\Bigg) ds \qquad (3)$$

Table 4. Estimation results by probit method (dependent variable: corporate overinvestment)

Variable	Coefficient	z-statistic	Probability of Rejecting Significance
Over_Confidence	1.608618	11.78586	0.0000
SALE	-2.92786	-2.23859	0.0252
CONSTRAINT	0.192038	11.54035	0.0000
CASH	-0.20952	-0.39781	0.6908
LEVERAGE	-1.51462	-4.07606	0.0000
BM	-0.29823	-3.81327	0.0001
ROA	1.914651	1.606298	0.1082
AGENCYCOST	2.726966	2.066475	0.0388
TANGIBILITY	-0.93837	-2.67847	0.0074
INV_OPPORTUNITIS	-0.45482	-4.83154	0.0000
OWNERSHIP_CONSTRANTION	-0.135	-3.89528	0.0001
Hosmer-Lemeshow test statistic (H − L) (P − VALUE)	Chi-Sq(8)= 13.0646 (0.1096)		

According to the results of estimating the H1 test model with overinvestment as a dependent variable, in the goodness of fit test of the model, i.e., Hosmer-Lemeshow, H0 of no significant difference between the estimation and experimental values of the variable has a two-sentence distribution. The goodness of fit of the model is confirmed if the H0 of these tests is not rejected. According to the table, the probability of this test is above 5%, indicating the goodness of fit of the above probit model. Furthermore, the managerial overconfidence coefficient (MANEGERAL_OVER) indicates a significant positive relationship between this coefficient and overinvestment.

Second Hypothesis

H2: Inflation uncertainty exacerbates the impact of CEO overconfidence on corporate overinvestment in TSE. The following model is used to measure it:

$$\text{Overinvestment}(Y_{it}=1|X'_{it}) = \Pr(Y_{it}=1|Y^{*}_{it}>0) = \Phi\Big(\delta_0 + \delta_1 \text{Over\_Confidence}_{it} + \delta_2 \text{Over\_Confidence}_{it} \times \text{Inflation Uncertainty}_{it} + \delta_3 \text{Sales}_{it} + \delta_4 \text{Constraint}_{it} + \delta_5 \text{Cash}_{it} + \delta_6 \text{Lev}_{it} + \delta_7 \text{BM}_{it} + \delta_8 \text{ROA}_{it} + \delta_9 \text{Agency Cost}_{it} + \delta_{10} \text{Tangibility}_{it} + \delta_{11} \text{Invest\_Oppertunity}_{it} + \delta_{12} \text{Own\_Concenteration}_{it} + \int_{-\infty}^{X'_{it}\infty} \left[\frac{1}{\sqrt{2\Pi\Pi}}\right] \text{Exp}\left[\frac{1}{2}\left(\frac{s-\mu}{\sigma}\right)^2\right]\Big) ds \quad (4)$$

Table 5. Estimation results by probit method (dependent variable: corporate overinvestment)

Variable	Coefficient	z-statistic	Probability of Rejecting Significance
Over_Confidence × Inflation Uncertainty	1.805695	13.196646	0000.0
SALE	-2.62177	-1.99109	0.0465
CONSTRAINT	0.204888	11.6757	0000.0
CASH	-0.32373	-0.60714	0.5438
LEVERAGE	-1.49377	-3.9996	0.0001
BM	-0.28208	-3.58403	0.0003
ROA	1.670985	1.392846	0.1637
AGENCYCOST	2.424927	1.824989	0.068
TANGIBILITY	-0.87468	-2.47301	0.0134
INV_OPPORTUNITIS	-0.41317	-4.33877	0000.0
OWNERSHIP_CONSTRANTION	-0.12521	-3.57227	0.0004
Hosmer-Lemeshow test statistic (H − L) (P − VALUE)	Chi − Sq(8)= 12.7261 (0.1216)		

According to the results of estimating the H2 test model with overinvestment as a dependent variable, the probability values of the Hosmer-Lemeshow test are above 5%, indicating the goodness of the fir of the above probit model. Furthermore, the coefficient of managerial overconfidence's effect on inflation uncertainty at a 95% confidence level has an error of less than 0.05%. Accordingly, H2 was confirmed, and it was found that inflation uncertainty exacerbates the impact of CEO overconfidence on corporate overinvestment in TSE.

Conclusion

This study aimed to investigate the effect of inflation uncertainty on the effect of managerial overconfidence on overinvestment. According to the results of the probit regression test, H1 was confirmed to have a significant effect of CEO overconfidence on the investment bias of listed companies in TSE. According to this conclusion, along with cognitive biases, the occurrence of overconfident behaviors by the CEO will lead to individual decisions based on personal insights and not specialized arguments. In other words, corporate capital expenditures increase, resulting in increased CEO overconfidence in decision-making, leading to overinvestment on investment projects. CEOs who make this misconception are more likely to invest in cash than to distribute cash profits. They also prefer financing within the company to financing outside the company to finance ongoing investment projects. With sufficient internal cash resources, CEOs tend to overinvestment based on the perceived error of overconfidence because they ignore the appropriateness between the return on financial resources and the company's financial planning when

estimating future returns. In other words, the transition from financing through the sale of fixed assets and the unwillingness to issue shares and increase the company's shareholders to financing through debt and the issuance of bonds can intensify the impact of managerial overconfidence on the likelihood of increased corporate overinvestment.

The results of this section are consistent with those obtained by Heaton (2002), Malmendier & Tate (2005), Lynn et al. (2008), and Shamsi et al. (2019). Furthermore, according to H2, inflation uncertainty exacerbates the impact of CEO overconfidence on corporate overinvestment in TSE. This result suggests the effect of inflation volatility on managers' ability to predict price changes accurately. Managers are incapable of predicting the price of their products and similar products, as well as choosing between producing more or postponing new investments. In other words, managerial overconfidence depends not only on the attributes of managers such as overconfidence but also on external environmental factors such as inflation volatility. Inflation uncertainty is considered as one of the most important external factors in companies when making investment decisions. Increased inflation can sometimes lead to changed managers' expectations of future uncertainty inflation; consequently, such uncertainty affects managers' ability to predict price changes accurately.

When product prices change, managers cannot predict the prices of their own products, complementary products, and competitive products. Therefore, they cannot decide whether or not to delay production, postpone investment, or sign short-term contracts to reduce investment altogether. Thus, inflation uncertainty can reduce corporate investment. However, it is unclear whether companies will consider it when making investment decisions because it has a significant impact on the scale of production and large-scale projects. The results of this section are consistent with those from research by Klayman et al. (1999), Wang et al. (2016), and Alinejad Sarokolaei et al. (2018).

According to the results, CEOs are recommended to abandon optimism about macroeconomic risks such as inflation and consider it as a warning for investment inefficiency, such as overinvestment. This is because inflation uncertainty leads to phenomena such as the sales downturn and the disturbed expected profitability of mixed projects. Hence, it is crucial to have reasonable expectations instead of adapting to past trends under such conditions. As noted earlier, it is advisable to choose financing methods based on stock issuance rather than using debt-based methods under inflationary conditions.

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