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In the Name of God, the Compassionate, the Merciful



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E-mail: ijaaf@um.ac.ir

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Structure of second page until the end of manuscript is as follow:

- *Introduction* Some paragraphs contain explaining the problem, literature review, object (purpose), importance and necessity of it.
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- Tables include variables, should contain a column for the symbols used for variables.

Articles Writing Guide

- Formulas represent centered in Times New Roman¹¹ and render in a two column table with no border and number with figure in parentheses.

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I am pleased to announce that the Ferdowsi University of Mashhad is publishing Iranian Journal of Accounting, Auditing & Finance (IJAAF). On behalf of the board of the IJAAF and my co-editors, I am glad to present the Volume 1, Issue 1 of the journal in December 2017; the journal will publish four issues in a year. The board includes experts in the fields of accounting, finance and auditing, all of whom have proven track records of achievement in their respective disciplines. Covering various fields of accounting, *IJAAF* publishes research papers, review papers and practitioner oriented articles that address significant issues as well as those that focus on Asia in particular. Coverage includes but is not limited to:

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Yours faithfully,
Mahdi Moradi
Editor in Chief



RESEARCH ARTICLE

Carbon Emission Disclosure and Firm Value: The Moderating Role of Corporate Governance

Muhammad Zikrul Fahmi*, Lilik Handajani, I Nyoman Nugraha Ardana Putra

Accounting, Faculty of Economics and Business, University of Mataram, Mataram, Indonesia

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Abstract

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The purpose of this study is to analyze the effect of carbon emission disclosure on firm value and the interaction of foreign ownership and foreign board diversity as moderation variables. This study is a causal associative study with a quantitative approach, researchers used 77 samples from several company sectors included in the carbon intensive industry listed on the Indonesia Stock Exchange (IDX) from 2021 to 2023 using moderated regression analysis. The results of the analysis show that carbon emission disclosure has a significant positive effect on firm value. foreign board diversity moderates negatively and foreign ownership does not moderate the relationship between carbon emission disclosure and firm value. The result practically can be a consideration for companies in carrying out carbon disclosure as well as input for investors in making investment decisions. The implication of this study is that it can be a consideration for the authorities in preparing regulations related to carbon emission disclosure, especially in Indonesia which is still voluntary.

Keywords:

Carbon Emission Disclosure,
 Firm Value, Foreign
 Ownership, Foreign Board
 Diversity

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*Corresponding Author: Muhammad Zikrul Fahmi
 Email: fahmi.zikrul1997@gmail.com
 Tel:
 ORCID:

1. Introduction

The growth of firm value is the long-term goal that businesses prioritize. A company's wealth is reflected in its firm value, which can be seen through its securities (Ifada et al., 2021). It serves as a primary goal for stakeholders, including investors, creditors, and managers. The significance of firm value prompts investors and creditors to adopt increasingly selective approaches when investing in or extending credit to companies. Fundamentally, every company aims to maximise profit, which, in the context of intensifying global competition, drives efforts to enhance competitiveness across various aspects, particularly in increasing stock prices (Mumpuni and Indrastuti, 2021).

Data from the IDX during the trading period from 2 to 5 January 2024 indicate a positive trend. The highest weekly increase was observed in the average daily stock transaction frequency, which rose by 29.83% to 1,154,208 transactions, compared to 888,989 transactions in the previous week. An increase was also recorded in the Composite Stock Price Index (IHSG), which grew by 1.07%, reaching 7,350.62 from 7,272.80 at the previous week's close. The IHSG achieved its all-time high during the closing of trading on Thursday (4 January), at the level of 7,359.76 (IDX, 2024).

The Industrial Revolution has resulted in increased carbon concentrations in the atmosphere, leading to global warming and climate change (Irwhantoko and Basuki, 2016). In many nations worldwide, the topic of global warming is currently being explored extensively. The threat posed by global warming has prompted various stakeholders to take significant action, including business entities, which are now expected to communicate their contributions to global warming due to the carbon emissions they produce (Choi et al., 2013). Carbon emissions are believed to be the primary factor contributing to global warming and environmental change (Muhammad and Aryani, 2021).

In 2021, the global total of Greenhouse Gas (GHG) emissions was recorded at 34,175.3 million tons of CO₂ equivalent, with a carbon increase of 1,753.7 MtCO₂eq over the 10-year period from 2012 to 2021. In Indonesia, GHG emissions also increased over the last decade. In 2021, Indonesia's total GHG emissions were recorded at 568.3 million tons of CO₂ equivalent, marking an increase of 98.2 million tons of CO₂ equivalent from 2012 (IEA, 2023). Given the impact of climate change on business sustainability, carbon emission disclosure has become an emerging issue in many countries, including Indonesia (Hermawan et al., 2018). In Indonesia, carbon emission disclosure is still voluntary (Irwhantoko and Basuki, 2016), which can be tolerated due to its novelty, resulting in only a few companies engaging in such disclosures (Anggita et al., 2022).

Concerns about environmental circumstances, especially the adverse effects of global warming, are the driving force behind this research. Numerous investigations have been carried out to examine the connection between firm value and carbon emission disclosure. As investors view the disclosure of carbon information as bad news, prior research suggests that there is a negative correlation between carbon emission disclosure and firm value. They believe that the costs involved do not justify the potential benefits (Matsumura et al., 2014; Muhammad and Aryani, 2021). Other researchers have found that carbon emission disclosure does not have a significant relationship with firm value, which may be due to the use of dummy variables that fail to explain the motives behind carbon emission disclosure (Sudibyo, 2018). On the other hand, some studies have shown a different result, where carbon emission disclosure positively affects firm value. By disclosing carbon information, which reflects a company's responsibility to the environment, a positive public image is formed. Furthermore, this disclosure is also believed to enhance competitive advantage (Hardiyansah and Agustini, 2021; Kurnia et al., 2021; Noor and Ginting, 2022; Rahmianingsih and Malau, 2022). Thus, another motivation for this study is the inconsistency in prior research. To address this, the researchers introduce the Corporate Governance variables of foreign ownership and foreign board diversity as moderating variables.

Companies in the carbon Intensive Industry sector that are listed on the IDX between 2021 and

2023 are the subject of this study. This study aims to investigate and evaluate the following questions: (1) Does carbon emission disclosure affect firm value in carbon intensive industries? (2) Can foreign ownership moderate the relationship between carbon emission disclosure and firm value in carbon intensive industries? (3) Can foreign board diversity moderate the relationship between carbon emission disclosure and firm value in carbon intensive industries? Additionally, this study attempts to close the gap left by earlier research in Indonesia, which has frequently concentrated on certain industries. This study focuses on companies in the carbon intensive industry, which includes several sectors in Indonesia, such as consumer non-cyclicals, industrial, basic materials, real estate management & development, transportation & logistics, infrastructure, and energy.

2. Literature review

2.1 Agency theory

Agency theory was first proposed by Jensen and Meckling in 1976. The core principle of agency theory is the existence of a relationship or contract between the principal, which is the shareholder, and the agent, which is the manager or corporate executive. A decline in firm value can be attributed to agency conflicts, and good corporate governance can reduce such conflicts (Sindy and Butar-Butar, 2023). Agency conflicts arise when managers have an obligation to maximize shareholder welfare, but at the same time, managers have their own interests in maximizing their welfare through bonuses promised by shareholders. The alignment of interests between these parties often leads to agency problems or conflicts. Management, entrusted with the responsibility of running the company, typically has more comprehensive information, unlike shareholders, who have limited access to information. This information imbalance can trigger conflicts between the parties. The differing interests lead both sides to seek ways to gain advantages for themselves (Nainggolan and Karunia, 2022).

A decline in firm value can be caused by agency conflicts, and good corporate governance can mitigate these conflicts (Sindy and Butar-Butar, 2023). Theoretically, this suggests that good governance practices lead to a reduction in agency costs. Therefore, it is important for companies to implement good governance principles (Arora and Sharma, 2016).

Environmental disclosures, particularly carbon emission disclosure, are one mechanism to minimise information asymmetry between principals and agents. External pressures arising from operational activities that produce carbon emissions, which adversely affect the climate, ultimately pose significant risks, such as declining firm value. The inclusion of foreign entities within a company's ownership and board structure is expected to provide more stringent oversight of corporate and environmental performance, thereby mitigating the potential reduction in firm value.

2.2 Legitimacy theory

First presented by Dowling and Pfeffer in 1975 (Jannah and Narsa, 2021), legitimacy theory describes how an organization engages with society at large and is related to the idea of the social contract. There is a connection between legitimacy and shifting societal norms. Because society has always aimed for a future in which every person has the right to a good life, access to freedom, justice, equality, a pollution-free environment, and other elements deemed necessary for human existence (Islam, 2017). Changes in societal expectations mean that what was once considered acceptable may now be viewed as unacceptable. This shift in expectations creates what is known as the legitimacy gap, referring to the disparity between what society expects organizations to do and how they should behave and act (Choi et. al., 2013). Thus, organizations must pay attention to these

changes in societal expectations to prevent threats to their survival (Islam, 2017).

Companies can engage in the necessary disclosures to meet these expectations and gain legitimacy from the public. In relation to declining firm value and the climate phenomena resulting from corporate activities, the appropriate disclosure, namely carbon emission disclosure, is required. According to Hardiyansah and Agustini (2021), companies that disclose carbon emissions exhibit good environmental performance, which results in the public granting legitimacy, thereby enhancing the company's image and attracting investors.

Firms that attain public legitimacy gain various benefits, including enhanced reputation and a positive image, which distinguish them from competitors and foster increased trust and loyalty among investors and customers. Furthermore, legitimacy aids companies in managing and mitigating negative issues while improving their ability to address criticism and safeguard their reputation. This creates a stronger foundation for long-term growth and sustainability.

2.3 Stakeholder theory

The theory regarding the relationship between a company and various stakeholders or interested parties, such as shareholders, employees, suppliers, government, and the general public, is known as stakeholder theory. This theory was initially developed by R. Edward Freeman in 1984 through his book *Strategic Management: A Stakeholder Approach*. The history of stakeholder theory begins with the idea that companies are not only responsible to shareholders but also to various other stakeholders who have an interest in the company. This theory has since evolved and become an integral part of strategic management, business ethics, and corporate social responsibility (Freeman et. al., 2021).

In its operations, a company impacts not only itself but also its stakeholders, including the broader community. The phenomena of global warming and climate change resulting from corporate operations negatively affect the environment, making it an important issue for discussion. Society, either directly or indirectly, may encourage companies to disclose environmental information, such as carbon emission disclosure. According to Oktarina (2018), the main objective of stakeholder theory is to help managers understand stakeholders and assist them in improving firm value by mitigating the negative impacts of corporate activities and minimizing harm to stakeholders.

Companies that understand the needs of stakeholders, particularly the community, have the potential to reduce the risk of conflicts and disruptions to their operations. The ability to comprehend and respond to community needs provides a competitive advantage, enabling companies to differentiate themselves from competitors and establish favourable conditions for sustainable growth and long-term success.

2.4 Signaling theory

Signaling theory explains an event where internal parties of an entity, possessing private information, whether positive or negative, must decide whether to communicate this information to external parties. This theory involves two parties: the internal company as the signaler and the external audience as the receiver. The theory focuses on the deliberate communication of positive signals to the public to convey the entity's positive actions with the aim of receiving a favorable response from the audience or receiver (Connelly et. al., 2011).

According to signaling theory, pressure on companies from various parties, including stakeholders, can be alleviated through carbon emission disclosures. This signals that the company is aware of the environmental crisis and is taking steps to mitigate the associated risks. Such actions can protect the company's reputation and image to a certain extent (Lu et al., 2021). The carbon

emission disclosure carbon emission disclosures made by companies, driven by global warming resulting from corporate operations, represent a form of non-financial disclosure. When this information is shared with the public, it is intended to serve as a positive signal indicating that the company is aware of, capable of managing, and responsible for the environmental risks it creates, thus safeguarding its image.

Carbon emission disclosures are expected to serve as positive signals, particularly to external stakeholders, as these disclosures demonstrate a company's commitment to reducing emissions generated through its operational activities. Such positive signals are anticipated to reflect the quality of management, attract investor interest, and ultimately contribute to an increase in firm value.

2.5 Hypothesis development

2.5.1 The influence of carbon emission disclosure on firm value

The increasing prominence of environmental issues has placed pressure on companies to provide information regarding their operational activities and their impact on the environment (Muhammad and Aryani, 2021). One of the contributions businesses can make to address environmental concerns, specifically on the issue of global warming, is by disclosing their carbon emissions (Akhiroh and Kiswanto, 2016).

Research conducted by Blesia et al. (2023) and Azhari and Hasibuan (2023) discovered a significant positive correlation between Indonesian firm value and disclosure of carbon emissions. Companies are under increased pressure from multiple sources to reveal the environmental effects of their operations. Similar findings were reported by Kurnia et al. (2021), although their study spanned two countries, Indonesia and Australia. In contrast to Australia, where carbon emission disclosure had no effect on business value, Indonesia showed a strong positive correlation between carbon disclosure and firm value. The substantial costs associated with carbon emission disclosure result in increased spending and cash outflows, which may impede the growth of the firm's value.

Other research conducted by Hardiyansah and Agustini (2021), Rahmianingsih and Malau (2022), Noor and Ginting (2022), Yuliandhari et al. (2023) states that carbon emission disclosure has a positive effect on firm value. The motivation for companies to disclose carbon emissions is to gain legitimacy from the public. Companies must pay attention to environmental factors that support sustainability, so that they can have a positive impact on society or the business itself. Disclosing carbon emissions data allows the public and investors to assess a company's level of concern and factor it into their investment decisions.

Research indicates that carbon emission disclosure positively correlates with firm value in Indonesia, despite the high costs involved. The market's positive response to carbon emission disclosure can enhance corporate sustainability and attract environmentally conscious investors, ultimately increasing firm value. Based on the theoretical framework above, the following hypothesis is formulated:

H₁: Carbon emission disclosure has a positive influence on firm value.

2.5.2 The moderating effect of foreign ownership

Jensen and Meckling (1976) propose that foreign ownership constitutes a corporate governance mechanism that can aid in controlling agency problems. The presence of foreign investors is seen as an effective supervisory mechanism for each decision made by management. The contractual relationship that exists between the principle and the agent is the foundation of agency theory; in this case, foreign ownership serves as the principal and gives the managers of the business (agents) the power to establish an advantageous employment contract. The objective is for agents to manage

resources prudently, thereby generating expected profits and mitigating risks in accordance with mutual agreements. Stakeholder theory further explains how corporate managers can more effectively manage relationships between stakeholders within a company. Enhancing firm value by minimizing stakeholder losses is a broad goal underscored by stakeholder theory (Oktarina, 2018).

There is a favorable correlation between foreign ownership and firm value, according to research by [Sari and Budiasih \(2018\)](#). More transparency in financial information is demanded by foreign investors than by domestic ones. Foreign investors are expected to perform greater control on business operations. By mitigating the negative impacts of C carbon emission disclosure, foreign investors tend to value this type of transparency more than local investors (Muhammad and Aryani, 2021). Based on these observations, the researcher formulates the following hypothesis:

H₂: Foreign ownership positively moderates the relationship between carbon emission disclosure and firm value.

2.5.3 The moderating effect of foreign board diversity

[Aksan and Gantiyowati \(2020\)](#) found no significant relationship between foreign board diversity and firm value, which is likely due to the low number of foreign board members, making it difficult to establish a robust link between these variables. Conversely, [Khairani and Harahap \(2017\)](#) found a positive association between foreign board diversity and firm value. Theoretically, a board member with an international background and accustomed to global culture is likely to contribute to environmental issues by implementing high standards in environmental management practices ([Khalid et. al., 2022](#)). A study by [Narsa and Jannah \(2021\)](#) concluded that foreign diversity positively impacts carbon emission disclosure. In relation to such disclosures, foreign diversity on boards introduces new perspectives in motivating and reporting current information related to carbon emission disclosure, which stem from experiences in leading previous companies and subsequently applying these practices in the present organization.

Boards with diverse national backgrounds possess broader information and knowledge, which is anticipated to contribute positively to addressing environmental issues through sound environmental management practices. In terms of carbon disclosure, this serves as a method for companies to attain legitimacy from the public, particularly among those affected by the company's operational activities. Effective environmental management by the company is also expected to receive a positive response from stakeholders, including the public and investors, ultimately enhancing firm value. Based on this background, the researcher formulates the third hypothesis as follows:

H₃: Foreign board diversity positively moderates the relationship between carbon emission disclosure and firm value.

3. Research methodology

3.1 Data

The secondary data that was used in this investigation was unbalanced data. From 2021 to 2023, all publicly traded companies classified as carbon intensive industries that were listed on the IDX represent the study's population. The researcher chooses particular segments of the population that are thought to be representative or highly informative about the issue or subject being studied using the purposive sampling technique ([Rasyid, 2022](#)). In other words, this sampling method involves selecting samples based on specific criteria. The sampling criteria for this study are as follows: (1) The public company is a carbon-intensive industry listed on the IDX from 2021 to 2023, as such industries tend to produce higher carbon emissions ([He et al., 2013](#)). (2) The company discloses carbon emissions in its annual or sustainability reports during the observation period. (3) The variables under study are fully available in the company's annual or sustainability reports or on the

company website from 2021 to 2023.

3.2 Research variables and measurements

3.2.1 Dependent variable

Firm value

The dependent variable in this study is firm value, which may be measured using methods such as Price to Book Value (PBV), Market Capitalization (MCAP), and Tobin's Q (Anggraeni, 2018; Muhammad and Aryani, 2021; Anggita et al., 2022).

For this study, Tobin's Q is used to measure firm value. Rather than employing the basic formula for Tobin's Q, the study uses the formula applied by Muslichah (2020), as the basic calculation requires detailed data, including the Replacement Value of Assets, which is challenging to obtain. Other studies, such as those by Lumapow and Tumiwa (2017) and Oktarina (2018), have also employed this approach to Tobin's Q. The formula to calculate Tobin's Q is as follows:

$$TQ = \frac{(MVE + D)}{BVA}$$

TQ = Tobin's Q value

MVE = Market Value of Equity (Current Price x Total Shares)

D = Total Debt

BVA = Book Value of Assets

3.2.2 Independent variable

Carbon emission disclosure

The independent variable in this study is Carbon Emission Disclosure (CED), measured using an index developed by Choi et al. (2013). This index is derived from factors identified in the information request sheets of the Carbon Disclosure Project (CDP), organized into five categories: climate change (risks and opportunities), GHG emissions, energy consumption, GHG reduction and its costs, and carbon emissions accountability. These five categories are further detailed into 18 items. Several other studies have adopted this index to measure CED, including research by Widyastuti et al. (2023), Sari and Budiasih (2022), Anggita et al. (2022), Jannah and Narsa (2021), and Ng et al. (2022). The maximum score each company can obtain is 18 if all disclosure categories are reported.

3.2.3 Moderator variable

Foreign ownership

The Foreign Ownership (FO) variable represents the presence of foreign ownership within a company. FO is measured by dividing the total shares owned by foreign investors by the total shares outstanding over a given period (Justina and Simamora, 2017). The formula is as follows:

FO = Total shares held by foreign investor/ Total outstanding shares

Foreign board diversity

The Foreign Board Diversity (FBD) variable reflects the diversity of foreign members on the board of commissioners. FBD is measured by dividing the number of foreign commissioners by the total number of commissioners (Innayah et al., 2021). The formula is as follows:

FBD = Number of foreign commissioners/ Total number of commissioners

3.2.4 Control variables

Firm Size: The firm's total assets, converted using the natural logarithm (ln), can be used to

calculate Firm Size (FS) (Kholmi et al., 2020).

Profitability: Profitability (PRO) is measured using the Return on Assets (ROA), which is the company's profit divided by total assets. The profitability value reflects the company's performance, where high profitability indicates strong performance (Rini et al., 2021). Profitability is calculated using the following formula (Fahmi, 2020):

$$PRO = \frac{Net\ Income}{Total\ Assets}$$

Leverage: Leverage is also used as a control variable in this study. High leverage indicates that a company heavily relies on third-party financing for its operational activities. Leverage (LEV) is measured by comparing total debt to total assets (Yusuf, 2020). The formula is as follows (Fahmi, 2020):

$$LEV = \frac{Total\ Debt}{Total\ Assets}$$

3.3 Empirical model

The analysis method used in this study is Moderated Regression Analysis (MRA). This method is applied to analyze the effect of CED on firm value, as well as the interaction effects of foreign board diversity and foreign ownership. The equations are as follows:

$$FV = \alpha + \beta_1 CED + \beta_2 FS + \beta_3 PRO + \beta_4 LEV + e \quad (1)$$

$$FV = \alpha + \beta_1 CED + \beta_2 FBD + \beta_3 FO + \beta_4 FS + \beta_5 PRO + \beta_6 LEV + e \quad (2)$$

$$FV = \alpha + \beta_1 CED + \beta_2 FBD + \beta_3 FO + \beta_4 CED * FBD + \beta_5 CED * FO + \beta_6 FS + \beta_7 PRO + \beta_8 LEV + e \quad (3)$$

Where:

FV = Firm Value

CED = Carbon Emission Disclosure

FBD = Foreign Board Diversity

FO = Foreign Ownership

FS = Firm Size

PRO = Profitability

LEV = Leverage

α = Constant

β = Regression Coefficient

e = Error

4. Results

Secondary data was used in this investigation. Companies in the carbon intensive industry sector that were listed between 2021 and 2023 on the IDX represent the research population. Several samples were chosen based on the predetermined classification criteria, as shown in the Table 1:

Table 1. Sample

Description	Total
Number of companies listed on the IDX in 2023 (Classified as Carbon Intensive Industry)	580
The company does not disclose carbon emissions by category	(503)
Number of sample companies	77
Number of observations (Unbalanced)	189

4.1 Descriptive statistics

The firm value variable in this study is measured using Tobin's Q (Monica et al., 2021). As shown in Table 2, the average firm value is 1.45. Given the comparison between the maximum, minimum, and average values, where the mean is closer to the minimum, it can be inferred that Indonesian companies have effectively managed their assets and possess good investment prospects. A Tobin's Q value greater than 1 indicates that the company has successfully achieved its objective of maximizing firm value, considering Tobin's Q as a ratio accounting for stock value, debt, and assets (Ramadhan et. al., 2023).

Table 2. Descriptive Test Results

	FV	CED	FBD	FO	FS	PRO	LEV
Mean	1,450	0.298	0.375	0.407	29,515	0.063	0.482
Median	1,117	0.278	0.333	0.342	29,442	0.046	0.430
Maximum	10,570	0.667	1,000	0.998	33,731	0.593	2,312
Minimum	0.183	0.056	0.143	0.000	25,313	-0.454	0.033
Std. Dev.	1,206	0.164	0.182	0.308	1,676	0.115	0.345
Observations	189	189	189	189	189	189	189

The carbon emission disclosure variable in this study is measured using the carbon measurement index developed by Choi et al. (2013). Table 2 indicates that the average carbon emission disclosure is 0.30. The maximum disclosure value of 0.67 suggests that, of the 18 categories of carbon disclosure, only 12 (or 67%) are disclosed, while the minimum value is 0.05 (or 5%), meaning the company disclosed only one category. Considering the average value's proximity to the minimum, it can be concluded that most companies show relatively low attention to carbon emission disclosure.

The foreign board diversity variable is measured as the ratio of foreign commissioners to total commissioners (Suranta et al., 2020). As seen in Table 2, the average foreign board diversity is 0.37. The maximum value of 1.00 indicates that 100% of the board of commissioners is composed of foreign members, while the minimum value of 0.14 signifies that foreign commissioners constitute only 14% of the total board.

The foreign ownership variable is measured by the ratio of foreign investors' total shares to total outstanding shares (Justina and Simamora, 2017). As displayed in Table 2, the average foreign ownership is 0.41. The maximum value of 0.99 suggests that 99% of the outstanding shares are owned by foreign investors, whereas the minimum value of 0.000 indicates that only 0.0027% of outstanding shares are held by foreign investors.

4.2 Classical assumption test

4.2.1 Multicollinearity test

Table 3. Multicollinearity Test

		CED	FBD	FO	FS	PRO	LEV
Carbon Emission Disclosure	CED	1.000	-0.125	0.027	0.330	0.108	-0.096
Foreign Board Diversity	FBD	-0.125	1.000	0.452	-0.199	-0.120	-0.092
Foreign Ownership	FO	0.027	0.452	1.000	0.091	-0.072	0.101
Firm Size	FS	0.330	-0.199	0.091	1.000	0.073	0.134
Provitability	PRO	0.108	-0.120	-0.072	0.073	1.000	-0.314
Leverage	LEV	-0.096	-0.092	0.101	0.134	-0.314	1.000

As indicated in Table 3, the multicollinearity test results show that the regression model is free

from multicollinearity potential, as all correlation coefficient values between independent variables are below 0.85, thereby failing to reject the null hypothesis (H_0) and confirming the absence of multicollinearity issues.

4.2.2 Heteroscedasticity test

Table 4. Heteroscedasticity Test

		Probability
Carbon Emission Disclosure	CED	0.753
Foreign Board Diversity	FBD	0.420
Foreign Ownership	FO	0.173
Firm Size	FS	0.396
Leverage	LEV	0.746
Profitability	PRO	0.145

As presented in Table 4, the results of the heteroscedasticity test reveal that each variable has a value greater than 0.05, indicating that the regression model is free from heteroscedasticity. This suggests that the research data is sufficiently homogeneous and reliable.

4.3 Regression analysis result

Model selection analysis, including the Chow Test, Hausman Test, and Lagrange Multiplier Test, was carried out in order to do the panel data regression analysis and give a summary of the study data. The most suitable model was found to be the Fixed Effect Model. The following are the outcomes of the panel data regression using the Fixed Effect Model:

Table 5. Panel regression result data (Fixed Effect Model)

Variable	Symbol	Coefficient	T	Prob.
C			4.965	(0.000)
Carbon Emission Disclosure	CED	2.279	2.042	(0.044)
Firm Size (Control Variable)	FS	-1.257	-4.844	(0.000)
Leverage (Control Variable)	LEV	0.743	1.468	(0.145)
Profitability (Control Variable)	PRO	1.892	2.058	(0.042)
Foreign Board Diversity	FBD	2.433	2.101	(0.038)
Foreign Ownership	FO	-0.587	-0.681	(0.497)
Foreign Board Diversity*CED		-9.469	-3.752	(0.000)
Foreign Ownership*CED		1.921	1.431	(0.156)
R-squared		Adjusted R-squared	F-statistic	Prob (F-statistic)
0.924		0.863	15.133	0.000

4.4 Hypothesis test results

Based on the results of the regression test presented in Table 5, the probability value (F-Statistic) is 0.0000, which is lower than the significance level of 0.05. This finding indicates that the independent variables collectively have a significant effect on the dependent variable. Table 5 shows that the R-squared (R^2) value is 0.9244, or 92.44%, suggesting a positive relationship between the independent variable that is carbon emission disclosure, and firm value as dependent variable. Furthermore, the Adjusted R-squared (Adj. R^2) value from the same test in Table 5 is 0.8633, or 86.33%. This percentage indicates that carbon emission disclosure as an independent variable accounts for 86.33% of the variance in firm value, with the remaining 13.67% explained by

other variables not included in this study.

From the tests presented in Table 5, the t-value for the carbon emission disclosure variable is positive at 2.0415, with a probability of 0.0437, which is lower than the significance level of 0.05 ($0.0437 < 0.05$). The first hypothesis (H_1), which claims that carbon emission disclosure has a positive impact on firm value, is supported by this finding, which results in the conclusion that the variable has a positive and significant effect on firm value.

This outcome aligns with Signaling Theory, which posits that companies must meet public expectations; any gap between public expectations and company behavior creates a Legitimacy Gap. To reduce this gap, companies can disclose information to meet expectations and gain public legitimacy. Stakeholder Theory further asserts that companies should operate not solely for profit but to benefit all stakeholders. By disclosing carbon emissions, a company can reduce the risk of conflicts with the public that may disrupt operations and cause financial losses. Additionally, Signaling Theory suggests that positive signals to the public may yield positive feedback or responses. This study's findings indicate that carbon emission disclosure serves as a positive signal for companies, as demonstrated by the increase in firm value. Empirical evidence from this study demonstrates that carbon emission disclosure plays a significant role in enhancing firm value. Not only does it provide competitive advantages, but it also helps companies gain legitimacy from both the public and investors.

Subsequent testing reveals an interaction between foreign ownership and the relationship between carbon emission disclosure and firm value. The t-value is 1.4308, with a probability of 0.1555, which is greater than the significance level of 0.05 ($0.1555 > 0.05$). This study rejects the second hypothesis (H_2), which claims that foreign ownership would strengthen the association between carbon emission disclosure and firm value. Instead, it shows that foreign ownership does not strengthen this relationship. This result runs counter to the theory this study developed. There is no empirical evidence that the relationship between carbon emission disclosure and firm value is significantly impacted by foreign ownership. Regardless of the percentage of foreign ownership, it does not use carbon emission disclosure to increase firm value.

Additionally, the investigation also shows that the association between carbon emission disclosure and firm value with the interaction of foreign board diversity. With a probability of 0.0003 and a t-value of -3.7523, the coefficient is -9.4692, below the significance level of 0.05 ($0.0003 < 0.05$). As a result, the third hypothesis (H_3), according to which the relationship between carbon emission disclosure and firm value is strengthened by foreign board diversity, is disproved. The study's hypothesis is refuted by this outcome. According to the test results, the association between firm value and carbon emission disclosure is weakened by foreign board diversity. A company's foreign board diversity percentage does not use carbon emission disclosure to increase firm value.

One possible reason why foreign board diversity and foreign ownership can not positively moderate relationship between carbon emission disclosure and firm value is that the average number of foreign committee members in this survey is still low at 37.5%. On the other hand, the lack of experience and understanding of new work environment conditions can also have a negative impact. The weakening of the firm's value may be caused by emerging agency conflicts. Carbon emissions information is expensive, and this information creates conflicts of interest and concerns among investors that the costs incurred are not commensurate with the revenues companies can earn.

5. Conclusion

This study analyzes diversity on the foreign board and foreign ownership as moderating factors to examine the impact of carbon emission disclosure on firm value. The market reacts favorably to carbon information and views it as a sign of company sustainability, as seen by the substantial beneficial impact of carbon emission disclosure on firm value. Therefore, companies that are transparent and responsible in disclosing carbon emissions tend to receive support from both the public and the market, as reflected in an increase in firm value. This is especially relevant given the increase in atmospheric carbon concentrations, which contribute to global warming and climate change due to corporate operational activities. The association between carbon emission disclosure and firm value is not strengthened by foreign ownership as a moderating variable. The impact of carbon emission disclosure on firm value is not influenced by the percentage of foreign ownership. Similarly, foreign board diversity diminishes rather than strengthens the link between firm value and carbon emission disclosure. Carbon emission disclosure in Indonesia remains voluntary, which means foreign ownership and foreign board diversity do not place sufficient emphasis on carbon disclosure. Moreover, providing carbon emission disclosure incurs significant costs, resulting in a potential conflict of interest, as the costs involved may not be offset by returns for the company.

The findings from this study provide insights for policymakers involved in developing regulations on carbon emission disclosure. In addition, Indonesia has implemented a carbon exchange transaction policy in line with the Financial Service Authority (OJK) policy number 14 of 2023 on carbon trading through carbon exchange. By regulating carbon emission disclosure, the government could more effectively monitor companies, particularly concerning carbon-related activities, and supervise companies that produce excessive carbon emissions. The results of this study can be practically used as consideration for companies when disclosing their carbon emissions, especially since disclosing carbon emissions has a significant positive impact on firm value. Although disclosing carbon emissions incurs costs, it is believed to have a positive impact on firm value. Finally, this study can provide input to investors in making investment decisions, by considering that companies that disclose carbon emission disclosure can increase firm value.

The main limitation of this study is the limited data due to the voluntary nature of carbon emission disclosure. Researchers may also face subjectivity issues when evaluating each indicator, as no regulation currently mandates how carbon emission disclosure should be presented. Based on this study's data limitations, future research could benefit from the establishment of regulations in Indonesia governing carbon emission disclosure, given its urgency in addressing climate change issues. Few companies currently disclose carbon emissions. Future studies are encouraged to adopt additional carbon emission disclosure indicators that are more relevant to the Indonesian context, or to explore other indicators that may be more suitable for the region.

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RESEARCH ARTICLE

The Information Content of Sustainability Reporting of Companies in Iran's Capital Market with an Emphasis on its Quality

Shahnaz Mashayekh*, Mahnaz Beizaeinezhad

Department of Accounting, Faculty of Social Sciences and Economics, Alzahra University, Tehran, Iran, Email:

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Abstract

The literature on corporate sustainability performance indicates that researchers have often focused on the individual dimensions of corporate sustainability performance. However, few studies have comprehensively measured the company's sustainability performance. In fact, many studies overlook the quality of sustainability reports, which can contain more information content. Therefore, this study investigates the information content of the sustainability reporting quality of listed companies in Iran. Examining 199 companies from 2014 to 2022, the study uses panel data analysis in EViews 9 software. The quality of sustainability reporting is measured using the reliability index by Sebrina and the Ohlson market value model is used to determine the information content. Findings indicate that the quality of sustainability reporting has information content but has not increased the information content of financial statements. This may be due to the novelty of sustainability reporting in Iranian companies. It is suggested that legislators conduct necessary investigations regarding the cost-benefit of making companies' sustainability reporting discretionary or mandatory.

Keywords:

Incremental Information
Content, Quality of the
Sustainability Report,
Relative Information Content

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*Corresponding Author: Shahnaz Mashayekh
Email: sh.mashayekh@alzahra.ac.ir
Tel: 09121490376
ORCID: 0000-0002-3723-4295

1. Introduction

Sustainable development supports economic and social progress while preventing environmental destruction and promoting the efficient use of natural resources. Companies play a crucial role in achieving sustainable development goals by implementing business practices that increase shareholder wealth and maximize employees' and society's economic and social well-being without negatively impacting the environment. Such activities of companies that contribute to sustainability are the process of creating a balance between economic, social, and ecological concerns (Mensah, 2019). Companies use sustainability reports to connect with their society and environment and manage interactions with various stakeholders for societal approval and activity continuation (Esmailzadeh et al., 2022).

Sustainability reports are critical to communicating the company's commitments and performance on sustainability issues. However, in the accounting literature, the reliability and validity of these reports have been widely criticized (Boiral et al., 2019).

The GRI standards help organizations increase their transparency and communicate both their positive and negative impacts on sustainable development. These standards enable consistent and high quality sustainability reporting, which helps organizations meet the needs of their stakeholders for comparable and reliable data (The GRI standards: a guide for policy-makers, 2021). To investigate the relationship between sustainability reporting and its quality for investors. Empirically, we aim to determine how investors perceive this information negatively or positively when estimating the company's value.

The information content of corporate sustainability reporting (CSR) has been studied from different theoretical perspectives, though yielding inconclusive evidence (Jadoon et al., 2021). Therefore, it is necessary for investors to re-examine the company's sustainability report, especially its quality. Amin and Salehnejad (2020) believe that the level of corporate sustainability reaches its peak in the maturity phase of the company's life cycle and has a positive and significant effect on economic value-added for the company. Studies that exclusively deal with the quality of sustainability reporting in Iran are not available. So, this study examines the information content of the company's sustainability report, emphasising its quality.

According to the stakeholder theory, sustainability reporting suggests that companies should meet the wider needs of stakeholders. This interaction with stakeholders can lead to innovations and improve the financial performance of companies. The increase in the sustainability disclosure level causes an increase in the value of the company's shares. Also, when there is no public disclosure of the company's sustainability reporting, the amount of risk accepted by investors will increase significantly (Rouhbakhsh, 2022).

The existing literature on corporate sustainability performance is dominated by two conflicting hypotheses: the social impact hypothesis and the trade-off hypothesis (Chen and Lee, 2017). Based on the social impact hypothesis, providing a wide class of stakeholders while improving the company's financial performance will ultimately increase the shareholders' wealth. This hypothesis aligns with the stakeholder theory (Alshehhi et al., 2018). On the other hand, based on the trade-off hypothesis, the company's sustainability activities will lead to unnecessary costs and ultimately reduce the company's profitability. This hypothesis opposes the stakeholders' interests (Marom, 2006; Jadoon et al., 2021).

Considering the existence of two contradictory hypotheses and inconclusive empirical evidence in corporate sustainability performance, it is necessary to examine the information content of corporate sustainability reports in listed companies in Iran to achieve a single theory.

While examining the information content of the company's sustainability report, this study also considers the quality of the sustainability report. This is an important factor for the capital market

practitioners.

2. Literature review

There is a global trend towards sustainable development. In addition, environmental issues such as air and water pollution, climate changes and ecosystem dangers, attention to corporate social responsibility and the risk the organizations faced during the spread of COVID-19. Therefore, the stakeholders need to be well informed about those risks and how they can affect the organizations by disclosing how social and environmental issues impact business operations (Metwally, 2023).

Environmental disclosure is positively linked to environmental performance. High quality environmental disclosers display effective corporate governance and tend to face less difficulties accessing capital markets. High quality environmental disclosures are value relevant and improve investor perceptions (Iatridis, 2013).

Internal Controls Reporting, Sustainability Innovation Performance, and Earnings Quality were rated first to third, respectively, among the 25 criteria affecting the quality of sustainability reporting, according to the FDANP (Fuzzy Decision-Making Trial and Evaluation Laboratory Analytic Network Process-based) (Esmailzadeh et al., 2022).

The IRI (integrated reporting index) showed an increasing trend, indicating an improvement in the overall disclosure quality of Indian companies. This quality upgrade of IR might result from the initiatives of the top management and awareness about the reporting (Devarapalli et al., 2024). Atika and Simamora (2024) investigated the effect of corporate culture on sustainability report quality; based on their research, low clan culture, high hierarchy culture, and high market culture lead to high sustainability report quality.

2.1 Assurance and quality

Al-Shaer (2020) concluded that firms devoting more resources to producing high-quality sustainability reports are likely to demonstrate an overall commitment to quality. This commitment alleviates auditors' concerns about the opportunistic use of sustainability reporting, reducing business risk and the effort auditors expend to verify financial reports.

Moroney et al. (2012) used an index based on the Global Reporting Initiative (GRI) to measure the quality of company environmental reporting. Results showed that the quality of voluntary environmental disclosures scores significantly higher for assured companies than unassured companies. The quality does not differ for assured companies, whether assured by accountants or consultants.

Auditors are important as change agents in implementing integrated reporting (IR) assurance. They support the correct interpretation of International IR Council standards and promote IR (Briem and Wald, 2018).

Internal auditors are a primary component of corporate governance mechanisms. Management uses their assurance to ensure the organization can report sustainable activities. However, the work of internal auditors in assuring sustainability complements external auditors and does not replace them (Metwally, 2023). The effectiveness of internal audits, risk management processes, and sensitivity to sustainability all had a significant positive relationship with sustainability audits (Amoako et al., 2023).

2.2 Stakeholder theory

Based on the stakeholder theory, companies must consider the interests of a wide group of stakeholders to achieve success. Therefore, while focusing on the interests of the main stakeholders such as shareholders, employees, customers, and the government, companies should consider the

interests of secondary groups such as environmental protection groups and civil society groups (Schaltegger et al., 2019). Despite the diverse stakeholder groups, companies should apply procedures and policies beneficial to all stakeholders (Darnall et al., 2010).

According to the stakeholders' demands for transparency, sustainability reporting is an important tool for decreasing information asymmetry. On the other hand, increasing transparency allows investors to have more appropriate evaluations of firms' activities and direct their investments to companies with more enthusiasm (Esmailzadeh et al., 2022).

Porter and Kramer (2006, 2011) examined the relationship between social and economic development from a different perspective by considering the conflicting views on sustainability activities (social impact hypothesis and the trade-off hypothesis). By stating that companies can not solve all of society's social and environmental problems, they should focus on social and environmental activities that benefit society and the company. As a result, reconciliation between conflicting hypotheses is possible.

Stakeholder theory claims that society will support a company if it receives value in return, especially in sustainability projects and activities. The focal business's key task is to coordinate value creation with and for stakeholders according to the common purpose (Freudenreich et al., 2020).

IR policy has emerged analogously with the institutional environment and stakeholders' expectations. The distinct nature of IR has caused a paradigm shift from silo thinking of wealth creation to integrated thinking of value creation (AbuRaya, 2024).

2.3 Value-enhancing theory

Porter and Kramer (2011), introducing the concept of shared value, stated that if a company chooses social and environmental activities that benefit society and the company, then these activities positively affect the company's value and support the value-enhancing theory. Conversely, if a firm does not choose a combination of social and environmental activities that benefits both the firm and society, such activities reduce value and support the trade-off theory.

Hence, an empirical study on the information content of corporate sustainability performance from the perspective of shared value is necessary. This study used stakeholder and value-enhancing theories and the concept of shared value as a theoretical basis.

CSR plays a significant role in enhancing firm value by promoting employee productivity, ensuring better operating performance, expanding the product market, improving capital market benefits, building a corporate reputation, and strengthening a firm's relationship with society, regulators and other stakeholders. CSR is used as a strategic tool to maximize value, and firms with better CSR performance have greater potential to increase shareholder value as well as the value of other stakeholders (Malik, 2015).

2.4 Research gap

The analysis and review of literature on corporate sustainability performance indicate that researchers have often focused on individual dimensions of corporate sustainability performance.

Few studies, however, have used a comprehensive measure of companies' sustainability performance, and they have not reached an agreement in this field. The reason for this uncertainty is that they have ignored the most critical factor in the company's sustainability report, which is the quality of the sustainability report. This factor can increase the information content of corporate sustainability performance (Jadoon et al., 2021).

Considering the empirical evidence in the field of corporate sustainability performance, it is

necessary to examine the information content of corporate sustainability reports and consider the quality of sustainability reports in listed companies in Iran. The main questions of the study are as follows:

1. Does the quality of sustainability reporting have information content?

2. Does the quality of sustainability reporting increase the information content of financial statements?

Therefore, the quality of sustainability reporting must be considered under the concept of shared value of information content. This study investigates the information content of the sustainability reporting quality of listed companies in Iran and helps capital market practitioners, particularly investors, evaluate a company's performance using sustainability reports.

2.5 Information content

The information content is the ability to measure performance to explain simultaneous changes in stock returns. This estimates the usefulness of performance measurement in investors' decision-making (Barton et al., 2010). If there is a statistical association between the accounting numbers and market values of equity, then accounting information is relevant. Traditionally, the focus on information content has been limited to financial information such as earnings, sales, book value of equity, comprehensive income, and operating cash flows (Beisland, 2009).

Another stream of information content has developed, considering non-accounting variables as important factors in determining stock prices (Aureli et al., 2020). It is emphasized that accounting information is not the only effective factor in explaining changes in the market value of companies. Rather, non-accounting factors are equally important and affect the market value and its changes (Lombardi et al., 2019).

As a result, research in the field of the information content of non-financial information revolves around corporate sustainability performance and its dimensions (Aureli et al., 2020). This adds quantitative and qualitative measures to explain simultaneous stock price changes.

2.6 Information content of sustainability reporting through CSP

From a theoretical point of view, the company's sustainability performance (CSP) is considered an intangible asset by investors and is reflected in the market value of the company (Kaspereit and Lopatta, 2016). CSP includes the dimension of corporate governance along with social and environmental dimensions.

Corporate governance deals with managing and controlling the company to provide transparency in financial reporting, risk management and stakeholder rights. Hence, corporate governance is essential to companies' sustainability because it aligns investors' interests with the company's overall purpose.

Moses et al. (2020) concluded that there is a positive association between the examined board governance elements and sustainability reporting quality (SRQ) based on multiple theories. Devarapalli and Mohapatra (2024) found a positive impact of board size, CEO duality, non-executive board members, financial leverage, the COVID-19 crisis and firm size on IR quality among Indian listed companies.

The results of previous empirical research indicate a positive association between CSP and market valuation (for example, Chang and Kuo, 2008; Lourenço et al., 2012; Kaspereit and Lopatta, 2016; Jung et al., 2018). The increase in companies' disclosure of sustainability information leads to improvements in their financial performance and value (Jafari Jam et al., 2019). There is a significant negative relationship between sustainability disclosure and systematic risk. Sustainability disclosure can create a positive image of the company among stakeholders and

reduce the systematic risk of the company (Khalifa Soltani and Alishahi Bejstani, 2022).

Tran et al. (2022) discovered a negative correlation between CSR and earnings management. Firms with high social responsibility are less inclined to manipulate earnings through accrual earnings management (AEM) and real earnings management (REM). These firms are less likely to distort economic performance by manipulating accounting practices or changing real business transactions.

On the other hand, Nugrahani et al. (2022) suggest that the industry type and government pressure have a notable positive impact on the disclosure of sustainability reports. However, the company's size does not influence the disclosure of sustainability reports.

2.7 Information content of quality of CSR

Environmental and consumer pressures positively affect the quality of sustainability reports, whereas shareholder, employee, government, and creditor pressures do not impact the quality of these reports. Also, when used as control variables, profitability and company size do not affect the quality of sustainability reports (Lulu, 2020).

According to Vitolla et al. (2020), IR quality is significantly and positively influenced by profitability, size, financial leverage, and the civil law system.

The review of previous studies indicates that the critical factor of financial reporting quality is ignored in relation to the information content of the CSP. It is believed that capital market participants such as investors and even financial analysts are interested in the quality of sustainability information because it will be difficult to obtain reliable information, especially when the reported nature is complex. Also, sustainability disclosures can play a role in any transition toward a less unsustainable society (Cho et al., 2015).

In this regard, Martínez-Ferrero and García-Sánchez (2017) believed that the quality of sustainability reporting reduces the cost of capital, which means the information content of the quality of CSR. In addition, the decrease in the cost of capital is significantly higher when sustainability reporting is assured by a top-tier accountancy firm instead of by engineering or consultancy firms. Furthermore, Bachoo et al. (2013) reported a positive relationship between the quality of sustainability reporting, future expected performance and the cost of equity capital for Australian listed companies. In addition, Rivera et al. (2017) showed a positive relationship between CSR strategic consistency in corporate economic and financial performance despite the turbulent financial environment.

Therefore, in this study, the following hypotheses have been considered:

H1: the quality of sustainability reporting has information content (relative information content of CSRQ).

H2: The SRQ increases financial statement information content (incremental information content of CSRQ).

3. Research methodology

This study designed a model and then conducted it in a hybrid (qualitative-quantitative) way. The study design approach began by developing a theoretical framework, stating hypotheses, collecting data, analyzing the data, and presenting research findings. The data for the study was gathered from 159 companies on the Tehran Stock Exchange (TSE) and 40 companies in the Over-the-Counter (OTC) market, totaling 199 firms, from 2014 to 2022.

In terms of methodology, this work is deductive research based on the approach, analytical research based on nature, applied research based on the purpose and cross-sectional and conclusive research based on the research design.

In this study, we utilized a valuation approach - the Ohlson model - to examine the information content of sustainability reporting quality among listed companies. The reliability index from Sebrina et al. (2023) was used to assess the quality of sustainability reporting, while the market value model developed by Ohlson (1995) was employed to determine the information content.

The panel data method was utilized to analyze the information content of both financial and non-financial aspects of sustainability performance and its various dimensions. This research used a hybrid approach, incorporating quantitative and qualitative measures as essential factors in explaining simultaneous stock price changes. The Levin, Lin, and Chu tests were conducted to ensure stability and that all variables remained stable over time. Following the research methodology, we detail the measurement of sustainability reporting quality (independent variable) and information content (dependent variable) within the econometric model.

3.1 Measuring the quality of sustainability reporting (independent variable)

The GRI standards ensure data quality and comparability and contribute to better decision-making by allowing access to information that promotes better decisions (The GRI standards: a guide for policy-makers, 2021)

Badia et al. (2020) analyzed the diffusion and quality of non-financial reporting tools in the public utility sector. They used the principles of the GRI framework to measure quality, including clarity and accuracy, timeliness and stakeholder engagement, comparability, and reliability. They addressed the quality issue and found that, overall, the accuracy/clarity and comparability of non-financial reporting is satisfactory; timeliness and stakeholder engagement appear to be acceptable, while reliability does not appear to be acceptable.

This paper also used the GRI framework to measure the quality of sustainability reporting. Based on this framework, sustainability reporting information should contain several features: clarity, accuracy, timeliness, comparability, and reliability.

Among these features, reliability means collecting, recording, compiling, analyzing and disclosing information and processes used to prepare sustainability reports to determine the quality and importance of information by examining them. Due to the nascent nature of sustainability reports in Iranian companies, only the reliability index can be used to measure the quality of sustainability reporting. Therefore, in the present research and following Sebrina et al. (2023), in order to measure the quality of sustainability reporting, the reliability index as described in Table 1 has been used:

Table 1. Measuring the Quality of CSR

Items	score
No sustainability report	1
There is a sustainability report	2
There is a sustainability report, and the company has a sustainability committee affiliated with the board of directors	3
Non-audit companies provide sustainability reports and assurances	4
A sustainability report exists and is externally guaranteed by one of the audit firms	5

3.2 Measuring information content (dependent variable)-econometric model

Because the purpose of this study was to investigate the long-term impact of sustainability reporting quality on capital market reaction, the panel data method was used to determine the information content of financial and non-financial information.

The market value model developed by Ohlson (1995) was applied to investigate whether investors value the quality of CSR.

Based on this model, stock market value is only a function of accounting earnings and book value. In this study, the Ohlson (1995) model was modified by including one additional non-financial variable: quality of CSR. The rationale behind this was that the quality of CSR reduces risk and economic uncertainty for investors and enhances earnings predictability (Lourenço et al., 2012). These benefits are achieved by adding credibility and reliability to CSR, which increases stakeholders' confidence in the information provided (Zorio et al., 2013), and investors can accurately calculate the corporate market value by reducing information asymmetry. In other words, responsibility reporting is a part of a firm's communication tools and GRI responsibility reporting produces a more precise market valuation of a firm (Schadewitz and Niskala, 2010). In this research, the following equations indicate the proposed model:

$$MV_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 BVPS_{it} + \varepsilon_{it} \quad (1)$$

$$MV_{it} = \beta_0 + \beta_1 EPS_{it} + \beta_2 BVPS_{it} + \beta_3 CSRQ_{it} + \varepsilon_{it} \quad (2)$$

Where "i" indicates the company, "t" is the year, "MV" is the market value per share, "BVPS" is the book value per share, and "EPS" is the earnings per share. CSRQ is the quality of CSR with values ranging from 1 to 5 (based on Table 1). A higher value indicates a higher quality of sustainability reporting.

A positive and significant relationship between MV and CSRQ indicates H1 verification. Also, a significant difference between adjusted R-squared of (1) and (2) models indicates H2 verification.

3.3 Data sources

The financial variables data (i.e., market value per share, book value per share, and earnings per share) were extracted from Rahavard Novin and sustainability reporting quality data was extracted from financial statements of the Codal database (located on the site Codal.ir).

All data were provided from 159 companies on the TSE and 40 companies in the OTC market.

3.4 Sample Selection

This study utilized panel data from 199 firms spanning from 2014 to 2022 based on the following criteria:

1. The listed companies in Iran, with their financial year ending in March each year.
2. The companies did not change their financial year during the research period.
3. The companies maintained continuous activity and actively traded securities throughout the research period.
4. The companies provided all necessary information for the research from 2014 to 2022.
5. The companies were not categorized as investment companies, banks, or financial intermediaries.

Adhering to these conditions and limitations, 199 companies were selected as the study population from 2014 to 2022.

4. Results

4.1 Descriptive statistics

Descriptive statistics and stationary tests of research variables are presented in Table 2. The results indicate that the sample companies have mean values of 15,973, 2,917, and 1,389 for market value, book value and earnings per share, respectively. The mean of companies' sustainability reporting quality is 1.49.

Standard deviation measures how (low or high) the data is spread out in relation to the mean.

The sample companies have standard deviation values of 25,240, 4,131, 3,043, and 0.51 for market value, book value, earnings per share and companies' sustainability reporting quality.

It is worth mentioning that in estimating the regression models, the values of companies' sustainability reporting quality have been multiplied by 1,000 to homogenise this variable's values with other variables.

Table 2. Descriptive statistics

	MV	BVPS	EPS	CSRQ
Mean	15,973	2,917	1,389	1.491
Median	6,909	1,918	573	1.000
Maximum	327,430	67,665	64,395	3.000
Minimum	386	-11,318	-5,553	1.000
Std. Dev.	25,240	4,131	3,043	0.508
Skewness	4.235	5.862	8.227	0.124
Kurtosis	5.276	8.783	12.31	1.242
Observations	1,791	1,791	1,791	1,791

4.2 Correlation test

The correlation results between the studied variables are presented in Table 3. The findings indicate a positive and significant relationship between book value per share (BVPS), earnings per share (EPS) and companies' sustainability reporting quality (CSRQ) with market value per share. This issue represents the information content of financial statements and CSRQ. To determine the relative and incremental information content of CSRQ, the estimation of regression models is necessary.

Table 3. Correlation Matrix

Correlation (Probability)	MV	BVPS	EPS
BVPS	0.711 (0.000)		
EPS	0.765 (0.000)	0.467 (0.000)	
CSRQ	0.094 (0.000)	0.142 (0.000)	0.121 (0.000)

4.3 Stationary test (Unit Root Test)

The stability test of a time series is crucial before adopting panel data. The Levin, Lin, and Chu test was conducted to test stability. The unit root test results based on the Levin, Lin, and Chu test indicate the stationarity of the variables during the research period. In this test, if the study variables contain a unit root, the expected probability is above 5%.

Table 4 shows that the probability of the Levin, Lin, and Chu test for all variables is less than 5%, ensuring the possibility of rejecting the existence of a unit root and the stability of all variables over time.

4.4 Empirical results

The results of F-Limmer and Hausman tests for models 1 and 2 are presented in Table 5. Table 5 shows that the probability values of Limmer's F statistic and Hausman's statistic in both hypotheses were less than the 5% significance level. Therefore, there is no sufficient reason to reject the panel data model with fixed effects, so the panel data model with fixed effects was used to test the

hypotheses.

Table 4. Stationary test

Variables	Jarque-Bera		Levin, Lin and Chu test	
	Statistic	Prob.	Statistic	Prob.
MV	4,874.32	0.000	-11.92	0.000
BVPS	596.585	0.000	-42.84	0.000
EPS	713.663	0.000	-7.330	0.000
CSRQ	235.311	0.000	-4.314	0.000

Table 5. F-Limmer and Hausman tests

Redundant Fixed Effects Tests- F-Limmer (Model 1)			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	1.937	(198,1590)	0.000
Correlated Random Effects - Hausman Test (Model 1)			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	31.881	2	0.000
Redundant Fixed Effects Tests- F-Limmer (Model 2)			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	1.965	(198,1589)	0.000
Correlated Random Effects - Hausman Test (Model 2)			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	9.034	3	0.029

4.4.1 Measuring Model 1

Table 6 presents the regression analysis results of the impact of earnings and book value per share on the market value per share to determine the information content of financial statements and a basis for measuring the incremental information content of CSRQ.

The results in Table 6 show that the effects of earnings and book value per share on the market value per share are positive (5.02 and 1.25, respectively) and significant (0.000 and 0.000, respectively) according to the probability of t statistics. Table 6 suggests that the financial statements of companies have information content. In other words, from the point of view of participants in the capital market, earnings and book value per share have been useful and desirable.

In order to test the autocorrelation in a regression model's output, we use the Durbin-Watson test. Durbin-Watson always produces a test number ranging from 0 to 4. In this test, the values 2.0 indicate zero autocorrelation, values below 2.0 mean positive autocorrelation and values above 2.0 indicate negative autocorrelation. The Durbin-Watson test statistic values in the range of 1.5 to 2.5 are relatively normal, but values outside this range could be a cause for concern. In Table 6, the Durbin-Watson statistic is 1.5, so it had no autocorrelation problem.

The F-test determine the overall significance of the regression. The results related to the F-statistic show that the regression model was generally significant. In addition, the results related to the adjusted coefficient of determination (adjusted R-squared) show that during the research period, approximately 63.2% of companies' market value changes were influenced by earnings and book value per share.

According to research, GRI responsibility reporting produces a more precise market valuation of a firm (Schadewitz and Niskala, 2010) and there is a positive association between CSP and market valuation (Chang and Kuo, 2008; Lourenço et al., 2012; Kaspereit and Lopatta, 2016; Jung et al., 2018). The increase in the disclosure of companies' sustainability information leads to improving their financial performance and value (Jafari Jam et al., 2019). Also, the increase in the sustainability disclosure level causes an increase in the value of the company's shares (Rouhbakhsh, 2022).

Table 6. Information content of financial statements (Model 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BVPS	1.245	0.199	6.245	0.000
EPS	5.019	0.276	18.16	0.000
C	5,369	489.5	10.97	0.000
R-squared	0.674	Mean dependent var		15,973
Adjusted R-squared	0.633	Akaike info criterion		22.214
F-statistic	16.41	Schwarz criterion		22.831
Prob (F-statistic)	0.000	Durbin-Watson stat		1.512

4.4.2 Measuring Model 2

Table 7 presents the regression analysis results of the impact of CSRQ along with earnings and book value per share on the market value per share to measure the relative and incremental information content of CSRQ.

The results in Table 7 show that the effects of BVPS, EPS and CSRQ on the market value per share are positive (1.24, 4.98, and 2.95 respectively) and significant (0.000, 0.000, and 0.025 respectively) according to the probability of t-statistics. This indicates the information content of CSRQ along with the information content of companies' financial statements. In other words, from the perspective of participants in the capital market, CSRQ has also been useful and desirable.

Considering the positive and significant impact of CSRQ on the market value of companies and considering the reduction of the impacts of BVPS and EPS on the market value of companies (from 1.25 to 1.24 and 5.02 to 4.98, respectively) with the addition of CSRQ to the model, there is not enough evidence to reject H1. In other words, CSRQ has relative information content.

In order to test the autocorrelation in a regression model's output, we use the Durbin-Watson test. The Durbin-Watson test always produces a test number ranging from 0 to 4. In this test, values of 2.0 indicate zero autocorrelation, values below 2.0 mean positive autocorrelation and values above 2.0 indicate negative autocorrelation. The Durbin-Watson test statistic values in the range of 1.5 to 2.5 are relatively normal, but values outside this range could be a cause for concern. In Table 7, the Durbin-Watson statistic is 1.5, so there was no autocorrelation problem.

The F-test determines the overall significance of the regression. The results related to the F-statistic show that the regression model was generally significant. Additionally, the results related to adjusted R-squared show that during the research period, approximately 63.3% of the companies' market value changes were influenced by BVPS, EPS, and CSRQ.

Finally, due to the lack of a significant difference between the adjusted R-squared of the two models (63.2% in model 1 and 63.3% in model 2), H2 is rejected. In other words, CSRQ lacks incremental information content. One reason for this result is the newness of sustainability reporting in Iranian companies.

Table 7. Information content of sustainability reporting quality (Model 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BVPS	1.241	0.199	6.229	0.000
EPS	4.985	0.276	18.03	0.000
CSRQ	2.947	1.312	2.246	0.025
C	1,058	1,981	0.534	0.593
R-squared	0.675	Mean dependent var		15,973
Adjusted R-squared	0.634	Akaike info criterion		22.212
F-statistic	16.39	Schwarz criterion		22.832
Prob (F-statistic)	0.000	Durbin-Watson stat		1.515

According to Lourenço et al. (2012), the quality of CSR reduces risk and economic uncertainty for investors and enhances earnings predictability. Also, the quality of CSR has information content (Martínez-Ferrero and García-Sánchez, 2017; Bachoo et al., 2013; Rivera et al., 2017). The IR quality is significantly and positively influenced by profitability, size, financial leverage and the civil law system (Vitolla et al., 2020).

5. Discussion and practical implications

The results suggest practical insights from a managerial perspective. According to Esmailzadeh et al. (2022), sustainability reporting is an important tool for reducing information asymmetry and meeting stakeholders' demands for transparency. Increasing transparency allows investors to evaluate firms' activities more accurately and effectively direct their investments. Therefore, a company's goal is to meet the needs of stakeholders and earn their trust through high-quality sustainability reporting information. Furthermore, Malik (2015) believes that CSR plays a significant role in enhancing firm value by promoting employee productivity, ensuring better operating performance, expanding the product market, improving capital market benefits, building a corporate reputation, and strengthening a firm's relationship with society, regulators, and other stakeholders. CSR is used as a strategic tool to maximize value, and firms with better CSR performance have greater potential to increase shareholder value as well as the value of other stakeholders. Therefore, by considering these two basic stakeholder theories and the value-enhancing theory mentioned in this paper, managers should disclose relevant and reliable information to investors to estimate the company's value for investment decisions in CSR reporting and educate users on how to interpret these reports effectively.

Based on the results, the quality of sustainability reporting has informational content (relative), but the quality of sustainability reporting does not increase the informational content of financial statements (incremental). This may be due to the newness of sustainability reporting in Iranian companies. Therefore, top managers must be proactive and knowledgeable about this concept, and policy-makers should create a business case for the informative content of CSRQ in the TSE.

6. Conclusion

The global pursuit of sustainable development has changed the role of companies. The traditional view of companies (i.e., the shareholders' view), which suggests that they are only responsible for creating shareholder value, has shifted. Now, companies focus on creating sustainable value which covers the four dimensions of sustainability: environmental, social, corporate governance, and economic. However, the CSRQ authenticates the reliability of information on sustainability reporting. In this sense, the quality of sustainability reporting is valued by investors. In this paper, we analyzed the information content of CSRQ and the information content of companies' financial statements.

According to external research, Schadewitz and Niskala (2010) show that GRI responsibility reporting produces a more precise market valuation of a firm and there is a positive association between CSP and market valuation (Chang and Kuo, 2008; Lourenço et al., 2012; Kaspereit and Lopatta, 2016; Jung et al., 2018). Additionally, Lourenço et al. (2012) show that the quality of CSR reduces risk and economic uncertainty for investors and enhances earnings predictability. Also, the quality of CSR has information content (Martínez-Ferrero and García-Sánchez, 2017; Bachoo et al., 2013; Rivera et al., 2017). The IR quality is significantly and positively influenced by profitability, size, financial leverage and the civil law system (Vitolla et al., 2020).

According to internal research, the increase in the disclosure of sustainability information by

companies leads to improving their financial performance and value (Jafari Jam et al., 2019). Also, the increase in the level of sustainability disclosure causes an increase in the value of the company's shares (Rouhbakhsh, 2022). There is a significant negative relationship between sustainability disclosure and systematic risk. Sustainability disclosure can create a positive image of the company among stakeholders and reduce the systematic risk of the company (Khalifa Soltani and Alishahi Bejstani, 2022).

The studies that exclusively deal with sustainability reporting quality in Iran are unavailable. Consequently, this study aimed to create a business case for the information content of CSRQ in TSE.

The results revealed that investors valued the overall CSRQ. In other words, from the investors' point of view, CSRQ has been useful and desirable. Hence, it can be concluded that CSRQ is relevant in terms of value and validates the social impact hypothesis. Also, CSRQ is concerned with the reliability of reported information through third-party assurance. However, due to the lack of significant difference between the adjusted R-squared of the two models (63.2% in model 1 and 63.3% in model 2), CSRQ lacks incremental information content. One of the reasons for this result is the newness of sustainability reporting in Iranian companies.

The findings of this research are useful for future research on CSRQ and for practitioners, such as regulators, standard setters, shareholders, and other stakeholders interested in CSRQ.

The current understanding of information content can be enhanced by focusing on institutional factors, such as exploring whether the basis of regulation of CSRQ (voluntary/mandatory) would affect the information content of CSRQ.

For future research, it is recommended to investigate the lag of dependent variables at $t+1$, considering the weak efficiency of the Iranian capital market. This delay may impact the effect of sustainability information on prices.

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RESEARCH ARTICLE

Board Diversity and Environmental Performance with a Focus on Moderating Effect of Board Independence

Sohrab Osta*, Nasim Parveen

Department of Accounting, Ilam University, Ilam, Iran

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Abstract

The present study was to investigate the relationship between board diversity and environmental performance with much emphasis on the moderating effect of board independence in this context. Four research hypotheses were tested and analyzed using the data from 108 companies listed on the Tehran Stock Exchange (TSE), Tehran, Iran, during 2018- 2023 (including 648 company-year observations) through Logistic Regression (LR). Environmental performance refers to the extent to which a company pays attention to the impacts of its operations on environmental pollution and was assessed through three operational components in the form of an environmental performance checklist. The study results established a significant positive relationship between age and tenure diversity and environmental performance in the companies listed on the TSE, Tehran, Iran. However, no significant relationship was found between gender diversity and environmental performance. As well, board independence and tenure diversity had moderating effects in the relationship between age diversity and environmental performance, but board independence could not moderate the relationship between gender diversity and environmental performance. The findings of this study make valuable implications for understanding how board diversity can serve as a driver for the environmental performance issue.

Keywords:

Board Diversity, Board Independence, Environmental Performance

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*Corresponding Author: Sohrab Osta
 Email: h.fakhari@umz.ac.ir
 Tel: 09183560288
 ORCID:

1. Introduction

Given the growing trend in the world's population and the expansion of business-related activities and then serious impacts on the environment, millions of people are globally concerned about the preservation of the environment. In view of that, some major issues like air quality and pollution, carcinogens, global warming, and overconsumption of non-renewable energy sources are every day's top stories. Many companies are further seeking for environmental efficiency, viz., increasing the production of goods and services and reducing their harmful impacts on the environment (Badavar et al., 2016). As the lack of macro policies and inattention to planning strategies are among the problems facing the environment, it is necessary to include them in the laws and regulations of most countries across the world. Currently, there are many policymaking laws and regulations to protect the environment in Iran, highlighting environmental issues in this region. Such laws and regulations are typically divided into financial and non-financial ones, wherein supervising the financial ones requires the establishment of appropriate accounting systems to provide better reports on financial and environmental performance (Abbasi and Mohammadi, 2012). In general, the evidence shows that boards and managers in large-scale companies lay much focus on environmental pollution reduction programs and the ways to improve them. There are thus significant implications for experts and policymakers regarding the effectiveness of internal management mechanisms in companies addressing the risks caused by climate change and the possible relationship between administrative reforms and policies related to environmental pollution. Shareholders are also putting much pressure on managers to assess the risks and opportunities related to climate change and report the financial consequences of their decision-making in companies. This now requires financial and human resources, technologies, as well as long-term strategic commitments by shareholders, boards, and chief executive officers (CEOs). Companies accordingly can create values when their management system contains different features, particularly in connection with the integration of economic, environmental, and social dimensions. Of note, beneficiaries with conflicting and heterogeneous interests raise demands for compensation for damages caused by environmental pollution (Sajjadi and Banobi Ghadim 2015). Independent boards evaluate management performance more efficiently, which in turn reduces environmental pollution. Since independent managers are not involved in daily operations and have indirect financial interests in companies, or they are dependent on CEOs, they are less influenced. On the other hand, opportunistic behaviors make them provide more realistic feedback about operations in companies and successfully supervise boards (Movahedi, 2015). In this context, female board members are more committed and stricter and less self-oriented in their decision-making, which makes them more successful (Wang and Coffey, 1998; Solberg, 2006). Moreover, female managers might have their own sociological perceptions and concepts to expand the decision-making scope in boards.

The results of previous studies and research on the concept of environmental performance show that most of the research has been conducted in developed economies such as the United States and Europe, where the level of environmental awareness is high. However, few studies have been conducted in developing countries. One reason for this could be the lack of appropriate and specific indicators and criteria for assessing environmental performance in developing countries. Of course, in some of these countries there are indicators for assessing environmental performance, but their reliability and accuracy are low. In this study, we selected three operational components in the form of an environmental performance checklist. Also, in this study, we examined the relationship between board diversity, which includes age diversity, tenure diversity, and gender diversity, on environmental performance in companies listed on the Tehran Stock Exchange, which was

conducted for the first time in Iran.

Against this background; first, the research problem was stated, and then the importance of the research, its objectives, hypotheses, variables, statistical population, samples, and setting were delineated. As the final point, the conceptual model definitions were given.

2. Theoretical foundations, literature review, and hypothesis development

2.1 Theoretical foundations

Thus far, numerous benefits have been raised for board performance evaluation, including the possibility of increased accountability and higher standards set for activities (Kazemi Ulom et al., 2019). Now, it is widely accepted that companies need to lay focus on environmental performance. They are also under much pressure from the society to be more accountable for environmental issues and climate change (Acar et al., 2021). Although the environment is a vital issue, board diversity has not attracted much attention in the related literature and limited studies have been so far fulfilled on age, tenure, gender, and some moderating factors. Over recent years, board diversity has been significantly addressed, especially in developing countries with emerging economies due to their specific requirements. Of note, companies with high diversity in their board members are able to bring wide-ranging perspectives to help obtain good environmental scores and meet interests in different groups (Al-Jaifi et al., 2023). Moreover, today's environmental changes push companies to respond to a series of undefined factors and become aware of all changes and problems (viz., internal and external complications) that occur in their surrounding environment. This puts companies in positions to have different but structured looks at environmental opportunities in challenging settings and then adopt approaches to deal with ups and downs. To survive and progress in these complexities, they need precise planning and appropriate strategies and tools to implement their goals, which demand the identification of the effective factors in this line. Likewise, investigating the complex environment of companies is always very important for owners and investors to boost management (Jian et al., 2019).

Board independence is one of the key mechanisms, which is of importance due to its influence on company results, including environmental performance. Empirically, it has been established that independent managers pay much more attention to environmental performance (Beji et al., 2021) and social awareness (Ibrahim and Angelidis, 1994) and are more concerned about compliance with laws and regulations related to environmental performance (Kassinis and Vafeas, 2002). Although board independence is an internal monitoring mechanism to minimize conflict of interest between managers and shareholders, the negative impact of CEO tenure on social and environmental disclosure in companies is more obvious in those with more independent managers (Khan et al., 2021). Board diversity can also lead to innovative decision-making in terms of protection of natural resources, waste management, and pollution reduction. As well, cultural differences and various experiences of board members can promote many attitudes and approaches to environmental issues. Balance and independence in boards accordingly play vital roles in environmental protection and recovery. A proper balance can thus result in making decisions in which the needs of the environment, such as saving forests, mitigating environmental pollution, and preventing biodiversity loss are taken into account (Katoria, 2020). Besides, board age is one of the most observable features of diversity, as it indicates the effect of different generations, values, motivations, cultures, habits, and experiences on the decision-making approaches adopted by managers. According to the Resource Dependence Theory (RDT), heterogeneous structures of boards are preferred over the homogeneous ones, so difference in board age can be useful for future planning and business success (Handajani et al., 2014). Different age groups in boards thus

contribute to better understanding of environmental, social, and corporate governance (ESG) issues and improvement in corporate governance attitudes. There are still few studies on the relationship between board age and environmental performance disclosure, and there is limited empirical evidence to prove that board age diversity produces higher performance in companies (Ali et al., 2014). Since the increase in mean age represents a homogeneous board structure, there is a negative relationship between board age and environmental performance, consistent with the RDT (Menicucci and Paolucci, 2022a). Gender diversity here refers to the active presence of women and men on boards, committees, and other positions. In recent years, studies have further highlighted the leading role of women in company management (Daily et al., 2000; Terjesen, 2009). In this sense, Imani et al. (2017) found that gender diversity in board members could improve their communication and the practice of diverse and operative viewpoints among them and audit committees. According to Joy (2008), the participation of women on boards of companies could boost the efficacy of communication with investors. As stated by Adams and Ferreira (2009), Abbott et al. (2012), Gul et al. (2008), and Kreder and Evert (2016), board members and accountability of top managers could augment board dynamism and independence, activities and efforts by auditors, disclosure, and management behavior, and consequently reduce capital costs.

From this perspective, the main question raised was: “How does board diversity, including board independence, act as a stimulus for environmental performance in companies?”

In other words, “How does board independence moderate the relationship between board diversity and environmental performance in companies?”

2.2 Literature review

Yavuz et al. (2025) examined whether ESG performance has an impact on financial performance? (Evidence from Turkey). The study employed panel regression analysis on data from 21 companies listed in the Borsa Istanbul-100 index over the period 2011–2020 to investigate the relationship between ESG sub-dimensions and firm performance. The findings indicate that adopting the environmental and governance sub-dimensions positively affects ROE and Tobin’s Q. However, the adoption of the governance sub-dimension negatively impacts Tobin’s Q while positively influencing ROE. No statistically significant results were found regarding the impact of ESG sub-dimensions on firms’ ROA ratios. Zhu et al. (2024) in their study titled “Addressing ESG Investing in China: Does Board Composition and Financial Decisions Matter?” found that there is a positive and significant relationship between board independence and gender diversity in board structure and ESG performance. In line with the study objectives, Al-Jaifi et al. (2023), reflecting on the effects of board diversity on environmental performance and the moderating effect of board independence with evidence from the Asia-Pacific region, recruited 14878 company-year observations from 11 Asia-Pacific countries, and showed a positive relationship between environmental performance and age and gender diversity, but board diversity had a negative relationship in this respect. This could be attributed to the Alliance Hypothesis (AH), in which longer board tenure could lead to favorable management biases and ultimately reduce environmental activities. They also confirmed that board independence moderated the relationship between tenure and gender diversity and environmental performance. Paolone et al. (2023) also investigated longer board and audit committee tenure and the way they could influence environmental performance. The data were collected from the Refinitiv Eikon database, as a sample of the European Union-listed companies belonging to old countries from 2018 to 2020. They concluded that longer board and audit committee tenure boosted environmental performance, suggesting that companies could consider tenure as a proxy for board oversight quality, and tenure was negatively correlated with environmental performance. Once boards had low turnover,

companies might achieve lower environmental performance. [Menicucci and Paolucci \(2023\)](#) further examined a sample of 247 Italian Cooperative Credit Banks (CCBs) for 2017-2021 and developed an econometric model using unbalanced panel data with company-year fixed effects and controls. Their findings revealed that board size and independence as well as the presence of corporate sustainability committee (CSC) had a positive effect on ESG performance of such banks, while there was no significant relationship between board age and such performance. In this context, [Cambrea et al. \(2023\)](#) studied a sample of Italian companies listed on the Telematics Market during 2019- 2023 and showed that a critical mass of at least three female managers was necessary to improve ESG performance, and female CEOs were the vital components of board mechanisms in terms of aligning stakeholders' needs, because they could increase such performance. As well, [Porter and Sherwood \(2022\)](#) explored the relationship between SEC laws and regulations with much focus on board independence and financial reporting quality, and examined different board independence paths.

Their sample included 1248 company-year observations, whose board composition was compared between 2001 and 2008. The results designated that companies chose between multiple paths to comply with independence requirements, and the way companies operationalized ESG requirements affected financial reporting quality. Moreover, [Menicucci and Paolucci \(2022b\)](#) shed light on the impact of board diversity and ESG performance of 105 Italian banks from 2017 - 2021, and then evaluated boards in terms of their characteristics, viz., size, age, gender, independence, corporate social responsibility (CSR), and CSC. Their main empirical results demonstrated that board size and independence and CSC presence positively shaped ESG performance in the given banks, while no significant relationship was found between board age and ESG performance. In addition, the relationship between board gender and performance was positive, but the effect of female managers on ESG performance when there were women was nonlinear. In [Kalbuana et al. \(2022\)](#), the Agency Theory (AT) was proposed as a solution to explain the roles of profitability, board size, and female board members under two categories, i.e., women on the board and those in commissions, as well as political connections with financial problems. The panel data were obtained from the companies listed on the LQ-45 for the Indonesia Stock Exchange in 2017-2021, and then analyzed by a quantitative approach through the Ordinary Least Squares (OLS) regression, the Fixed and Random Effects, and strong relationships, simultaneously. The analysis results revealed higher accuracy compared to the Partial Correlation Test. As elucidated, profitability ratio had a negative effect on financial distress and board size positively influenced it, but female board members had no impact on financial distress. However, women on the board had a positive effect on financial distress and political communication was not so.

2.3 Hypothesis development

2.3.1 Age diversity

Upon raising the research questions, the hypotheses were developed to express a specific relationship between two or more variables. In the literature related to board age diversity, there were different views about the importance of this variable and participation in environmental activities. In this regard, [Said et al. \(2012\)](#) concluded that companies with older managers practiced more environmental performance disclosure, because they could apply their experiences into decision-making. In contrast, Ibrahim and Hanefah (2016) found a positive relationship between young board members and environmental activities, that is, they stated that young managers were more concerned about environmental issues. Given this, the first research hypothesis (1) was developed as follows:

H1: There is a significant relationship between board age diversity and environmental performance.

2.3.2 Tenure diversity

In the literature on board tenure diversity, the significance of this variable and contribution to environmental activities had been thus far clarified. For example, Mahmoodi and Ghaffari (2016) established a significant positive relationship between management tenure and financial performance in companies in terms of the environment, work environment, society, and country and the capital market in relation to corporate responsibility. As well, Al-Jaifi et al. (2023) explained that environmental performance was positively and negatively correlated with board diversity, which was ascribed to the AH, in which long-terms tenure in boards could induce managerial biases and finally reduce environmental activities. Accordingly, the second research hypothesis (2) was developed as follows:

H2: There is a significant relationship between board tenure diversity and environmental performance.

2.3.3 Gender diversity

As shown in the literature on board gender, there were various perspectives toward this variable and involvement in environmental activities. In this line, Parsa and Kanani (2022) argued that board gender diversity had an effect on CSR. On the other hand, Saghafi and Hajiha (2022) investigated the relationship between board gender diversity and CSR, and then and showed that the presence of female board members and financial expertise of board members did not significantly affect CSR. Considering this, the third research hypothesis (3) was developed as follows:

H3: There is a significant relationship between board gender diversity and environmental performance.

2.3.4 Moderating effect of board independence

Board independence is a monitoring mechanism in the company that is essential for the company because it protects the interests of shareholders and checks the balance of management. According to the AT, independent directors have more control and monitoring over the management of the company. In addition, the stakeholder theory states that independent directors need social demands. For this reason, companies engage in environmental activities. Considering the above, it is argued that independent directors have a high awareness of social and environmental issues and are likely to present themselves as responsible for solving such issues. The fact that independent directors are more likely to be sensitive to stakeholder pressure on environmental issues is justified because engaging in sustainability projects or activities, including environmental ones, for the benefit of stakeholders increases their reputation and ultimately increases the likelihood of their board nomination (Post et al., 2014).

Nadeem (2020) supported that firms with higher board independence undertake supplemental environmental projects more frequently. Beji et al. (2021) provided evidence that independent directors care more about CSR performance. Furthermore, De Villiers et al. (2011) found that the environmental strengths of firms are positively and significantly related to board independence. Considering the above, the fourth hypothesis of the research is designed as follows:

H4a: There is a significant relationship between board age diversity and environmental performance moderated by board independence.

H4b: There is a significant relationship between board tenure diversity and environmental performance moderated by board independence.

H4c: There is a significant relationship between board gender diversity and environmental performance moderated by board independence.

3. Methods

In total, a sample of 108 companies listed on the TSE, Tehran, Iran, were selected from various industries (viz., manufacturing and industrial). They consisted of subcategories, and selected due to the significant impact of their activities on environmental performance. Since financial and investment companies could operate under different laws and regulations, and they had their own financial reporting characteristics, they were excluded. In this study, environmental performance refers to the extent to which a company pays attention to the impacts of its operations on environmental pollution and was assessed through three operational components in the form of an environmental performance checklist. As a result, the data from 2018 to 2023 were collected and analyzed using content analysis. The reason for choosing this time frame was that a longer time horizon, for example, over five years, could mitigate concerns about the unreliability of the accounting data (Cornett et al., 2010). The study data were collected manually from the CODAL database, and then the financial information of the companies was extracted from the software package developed by the TSE. Table 1 presents the selection method for sampling companies and industries. In total, 648 company-year observations were obtained from financial reports and analyzed during hypothesis testing. To control the outliers, all variables were winsorized at the 1% and 99% levels.

Table 1. Sample selection process

Description	Frequency	Percentage
Total number of companies listed on TSE at the end of 2023	603	100
Criteria		
Companies not active in TSE during 2018-2023	217	35.98
Companies listed on TSE before 2018	161	26.70
Companies other than holding companies, investment companies, financial intermediaries, banks, or leasing companies	61	10.11
Companies whose financial year did not end on March 29 or changed financial year during study	56	9.28
Companies whose data were not available during study	-	-
Sample size	108	17.91

3.1 Models

Given that the dependent variable (namely, environmental performance) had two modes of 0 and 1, a multiple Logistic Regression (LR) model was used to test the research hypotheses. Although the coefficients of the independent variables could be estimated like that in multivariate regression models in LR, the method of estimation was completely different. The OLS regression was further practiced in the multivariate regression model, in which the sum of the squared difference between the actual and predicted values of the dependent variable was minimized. In LR, another method called the Maximum Likelihood Estimation (MLE) was employed due to the non-linear nature of logit transformation.

Model (1) which is for testing the first, second, and third hypotheses of the research:

$$ENV_{it} = \beta_0 + \beta_1 AGE_{it} + \beta_2 TENURE_{it} + \beta_3 GENDER_{it} + \beta_4 SIZE_{it} + \beta_5 ROA_{it} + \beta_6 LEV_{it} + \beta_7 BODSIZE_{it} + \varepsilon_{it} \quad (1)$$

Model (2) which is for testing the fourth hypothesis a, b, c:

$$\begin{aligned} ENV_{it} = & \beta_0 + \beta_1 AGE_{it} + \beta_2 TENURE_{it} + \beta_3 GENDER_{it} + \beta_4 BODIND_{it} \\ & + \beta_5 AGE * BODIND_{it} + \beta_6 TENURE * BODIND_{it} \\ & + \beta_7 GENDER * BODIND_{it} + \beta_8 SIZE_{it} + \beta_9 ROA_{it} \\ & + \beta_{10} LEV_{it} + \beta_{11} BODSIZE_{it} + \varepsilon_{it} \end{aligned} \quad (2)$$

In both models, the dependent variable was ENV. Board diversity was further measured with reference to three components of AGE, TENURE, and GENDER. As well, AGE_{it} refers to the age diversity, TENURE_{it} is the tenure diversity, GENDER_{it} shows the gender diversity, ROA_{it} stands for the return on assets, SIZE_{it} indicates the actual reporting of total assets, LEV_{it} represents the ratio of book value of debt to book value of total assets, BODSIZE_{it} denotes the board size as the total number of board members, β_0 characterizes the constant coefficient, β_i is the regression coefficient, and ε suggests the error term of the model. In further tests, the Fixed Effects Method and the modified Test of Endogeneity in regression methods (the Homogeneous Two-Stage Regression Method) were utilized.

3.2 Variables

3.2.1 Dependent variable: environmental performance

According Table 2, It indicates the extent to which the company pays attention to the impact of its operations on environmental pollution. This item has the following operational components. (Zandi and Faghani, 2018).

Table 2. Environmental Performance Checklist

	Indicators	
	Product health and safety standards	Environmental costs such as pollution control
Paying attention to environmental protection in production/distribution processes		

The following relationship is used to measure it:

$$Environment_{it} = \frac{\sum_{n=1}^n x_i}{n_i}, 0 \leq Social_i \leq 1$$

n_i = Number of items disclosed by the company

x_i = Dummy variables are assigned the value 1 if the item is disclosed and zero otherwise

3.2.2 Independent variable: board diversity

The key point in the efficient composition of boards was to ensure that their members had enough skills, experiences, and knowledge to analyze the problems in their companies and develop frameworks to find solutions in this line. Accordingly, the best ideas and decisions in board meetings with effective compositions could raise questions in order to explain and interpret the issues facing boards and demand information to help in analyzing the challenges and phenomena. Three key elements needed to be taken into account to create an optimal board composition and select members. Considering these elements and giving specific weight to each one according to the expected roles and expectations in boards could thus significantly contribute to overall improvement and increase collective success. Board diversity could be accordingly measured via three components of age diversity (AGE) or the mean age of managers, tenure diversity (TENURE), as the number of years of service by board members, and gender diversity (GENDER), referring to the percentage of women on boards. (Al-Jaifi et al., 2023)

3.2.3 Moderating variable

In this study, board independence (BDIND) was introduced as the moderating variable, equal to the ratio of non-commissioned managers to the total number of members. (Nakano and Nguyen, 2012).

3.2.4 Control variable

Some control variables in the related literature on environmental performance in companies were further considered. First, return on assets (ROA), calculated as the ratio of net income to mean total assets, was controlled (Imhof and Seavey, 2014). The next was company size (SIZE), computed as the natural logarithm of total assets (De Jonghe et al., 2015). As well, leverage (LEV) was another control variable, calculated as the ratio of total debt to total assets (Benlemlih et al., 2018). Furthermore, the fourth control variable was board size (BDSIZE), equal to the total number of board members.

4. Findings

4.1 Descriptive statistics

The sample examined during 2018-2023 included 108 companies listed on the TSE, Tehran, Iran. Given the combination of data, there were 648 company-year observations. The indices of central tendency were mean and median, and the measures of dispersion were standard deviation (SD) as well as maximum and minimum (Table 3).

Table 3. Descriptive statistics for study variables

Variables	Mean	Median	SD	Minimum	Maximum
Environmental performance	0.722	0.100	0.150	0.000	1.000
Age diversity	48.000	42.000	0.1092	36.000	65.000
Tenure diversity	3.448	2.652	5.216	1.000	8.000
Gender diversity	10.715	8.000	1.036	0.000	20.000
Board independence	2.541	2.316	1.036	1.061	5.6131
ROA	10.352	9.022	11.044	-40.132	45.478
Company size	8.4312	7.5229	0.2009	2.1205	13.109
LEV	0.6731	0.593	0.1821	0.451	0.921
Board size	5.000	5.000	0.091	3.000	7.000

Mean, as the main index of central tendency, specified the balance point and the center of dispersion. As presented in Table 3, the mean value of environmental performance was equal to 0.10, suggesting that 10% of the companies had components related to environmental performance. The median was also the point that divided the sample into two equal parts. In other words, 50% of the observations were before and 50% of them were after it. If the median was close to the mean, it denoted that the data distribution was close to the normal state. One of the leading measures of dispersion was thus SD. Accordingly, the data dispersion was optimal.

4.2 Inferential statistics

The inferential statistics used in this study was multivariate regression in order to discover the relationships between the independent and dependent variables by controlling the effect of other variables. In addition, regression tests were employed to ensure the reliability of the results.

4.2.1 Model selection

As the data recruited in this study was a combination of cross-sectional and time-series ones, the type of data (viz., composite or panel) needed to be determined using diagnostic tests before fitting the models. For this purpose, F-Limer Test (Chow Test) was operated. The F-Limer Test and

Hausman Test results are given in Table 4.

Table 4. F-Limer test and Hausman test results

Models	Tests	Degree of freedom	Statistic	Probability	Results
Model 1	F-Limer Test	6.113	0.381	0.849	Pooled
Model 2	F-Limer Test	6.113	0.279	0.918	Pooled

As shown in Table 4, the F-Limer Test statistical probability in all four models was greater than 0.05; therefore, the pooled data method was used to estimate them.

4.2.2 Normal distribution of error components

To check the normality of the error components, the Jarque-Bera Test was applied, whose results are presented in Table 5. Accordingly, the significance level in the Jarque-Bera Test was higher than the level of error intended (5%) in all four models in this study. Therefore, the null hypothesis, viz., the normality of the error components, was not rejected, so the error components of the models had a normal distribution.

Table 5. Error component normality test results

Models	Jarque-Bera Test statistic	Statistical probability (Sig.)	Results
Model 1	0.8491	0.2819	Normal
Model 2	1.019	0.1649	Normal

4.2.3 Heterogeneous variance of error components

In the OLS regression, the error components needed to have constant and equal variances, but a fixed one if there was a heterogeneous variance of the error components. Accordingly, the presence of heterogeneous variance was tested, and the Breusch-Pagan Test was used to check the hypothesis (Table 6). The statistical probability for all four models was higher than the 5% error level, so the null hypothesis, i.e., the existence of equal variance of the error components was not rejected. Therefore, there was no heterogeneous variance of the error components.

Table 6. Breusch-Pagan test results

Models		Degree of freedom	Statistic	Statistical probability (Sig.)
Model 1	F-statistic	6.114	0.471	0.719
	Observation×			
	R-squared	6.000	2.291	0.721
Model 2	F-statistic	6.114	1.918	0.116
	Observation×			
	R-squared	6.000	8.884	0.116

4.2.4 Testing H₁, H₂, & H₃

Table 7 shows the summary of fitting the LR model obtained from testing H₁, H₂, and H₃ as well as its estimation. Accordingly, the LR statistical probability was less than the 5% error level, pointing to the model significance at the 95% confidence interval with high reliability. The Durbin-Watson statistic was also equal to 2.109, implying the absence of autocorrelation between the error components of the model. The variance inflation factor (VIF) statistic then suggested no collinearity between the independent variables. Moreover, the coefficient of determination of the model was 0.591, denoting that about 59% of the variances in the environmental performance were explained by the explanatory variables of the model.

Testing the coefficients of the model for H1, the Z statistical probability of board age diversity was 0.0001, which was below the 5% error level. Considering the Z statistic, equal to 4.911 and outside the critical range (-1.96 to 1.96), H1 was confirmed with the 99% probability. Besides, beta coefficient for board age diversity was 0.214, which indicated the significant positive effect of this variable on environmental performance. Regarding the coefficients of the model for H2, the Z statistical probability of board tenure diversity was equal to 0.000, which was less than the 5% error level. Considering the Z statistic, equal to 9.918 and outside the critical range (-1.96 to 1.96), H2 was correspondingly confirmed with the 99% probability. Beta coefficient for board tenure diversity was 0.455, implying the significant positive impact of this variable on environmental performance. With regard to the coefficients of the model for H3, the Z statistical probability of board gender diversity was 0.8048, which was higher than the 5% error level. Given the Z statistic, equal to 0.381 and within the critical range (-1.96 to 1.96), H3 was confirmed with the 99% probability.

Table 7. Results of fitting Model 1: Assumptions one, two, and three

Variables	Coefficient	Z statistic	Statistical probability (Sig.)	VIF
Constant coefficient	4.168	21.510	0.000	-
Age diversity	0.214	4.911	0.000	1.669
Tenure diversity	0.455	9.918	0.000	1.569
Gender diversity	0.065	0.381	0.804	1.415
ROA	0.719	7.088	0.000	1.561
Company size	1.249	10.221	0.000	1.665
LEV	-0.718	-9.988	0.000	1.612
Board size	0.615	4.328	0.000	1.481
LR statistic	209.2291	Nagelkerke's coefficient of determination	0.591	
LR probability statistic	0.0000	Durbin-Watson's statistic	2.109	

4.2.5 Testing H4

The results of testing H4 (Table 8) showed that the LR statistical probability was equal to 0.0000, revealing the appropriateness and significance of the model. The Durbin-Watson's statistic value was also 1.877, implying the absence of autocorrelation between the error components of the model. As well, the VIF statistic denoted the absence of collinearity between the independent variables. The coefficient of determination of the model was also 0.471, showing that about 47% of the variances in environmental performance were explained by the explanatory variables of the model.

Regarding the coefficients of the model for H4-1, the Z statistical probability of board age diversity×board independence interaction was 0.000, which was less than the 5% error level. According to the Z statistic, equal to 9.699 and outside the critical range (-1.96 to 1.96), H4-1 was confirmed with the 99% probability. Thus, the moderating effect of board independence on the relationship between board age diversity and environmental performance was established. For the coefficients of the model for H4-2, the Z statistical probability of board tenure diversity×board independence interaction was 0.000, which was below the 5% error level. Given the Z statistic, equal to 5.611 and outside the critical range (-1.96 to 1.96), H4-2 was confirmed with the 99% probability. In view of that, the moderating effect of board independence on the relationship between board tenure diversity and environmental performance was validated. With respect to the coefficients of the model for H4-3, the Z statistical probability of board gender diversity×board independence interaction was 0.4562, which was more than the 5% error level. According to the Z

statistic, equal to 0.049 and within the critical range (-1.96 to 1.96), H4-3 was rejected with the 99% probability. Therefore, the moderating effect of board independence on the relationship between board age diversity and environmental performance was not settled. In other words, board independence failed to moderate the relationship between board gender diversity and environmental performance.

Table 8. Results of fitting Model 2: Assumptions four a, b, c

Variables	Coefficient	Z statistic	Statistical probability (Sig.)	VIF
Constant coefficient	3.265	16.152	0.000	-
Age diversity	0.381	2.646	0.019	1.811
Tenure diversity	0.695	10.619	0.000	1.612
Gender diversity	0.718	0.419	0.719	1.481
Board independence	-0.611	-8.940	0.000	1.815
Board age diversity×board independence	0.719	9.699	0.000	1.261
Board tenure diversity×board independence	0.309	5.611	0.000	1.145
Board gender diversity×board independence	0.104	0.049	0.456	1.118
ROA	0.411	7.884	0.000	1.214
Company size	0.074	3.774	0.006	1.156
LEV	-0.611	10.452	0.000	1.254
Board size	0.310	5.991	0.000	1.883
LR statistic	109.991	Nagelkerke's coefficient of determination		0.471
LR statistical probability	0.0000	Durbin-Watson's statistic		1.877

5. Conclusion

Boards are required to consider diversity because of its impact on environmental performance. The search for social legitimacy and the need to meet expectations and demands among stakeholders has so far made companies more aware of the environmental consequences of their activities. Much concern about environmental issues has accordingly led organizations toward implementing preventive strategies in response to public awareness. In this context, environmental policies may be encouraged by corporate governance mechanisms, especially by boards. The present study was thus an attempt to extend previous research by analyzing the role of other less-explored board characteristics, such as cultural diversity, experience, and board tenure, pushing boards to get more prepared to advise and monitor the management in the current competitive environment and lay focus on environmental issues. In addition to boosting corporate governance, companies with better governance would accordingly become more environmentally responsible as shown in available evidence (Chan et al., 2014; Fiandrino et al., 2019; Harjoto et al., 2015).

Of note, environmental performance has been documented as a critical aspect receiving much more attention in companies. Although regulators ask companies move toward board diversity, communities demand them be more environmentally responsible. However, there is still variation in environmental performance among companies. This study aimed to enrich the literature on board diversity and environmental performance by addressing the ways board age, tenure, and gender diversity could influence environmental performance across countries. In this sense, the study results showed that board age diversity had a positive effect on environmental performance, suggesting that companies with older board members were more involved in environmental activities. As well, a positive relationship was observed between board tenure diversity and environmental performance, implying that companies with long-term board tenure might be less

risk-averse to undertake environmental activities. In terms of board gender diversity, female managers were more inclined toward environmental activities.

The study has implications for investors to consider board diversity when making their trading decisions. Traders are further required to know that more diversity in boards indicates commitment to CSR and inclusion, which can be attractive to social responsibility investors. In this sense, they may invest more in companies prioritizing diversity and inclusion and demonstrate good environmental performance, thereby influencing the patterns adopted by traders in their investment choices. In addition, regulators are suggested to formulate policies and operational initiatives to improve environmental performance in companies. The study results are accordingly robust enough for alternative methods of estimation. Hence, examining other board characteristics in future research is recommended. For the Adjusted Analysis, the study results also offer valuable theoretical and practical implications. From a theoretical perspective, this study enriched the literature by providing empirical evidence on the moderating effect of board independence on the relationship between board diversity and environmental performance in companies. Significantly, the results demonstrated that board independence moderated the effect of gender and board diversity on environmental performance. Companies are thus expected to recruit independent female board members, which is critical to an increase in environmental performance. Some valuable concepts were additionally developed for shareholders. Finally, LR was utilized to analyze the hypotheses (Table 9).

Table 9. Study results summarized

Hypotheses	Description	Results
H_1	There is a significant relationship between board age diversity and environmental performance.	Confirmed
H_2	There is a significant relationship between board tenure diversity and environmental performance.	Confirmed
H_3	There is a significant relationship between board gender diversity and environmental performance.	Rejected
$H_{4,a}$	Board independence has a moderating effect on the relationship between board age diversity and environmental performance.	Confirmed
$H_{4,b}$	Board independence has a moderating effect on the relationship between board tenure diversity and environmental performance.	Confirmed
$H_{4,c}$	Board independence has a moderating effect on the relationship between board gender diversity and environmental performance.	Rejected

The first hypothesis claimed that age diversity has a positive and significant effect on environmental performance in companies listed on the Tehran Stock Exchange. This meant that board age diversity had a significant positive effect on environmental performance in the companies listed on the TSE, Tehran, Iran. These results were in line with the reports in Malekian et al. (2019), Vaziri (2021), Ahmadi et al. (2023), Menicucci and Paolucci (2022b), and Al-Jaifi et al. (2023). In the literature related to board age diversity, there were different views about the importance of this variable and participation in environmental activities. For example, Said et al. (2012) concluded that companies with older managers had more environmental disclosure, because they could make the best use of their experiences in decision-making. In contrast, Ibrahim and Hanefah (2016) found a positive relationship between young managers on the board and environmental activities, so they were more concerned with environmental issues.

The second hypothesis claimed that board tenure diversity had a significant positive effect on environmental performance in the companies listed on the TSE, Tehran, Iran. Beta coefficient for board tenure diversity, indicating the significant positive impact of board tenure diversity on

environmental performance. This signified that board tenure diversity had a significant positive effect on environmental performance in the companies listed on the TSE, Tehran, Iran. The results were accordingly in agreement with the reports in Mahmoodi and Ghafari (2016) and Paolone et al. (2023). As stated in Gallego-Álvarez and Rodriguez-Dominguez (2023), these characteristics had a positive effect on a wider range of environmental activities. Thus, companies whose boards were more diverse in terms of gender and cultural background could take more actions. Moreover, boards whose members had more experiences in the industry were more inclined to carry out such environmental activities. Similarly, the effect on environmental views was also positive when members had served with long-term positions in boards. These characteristics could help promote an approach toward sustainability and environmental concerns. The advantages of a broader knowledge base and board diversity could thus lead to a pro-environmental perspective in companies.

The third hypothesis claimed that board gender diversity could have a significant positive effect on environmental performance in the companies listed on the TSE, Tehran, Iran. However, the results of testing the third hypothesis of the research showed that the third hypothesis of the research was not confirmed. This means that no significant relationship was found between gender diversity and environmental performance in companies listed on the Tehran Stock Exchange. supporting the results in Salehi and Eskandarli (2019), Malekian et al. (2019), Parsa and Kanani (2022), Saghaei and Hajiha (2022), Jari Al-Saedi et al. (2022), Menicucci and Paolucci (2022a), and Al-Jaifi et al. (2023). Usually, women who take on management positions have characteristics that are different from the general population of women. Therefore, a situation arises where gender may not have a different impact on the value of the company. Therefore, it is acceptable that gender diversity does not affect the environmental performance of the company.

The first sub-hypothesis of the fourth hypothesis claimed that there is a moderating effect of board independence on the relationship between board age diversity and environmental performance. According to the t statistic, This hypothesis was confirmed with the 99% probability. This implied the moderating effect of board independence on the relationship between board age diversity and environmental performance. The results were also in agreement with those in Mohammadi and Momeni (2021) and Menicucci and Paolucci (2022a).

In the second sub-proposition of the fourth hypothesis board independence could have a moderating effect on the relationship between board tenure diversity and environmental performance. On the subject of the model coefficients, the t statistical probability of board tenure diversity×board independence interaction was confirmed with the 99% probability, denoting the moderating effect of board independence on the relationship between board tenure diversity and environmental performance. The results were thus along with the reports in Mahmoodi and Ghaffari (2016).

In the third sub-hypothesis of the fourth hypothesis, it was claimed that board independence could have a moderating effect on the relationship between board gender diversity and environmental performance. However, the results of testing this research hypothesis showed that the research hypothesis was not confirmed. Based on this, the moderating effect of board independence on the relationship between board age diversity and environmental performance was not confirmed. In other words, board independence failed to moderate the relationship between gender diversity and environmental performance, which was in line with Menicucci and Paolucci (2022b).

As stated in Al-Jaifi et al. (2023), environmental performance was positively related to board age and gender diversity and negatively correlated with board diversity. These results were attributed to the AH, in which long-term tenure in boards caused a managerial-friendly bias that ultimately reduced environmental activities. It was also established that board independence moderated the

relationship between board tenure and gender diversity and environmental performance. In this regard, Liao et al. (2019) found a significant positive relationship between board gender diversity, measured as the percentage of female managers on boards and the willingness to disclose greenhouse gas information. In addition, boards with independent managers or environmental committees tended to be more environmentally transparent. However, such an impact was negligible if committees were not large enough, independent, or active. These results were consistent with the Stakeholder Theory and showed that diverse and independent boards and board-level environmental committees might help balance the financial and non-financial objectives in companies with limited resources and then minimize or adjust conflicting expectations among stakeholders.

Considering the results of testing the research hypotheses, legislators are suggested to take the necessary measures to introduce a mandatory quota for women on boards in order to promote their presence in higher organizational positions in companies. Shareholders are further advised to consider board gender diversity when choosing companies for investments, because companies with gender diversity pay much more attention to environmental pollution reduction programs. It is also recommended to develop laws and regulations in the TSE, Tehran, Iran, to measure and specify environmental responsibilities of companies during their activity as much as possible. Besides, companies should strive to attract independent female board members, as a characteristic critical to increasing environmental performance. Other practical implications for accountants, top managers, and financial managers are to develop capabilities with regard to perceived environmental uncertainty to handle environmental management accounting tools and thus improve organizational environmental performance. Shareholders are additionally suggested to consider board independence before choosing companies for investments, because those with board independence have more environmental pollution reduction programs.

It is recommended that company managers: implement environmental performance indicators as a management method in their organization to improve operational processes in this direction and, consequently, gain long-term economic benefits and accelerate innovation.

Given some inclusion criteria for the companies (e.g., the financial year at the end of March and no changes in the financial year, etc.), 108 companies were selected as the samples, so the generalization of the results to other companies should be done with caution. Based on the theoretical foundations, there were many variables that could shape the dependent variable, but not fully considered in the model and analyzed, which was one of the other study limitations.

The findings of this study provide valuable implications to the traders as a more diverse board may signal a company's commitment to social responsibility, diversity, and inclusion, which can appeal to socially responsible investors. These investors may be more likely to invest in companies that prioritize diversity and inclusion and demonstrate good environmental performance, thereby influencing the paradigm of traders in their investing choices. From a theoretical perspective, this study enriches the literature by providing empirical evidence about the moderation effect of board independence on the associations between board diversity and environmental performance. Notably, the results suggest that the board independence level moderates the effect of age and tenure board diversity on environmental performance. This, in other words, expresses the weak role of women on corporate boards. The findings of this study also provide valuable implications for firms' shareholders as their voting decisions to elect the board of directors need to consider the diversity of the board due to its impact on environmental performance. This study is not circumscribed by any definitive limitations that might impede future research efforts, although the dataset used in this study warrants further consideration. While the current dataset encompasses all publicly listed firms that have an available environmental performance score on TSE.

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RESEARCH ARTICLE

Identifying Behavioral Financial Components Using Emotional-Cognitive Dimensions and its Role in the Capital Market Crisis

Helsa Babaei, Nader Rezaei*, Asgar Pakmaram, Rasool Abdi

Department of Accounting, Bonab Branch, Islamic Azad University, Bonab, Iran

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Abstract

The current mixed type of research (qualitative and exploratory) aims to identify behavioral financial components using emotional-cognitive dimensions and their role in the capital market crisis. The research findings contribute to academic knowledge and have significant practical implications, providing valuable insights for professionals in the finance and investment field, policymakers, and other stakeholders. In the first stage of the research, interviews were conducted with 21 experts, including professors of accounting and finance, managers of official brokerages, and official analysts of the capital market. The factors affecting behavioral finance with an emotional-cognitive approach and its role in the capital market crisis were presented. The results showed that the most important causes of financial behavior are people's social attitudes towards the investment field, emotional and cognitive factors, the type and manner of accessing information, and behavioral and individual tendencies of investors. The basis of this irrational behavior can be factors such as the economy involved in sanctions and inflationary conditions, the lack of dynamics of capital market rules, the misperception of investors, and the type of ownership of stock companies. The diverse characteristics of industries, the policies of the stock exchange organization and the governors, the uncertainty of economic policy, the society itself, and political factors can be raised as interventionists in creating critical conditions and moving towards behavioral finance. Appropriate training, governance attitudes to this matter, the presence of consultants and analysts, and monitoring and increasing the financial literacy of investors are suitable strategies to respond to the efficiency of the capital market. Not paying attention to behavioral finance will adversely affect investors, macroeconomics, society, and the capital market. In the second stage of the research, by using exploratory analysis and by distributing a questionnaire made by the researcher and taken from the qualitative model of the study among 340 capital market participants and with exploratory analysis, it was determined that 11 basic concepts (influential factors) of behavioral finance have the most significant impact. It has emotional and cognitive biases in Iran's capital market crisis.

Keywords:

Behavioral Finance, Components of Behavioral Finance, Cognitive Biases, Emotional Biases

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*Corresponding Author: Nader Rezaei
 Email: rezaeinader01@gmail.com
 Tel: 09144815093
 ORCID: 0000-0001-9907-4648

1. Introduction

Behavioral finance is a relatively young and productive field of finance that is rapidly developing and finding its place in practice. Proponents of behavioral finance claim that classical finance requires using very restrictive assumptions and rules of an exact science that fail to explain the complex reality of finance (Chowdhary, 2020). By incorporating psychological elements, behavioral finance seeks to fill the gaps and improve classical finance theory. Psychological elements play an essential role in investors' decision-making process. Hence, behavioral finance bridges the gap between classical finance and financial realities. It also informs investors, portfolio managers, financial professionals, and other market participants on how to make better financial decisions. According to Bikas et al. (2013), the key difference between classical finance and behavioral finance is reflected in the fact that classical finance deals with the question of why investors make decisions. It has no business. Moreover, unlike classical finance, which is based on the concept of perfect rationality. In other words, classical assumes a perfectly rational investor who is well-informed and has perfect knowledge. In contrast, behavioral finance assumes an ordinary investor, i.e., the average person who is not fully informed and has insufficient knowledge and with purely economic motives. It is not guided (Chowdhary, 2020). Ordinary investors are people who make systematic mistakes in their decision-making process. Their ability to multitask could be improved, as could their capacity to process information. Also, their ability to solve complex problems is small. Ordinary investors are characterized by cognitive defects leading to irrational financial decision-making. In real-life situations, decisions are often made based on subjective assessments, preferences, and biases that do not reflect real-world facts. Answers usually depend on how questions are framed; decision-makers are generally guided by their fears instead of facts and use mental accounting. Hence, they ignore that different asset portfolios are interrelated (Curtis, 2004). Due to the asymmetry of information and the limitation of the cognitive capacity of decision-makers, errors occur in their behavior, which negatively affects the outcome of the decision-making process (Nikolić, 2018). As a result, it can be claimed that, just as a doctor does not prescribe a common medicine for all patients, the discussion of investment can also be different from one person to another. Unlike classical finance, people's investment is influenced by various factors, the knowledge of which in each environment leads to It being invested in creating a safe platform. It should be accepted that behavioral finance is an integral part of the investment, and knowing the components affecting investment from the emotional-cognitive dimensions with an emphasis on the financial crisis of Iran's capital market seems necessary. In this regard, the current research aims to identify behavioral financial components using emotional-cognitive dimensions and their role in the crisis of the Iranian capital market (exploratory analysis). First, the theoretical foundations and empirical background of the research are mentioned. Then, the research method is proposed, and as a result, the research findings and suggestions for improving the investment conditions in Iran's capital market will be presented.

2. Theoretical principles of the study

Classical financial economics theorizing is based on methodological individualism in the framework of Cartesian epistemology. Based on this rational structure, the investor benefits from unlimited rationality, selfishness, and will. Based on these three assumptions, the basic principles of the investor's behavior are formalized as a set of thematic principles, and all theorems and theories are produced by logical deduction from the thematic principles. This methodological approach claims to be able to descriptively and prescriptively describe, explain and predict investor behavior in the form of the principle of the optimizer factor; But in practice, the observed behavior of financial markets has a significant distance from what these theories have predicted; especially, the

observation of numerous financial crises and the inability of this knowledge to explain the reasons for their occurrence has damaged the validity of this knowledge ([Hasanpour et al., 2022](#)).

There are two views on financial markets. One is the classic view of the capital market, which refers to the efficiency of the market, and the other is the opposite view, which is referred to as behavioral finance. The efficient market hypothesis was considered one of the main bases for making investment decisions. According to this theory, no investment can obtain an abnormal return above the average return based on knowledge and the ability to process information ([Alnajjar, 2013](#); [Ross et al., 2016](#)). This theory assumes that investors are rational and use a variety of models to narrow down investment opportunities. However, this theory could not justify the market anomalies, which led to various financial crises ([Zeynivand et al., 2023](#)). The Internet bubble bursting in the 1990s, the Dotcom crisis, the stock market crash in 2002, and the banking crises in 1994 ([Sharma and Kumar, 2019](#)) were among these crises. The second half of 2001 began with an unexpected financial crisis in the US stock market, and the credit crisis of 2007 hit the world economy as the deepest recession since the Great Depression of the 1930s. According to classical financial predictions, such crises should not happen.

Contrary to what was expected, classical financial theorists needed help explaining the causes and the roots of the phenomena of these crises. However, the rival thoughts that had obtained a unique opportunity to prove the classical financial inefficiency each explained the problem within the framework of their paradigm, and among these views, the behavioral approach was given more attention. In explaining the causes of crises, behavioral finance claims that investor errors are not random and occur systematically at the micro and macro levels.

The systematicity of errors means that learning and arbitrage mechanisms cannot limit or eliminate the effect of individual errors. Behavioral economists use the term bias to explain systematic errors. Bias is the significant distance of observational data from classical financial forecasts. According to the behavioral finance claim, bias causes investors to choose a non-optimal portfolio at the micro level. The inefficiency of the error correction mechanism leads to the effect of biases at the macro level in the form of the inability of the market to return to the predicted equilibrium and, as a result, creates a financial crisis ([Hasanpour et al., 2022](#)). As a new school of thought in finance and economics, behavioral finance has given a unique role to investors' feelings and inner states in the decision-making process. In this paradigm, the price of securities depends on fundamental variables such as profit and estimation of the company's future cash flow and investors' emotions and mental conditions.

It is evident that if the influence of investors' decisions on their emotions is greater than usual, phenomena such as extreme fluctuations, bubbles, and collapse will occur, and all signs of crisis in the stock market will occur ([Zhang et al., 2019](#)). Therefore, it is evident that with the increase in the weight of emotions in investors' buying and selling decisions, the possibility of extreme price fluctuations in the form of bubbles, falling prices, and collective behavior will increase, resulting in market inefficiency. The studies of [Golarzi and Piri \(2022\)](#) showed that investors' sentiments have a positive and significant effect on the probability of a crisis in the Tehran Stock Exchange, which is consistent with the findings of [Kumar and Lee \(2006\)](#), [Huang et al. \(2010\)](#), [Yin and Tian \(2017\)](#), [Ruwei et al. \(2019\)](#), [Pan et al. \(2021\)](#) were consistent. Therefore, it can be acknowledged that one of the factors that have a significant relationship with behavioral finance is the role of the financial crisis, which can influence people's decisions in the financial markets. As a result, people's decisions in the financial markets also influence the investment environment. In other words, we will witness a capital market crisis with increased emotional behavior and cognitive and emotional biases. On the other hand, when critical conditions prevail, investors enter the capital market with short-term goals, which can cause irreparable damage to the capital market and, as a result, the

country's economy. Slow down. In this situation, psychology and behavioral economics provided extensive evidence and showed that people are vulnerable to biases, use shortcuts in their investment thinking, and have biases in their decisions. According to the above, the current research aims to identify and identify the behavioral financial components using emotional-cognitive dimensions and explain their role in the capital market crisis, and this research seeks to answer the following questions:

- What causes emotional and cognitive bias in Iran's capital market crises?
- What are the background and contexts of emotional and cognitive bias in Iran's capital market crises?

What are the appropriate strategies for recognizing emotional and cognitive biases in Iran's capital market crises?

- What are the behavioral financial intervention factors from the cognitive dimension in Iran's capital market crises?
- What are the consequences of behavioral financial biases in Iran's capital market crises?

One of the theories proposed in this field is the hypothesis that the reaction is less than expected by investors. In connection with the causes of the phenomenon of reactions that are less than expected by investors, various researchers have stated a series of psychological factors and placed this issue in the field of behavioral finance. Some important factors raised are: 1- The conservative view presented by Edwards (1968) indicates that investors slowly adapt to the new news that enters the market and their expectations are slowly introduced in the market prices. 2- According to [Kahneman and Tversky \(2013\)](#), the anchoring theory supports conservatism, in which people use a certain part of information. as proposed by Daniel et al. (2001), overconfidence causes people to overestimate their abilities and creativity and make more transactions.

[Selden \(1912\)](#) believes that stock prices in the market are affected by the mental attitudes of investors. Based on this, [Kahneman and Tversky \(2013\)](#), by presenting the famous perspective theory, established the basis for introducing the types of cognitive-emotional biases of investors in the capital market ([Babajani Mohammadi et al., 2017](#)). Prospect theory was developed to predict behavior (how people behave) and not to determine optimal behavior (expected optimal behavior theory). This theory describes people's decision-making under uncertainty about the maximum value. [Werner, Bonnet, and Thaler \(1985\)](#) proposed mental accounting and overreaction in the stock market. Samuelson and Zeckhauser (1988) introduced the status quo bias by examining investors' biases in the market. The main point of this critical study was [Fernandes \(2007\)](#), who showed with economic models that uncertainty causes a bias to maintain the status quo. This was while [Benartzi and Thaler \(1995\)](#) introduced behavioral concepts directly into the field of investment and introduced conservatism bias.

[Grinblatt et al. \(1995\)](#) presented mass behavior, and [Basu \(1997\)](#) found that by examining lousy news, bad news spreads faster. Investors' biases in the capital market are generally divided into two groups: cognitive and affective biases. Cognitive biases are any errors that may occur because of the analysis of a decision and are caused by weakness in reasoning and information. Cognitive biases have an adverse effect on the process of human cognition and impair cognition. Overconfidence, reliance and adjustment, agency, accessibility, self-documentation, the illusion of control, conservatism, ambiguity avoidance, mental accounting, confirmations, events, recent events and shaping, and situational effect are considered among cognitive biases. However, emotional biases state that emotions are an irreplaceable human dimension and influence decisions. Emotional biases include overestimation, self-control, optimism, loss aversion, regret avoidance, and maintaining the status quo. These biases are common in investors who prefer conditions to remain relatively

constant and not change. Alternatively, we will face a situation where investors value the asset more when they own it than when they do not possess it.

Therefore, in the status quo bias, investors in the capital market think that by maintaining the status quo, they will stabilize their position in the market and operate with risk aversion, in other words, with more conservatism in the market. Therefore, they influence the market with another bias called anchoring in the stock without logic. It is expected that investors will always be affected by different biases, and these biases will have different consequences in capital market crises. Its investigation of the Iranian capital market environment seems necessary and essential to show the investors' view of the capital market and the psychological factors of investment under the supervision and risk tolerance of the investor cause decisions. However, behavioral finance states that expectations and risk are outside the scope of logic and rationality. This critical thing prompted the researcher to investigate the cause of Iran's capital market crisis with an emotional-cognitive approach, which should have been considered in previous studies, and this gap in the realities of the capital market and previous studies caused uncertainty towards the market. In general terms, uncertainty refers to cognitive situations that include incomplete or unknown information. This applies to predictions of future events, measurements already made, or unknowns. Uncertainty is visible in the environment or arises from a need for more awareness. On the other hand, uncertainty in critical situations can create emotional and cognitive biases in investment. It can be concluded that certain biases, such as overconfidence, confirmation and self-verification bias, and loss aversion bias, make people unjustifiably feel good about themselves. Therefore, the mentioned biases are elements of self-deception. Confirmation bias means underestimating evidence contrary to one's beliefs and, at the same time, over-relying on evidence in favor of a belief, ultimately leading to overconfidence in one's abilities. Self-affirmation also makes people feel good because they believe their skills cause success and blame external factors for potential failures. By summarizing cognitive biases, we can conclude that they are similar and intertwined. It is difficult to determine the precise boundary between different cognitive biases. In other words, it is difficult to determine where one cognitive bias ends and another begins. Instead of the individual and isolated effect of a cognitive bias, it is more realistic to discuss their joint effect on financial decision-making. Therefore, the current research tries to understand behavioral finance better and identify its components to determine its dimensions and consequences in the Iranian capital market. In this regard, the following question is raised, the answer to which will indicate the position of financial behavior and its importance in the capital market of Iran. Therefore, the main research question is:

What are the behavioral financial components of emotional-cognitive dimensions and their role in the Iranian capital market crisis?

2.1 The empirical background of the study

Mohanty et al. (2023) concluded that recency biases potentially impact investor decision-making, while overconfidence bias has a negligible impact on investor decision-making. Wu et al. (2021) showed that investors' sentiments can significantly affect the risk of stock price decline in both the Shanghai and Shenzhen markets. In addition, the more pessimistic investors are the risk of the share price falling increases and vice versa. Guglielmo Maria Caporale et al. (2021) investigated the effect of investors buying and selling transactions on the volatility of the Korean stock market during two crises, the 1997 Asian crisis and the 2008 global financial crash. They investigated the buying and selling behavior of domestic investors versus foreign and institutional investors. The research results showed that buying and selling transactions asymmetric affected volatility, which depended on the type of investor's buying and selling and the stage of the business cycle. Buy

orders were much more informative than sell orders, as most of their volatility was lower in pre-crisis periods. In contrast, post-crisis buys and sells were traded regardless of who (institutional or individual investors) and with what information (member, non-member) trades, has had positive fluctuations.

Most importantly, the breakdown of total buy and sell trades into trader-type categories showed that some institutional investors were more informed traders who stabilized the market than those who consistently increased volatility. Foreign investors reduced the volatility crisis through their purchases and total trading activity in the Asian sample, but only before the recent global financial turmoil. [Rezaei and Elmi \(2018\)](#) stated that the stock market is influenced by news and information. If the stock market is inefficient, the stock price reaction to news and information puts the stock market in overreaction and underreaction mode. Many models have already been proposed using different tools and techniques to predict stock market behavior. This study modeled the stock price reaction in the stock market with a behavioral finance approach. The statistical population of this research includes companies admitted to the Tehran Stock Exchange.

The final price data for the end of June, September, Azar, and March were analyzed as examples to predict the stock price. This research used Bayes' law to estimate the probability of changing the model. Through this law, the probability of the occurrence of an event can be calculated by conditioning the occurrence or non-occurrence of another event. The model estimation results showed the possibility of being in the regimes of high volatility (non-reaction) and low volatility (non-reaction of the stock price despite the shocks to the stock market). The closing price remained constant in monthly modeling, while the actual stock price did not differ from the market price. Bird et al. (2017) examined whether financial markets fully exhibit the characteristics associated with the efficient market hypothesis or whether behavioral approaches that emphasize excessive pessimism and confirmation bias also provide evidence of functioning markets. They tested several essential aspects of market behavior. Specifically, they examined the extent to which significant changes in risk premiums among crisis-affected countries were related to news. Also, they investigated whether the effects of good and bad news were symmetrical. Finally, they investigated whether the change in the risk premium in Greece affects the premium in other countries in an asymmetric and biased way. They found that although there is considerable evidence that financial markets often function effectively during crises, there are also essential deviations from this pattern consistent with the behavioral approach. Their findings suggest that functional and behavioral approaches are helpful when trying to understand the functioning of markets. [McNair et al. \(2016\)](#) showed that understanding the individual factors associated with consumer financial behaviors during periods of specific financial stress may provide new insights into better control of one's finances and reducing one's spending. The research method used was linear regression and variance analysis. Also, the behavior of borrowing was investigated using binary logistic regression. In this research, it is mentioned that certain individual differences lead to different financial behaviors. Their findings show that interventions to improve financial decisions by recognizing individual issues can lead to greater effectiveness. If psychological issues such as developing coping skills (coping with stress, etc.) are emphasized, it will be more effective in controlling people's financial behaviors ([Karami et al., 2023](#)). [O'Neill and Xiao \(2012\)](#) examined the financial method before and after the recent global financial crisis. Data were obtained from an online financial self-assessment tool using responses from January 2005 to December 2010. For comparison, 10,661 respondents were divided into groups before and after December 31, 2007. A significant difference in the period was found in the positive direction for test scores, which indicates the frequency of performance of 12 financial methods and the total score of all measures. After converting the items into three general behavior categories, the scores for all three behaviors (budgeting, spending, and saving) were significantly

higher after the financial crisis began. [Rajabi et al. \(2023\)](#) investigated the impact of financial-behavioral factors on investors' decision-making from the point of view of managers of investment companies in the Iranian Stock Exchange. Experts have been consulted in this field regarding financial-behavioral factors and its impact on managers' decision-making. Based on the obtained results, all six dimensions are greater than 0.3 and the t-statistic value is greater than 1.96, so the six main financial-behavioral factors correctly justify and interpret the effects of these behaviors on investors' decision-making in the Iranian stock market. they do [Aalipour and Zanganeh \(2023\)](#) conducted research entitled a study on emotional finance as a new approach to understanding and influencing stock markets (from a behavioral finance point of view). They provided new explanations about the causes and predictions of crises and bubbles that have been experienced repeatedly, especially since the 2000s. This framework uses concepts such as narrative, group feeling, mental conditions, and imaginary goals that have not been included in financial studies. This paper analyzes and models the basic components of the theory in the context of factors and their effects. Does this report present findings to help market regulators, fund managers and investors understand market bubbles? [Karami et al. \(2023\)](#) stated that the behavioral finance perspective that emerged from the integration of psychology and finance states that psychology plays a role in financial decision-making. Golarzi and Piri (2022) stated that investors' emotions can cause them to make emotional and sometimes irrational decisions and, as a result, cause anomalies such as extreme price fluctuations and even crises in the financial markets. The statistical population of the 15 years from 2006 to 2020 is based on 179 companies admitted to the Tehran Stock Exchange, which, by applying logistic regression, concluded that investors' sentiments could be effective on the possibility of a financial crisis in the capital market. [Khodaparast Salek Moallemi et al. \(2022\)](#) investigated the experimental behavioral finance test to compare the efficiency of common stock cost models under the influence of the fundamental characteristics of companies. To achieve the goal of the research, data from 87 sample companies were collected in 2017 and analyzed using the descriptive analysis method by performing the Data Envelopment Analysis (DEA) test and paired t-test. Gordon and Olson-Junter growth models have been used to compare the performance. Considering the test results and comparing the explanatory power and accuracy of each model, it can be said that the two Olson-Junter and Gordon models are suitable at different confidence levels. and have reliability and there is a significant difference between these two models in terms of comparison. Based on the results, the level of dimensions of personality types included in the research as a moderating variable, a strong relationship between the significant difference between the efficiency of common stock cost models (Gordon model) and the Olson Junter model). [Abdi Golbaghi et al. \(2021\)](#) studied the prediction of changes in the exchange rate based on behavioral finance and classical finance using the systemic dynamics approach. In their research, they tried to provide a model with more explanatory power to realize this by using the integrated approach of behavioral finance and classical financial approaches. In this regard, a model based on the approach of systemic dynamics, considering the impact of psychological, political and economic variables, has been presented. The results obtained from the research indicate that on average, each of the four situations of widespread prosperity, the prosperity of behavioral trends, stagnation of behavioral trends and widespread stagnation can respectively be 5.37%, 4.31%, 3% and Reduce 2.4% of behavioral distortions in the currency market. [Naib Mohseni et al. \(2021\)](#) show that the causal factors affecting investors' decision-making are regret, greed, fear, cognitive dissonance, reputation effect, mental anchor, self-documentation, loss aversion, gambling pleasure, investment thinking, mass behavior, having foresight, imagery, false excitement, false self-confidence, bias towards the past, novelty, mental accounting, empowerment, transactional asymmetry, similarity error, amber effect, gambler's illusion, motivation, time horizon, initial profit

effect, experience, age, gender, and analysis. Based on the research results, individual investors can improve the quality of their decision-making and make better investment decisions by identifying and reducing their mental strains by implementing the presented strategies. These strategies include self-awareness, note-taking, knowledge of the capital market, concentration, overview, patience, acceptance and examination of mistakes, self-reliance, consultation, criticism, flexibility, study, diversification, and distraction. Bekhardi Nesab et al. (2019) showed that the conflict of interest between the manager and the owner had a negative effect on the investors' reaction, and the investor's support directly affected the investors' reaction. Also, another result of the research has been that the positive effect of investor support and the negative effect of the conflict of interests between the manager and the owner on the reaction of investors during the economic recession are strengthened. Finally, the interaction effect of investor support and the conflict of interests between the manager and the owner during the economic recession has had the opposite effect on the investors' reaction. Hassas Yeganeh et al. (2018) identified and evaluated the behavioral financial factors affecting the investment selection of angels. After studying the background and literature of the subject, they provided a total of 23 behavioral financial variables to a Delphi group. After reaching a consensus and removing some variables, they compiled a research questionnaire and used a sample of 183 people from Angeles based on behavioral financial factors. The effect on their decisions was investigated and questioned. Next, the collected data were first analyzed using exploratory factor analysis. Seven hidden factors, including hope, hindsight, overconfidence, simplicity, risk-taking, mental accounting, and self-documentation, were identified as behavioral financial factors affecting angels' decisions. Then, a hypothesis with the theme of investigating the possibility of limiting the variables to seven factors was tested using confirmatory factor analysis. Finally, these number of factors were confirmed again. Dadras et al. (2018) showed that internal and external studies had identified relatively similar influential factors such as financial ratios, recommendations, behavioral trends, etc. Also, the effect of demographic factors on investors' behavior in the Tehran stock market has yet to be studied. Miralavi and Pourzmani (2018) showed that all factors except the overconfidence factor influenced investment and the extent of this effect for each of them, including relative profit and loss factors, tendency effect, conservatism, mass behavior, agency intuition, ownership effect, and the avoidance of regret has been different. Among these factors, relative profit and loss have the most significant effect. The factor of regret avoidance has had a minor effect on the investment of financial assets in the stock exchange, directly affecting the stock price index. Gurjizadeh and Khanumahdi (2016) showed that, in order, the amount of current return obtained by the investor in the stock exchange, savings, years of presence in the stock exchange, income, and investment horizon had the most significant effect on the amount of investment of people in the stock exchange. Gharib Lo and Sharfi (2013) showed that Sunday had a strong effect and Saturday had a semi-strong effect compared to other days of the week, and the average efficiency was lower than other days. Wednesday also showed a strong effect compared to other days of the week, and its average yield was higher than other days. Regarding the volume of transactions, there was also the effect of Saturday and Wednesday, so the average of transactions on Wednesday was higher than on Saturday. These effects showed the shareholders' hopes on Wednesday regarding obtaining higher returns in the coming week, buying more shares, and the loss of their hopes in the first week regarding higher returns and selling their shares.

3. Research method

The time dimension includes cross-sectional research and the year 2023; the interviews and questionnaires were prepared in 2023. Therefore, regarding the method and nature of data collection, it is descriptive, which includes a set of exploratory factor analysis methods to describe

the research subject. The first stage was done qualitatively to develop knowledge of traders' behavior. From the point of view of the implementation process (type of data), this research is a type of mixed research, and at the same time, a qualitative and quantitative approach was considered. The first part (data) was collected through interviews. Also, this section includes analytical and interpretation methods used to reach findings or theories. These methods include methods of conceptualization of data, which is expected for coding. Open, central, and selective coding methods have been used in this research. The last part of the first stage of the research consists of written reports or drawing diagrams and figures with oral presentation, which is used in this research using the graphical method. Then, using a researcher-made questionnaire, the analysis and confirmation of the components in the broader society were discussed. Also, from the point of view of the result of the implementation, the current research is of a fundamental type, which is carried out to discover the nature of the phenomena. From the point of view of implementation logic (or type of reasoning), it is of inductive type because, in this research, the interviewees provide explanations regarding the results of the phenomena according to their experience. According to Table 1, The statistical population of the qualitative stage of the research includes the leading experts and activists in the field of behavioral finance in the country, including university professors who teach investment courses at the graduate level, as well as managers of official capital market brokerages and capital market analysts, who at this stage, according to the goal The research uses snowball or chain sampling method to select research experts. In the second stage of the research, the identified influential factors were provided to more than 400 experts and capital market activists, and 340 questionnaires were tested according to the process of reliable information.

In the interview process, first, several knowledgeable persons with financial and accounting education and sufficient experience (teachers of financial and investment courses in graduate school, managers of official capital market brokerages, and official capital market analysts) and related to the subject in a targeted manner by the professors The guide and consultant were proposed and adapted based on the conditions of the statistical sample and then selected, and at the end of the interview, they were requested to introduce other informed and knowledgeable people regarding the subject of the research. The interview continued until a new idea was obtained; theoretical adequacy or theoretical saturation occurred. It should be noted that the repetition of codes was observed in 16 interviews. However, the data collection process continued until the 21st interview to ensure complete theoretical saturation, so a total of 21 interviews were conducted, and the information related to the characteristics of the interviewees is shown in Figure 1.

Table 1. The employment status and educational qualifications of the participants in the research

Job position/Education	PhD	Master's	Total
University faculty	14		14
Broker managers and capital market analysts	2	5	7
Total			21

Table 2. The amount of work experience (in terms of years) of the participants

Description	Frequency – work experience in terms of year
Over 25 years old	6
20-25 years	5
10-20 years	8
under 10 years old	2
Total	21

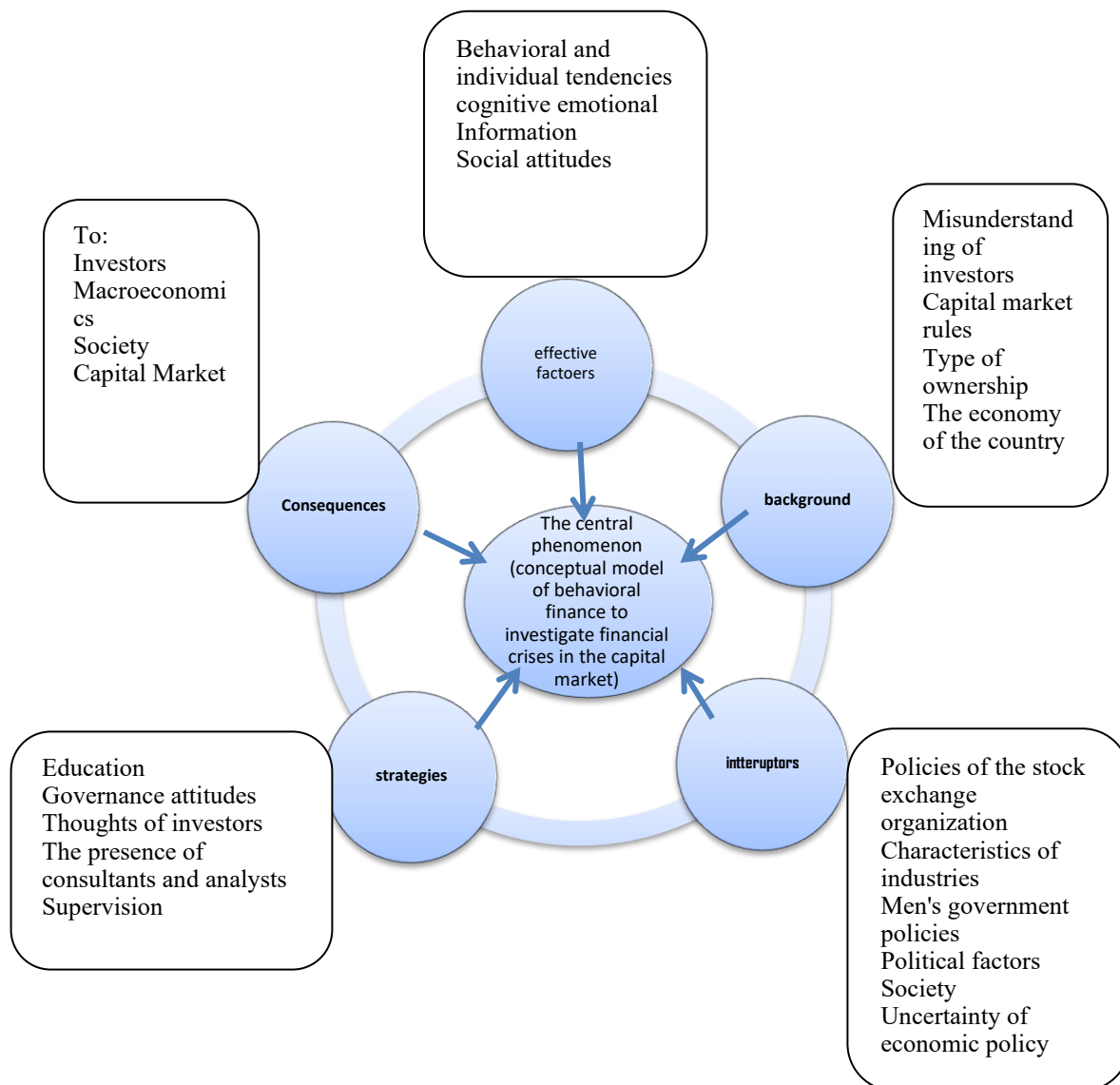


Figure 1. Paradigm model of emotional and cognitive biases in capital market crises

According to Table 2, The average duration of the interviews was 48 minutes. The total frequency of concepts extracted from open interviews (taking into account similar codes) is 72 concepts (central coding), which were classified into 32 categories (selective coding) and averaged about seven new concepts (subcategory) from each interview. Was extracted, and each concept was repeated four times on average.

Data analysis in grounded theory is done through three stages of coding. The first step is to find conceptual categories in the data at the initial level of abstraction. The second step is to find connections between these categories, and the third step is to conceptualize and report these connections at a higher level of abstraction. It is worth noting that these steps are not necessarily done sequentially but overlap and are done simultaneously. The questions asked at this stage are:

- What causes emotional and cognitive bias in Iran's capital market crises?
- What are the contexts of emotional and cognitive bias in Iran's capital market crises?

- What are the appropriate strategies for recognizing emotional and cognitive biases in Iran's capital market crises?
- What are the behavioral financial intervention factors from the cognitive dimension in Iran's capital market crises?
- What are the consequences of behavioral financial biases in Iran's capital market crises?

The stages of coding and analysis are as follows (Dadashzadeh et al., 2019):

Open coding is crushing, comparing, conceptualizing, and categorizing data. The open coding method not only leads to the discovery of categories but also clarifies their characteristics and dimensions. This text coding is done after repeated and detailed reading of its items, where the meaningful units are introduced, explained, and named. These units may be words, phrases, or larger pieces of text. The researcher can reach tens or even hundreds of conceptual labels in the research process. These concepts must be classified. Concepts are categorized and classified based on their similarities, which is called categorization. When concepts are compared with each other and appear to be related to similar phenomena, categories are discovered, and thus, concepts are grouped in a higher order. A category is a concept that is more abstract than other concepts; That is, the title abbreviated to the categories is more abstract than the concepts that make up the set of that category. Categories have high conceptual power Because they can collect concepts and sub-categories on their axis. Therefore, this type of coding has created a set of conceptual categories. Then, these concepts with commonality were classified at a higher level (Bazargan, 2013).

The main sentences were extracted and coded from the interview text in the open coding stage. For example, the coding process is presented in the following quote:

Financial behavioral patterns have different forms. If, in general, we consider investors' decisions far from logic and rationality, the issue of behavioral biases or behavioral distortions of investors is raised. These behavioral biases can have different forms, and various studies have studied them. Among these biases is the excessive conservatism of investors...

In this quote, investors' excessive conservatism is presented as the concept of infrastructure in the form of causal factors.

In another quote:

Let us separate emotional and cognitive factors from behavioral factors. Including gender, age of people, experience of investors, and financial knowledge, which are influential factors...

In this quote, concepts such as gender, people's age, investors' experience, and financial knowledge were introduced as causal factors.

Axial coding is a series of procedures after open coding to connect information in a new way by establishing links between categories (Bazargan, 2013). In axial coding, extracted categories are presented around the axes of "causal" conditions, "phenomena", "substrate", "intervening" conditions, "strategies," and "consequences."

.... The policies of the stock exchange organization require companies to report promptly.

Industries have characteristics, such as rules and regulations and intensity of competition, which can be very effective in improving performance and attracting capital.

... Upstream laws, including commercial law requirements in corporate governance, auditing, and inspection of companies, can be effective.

Government policies can effectively stabilize investment and encourage investors towards a safe and stable future. Policies that provide stability and a bright future for investors...

In this quotation, the concepts of stock exchange organization policies, industry characteristics, etc., were raised as factors of strategies. Common perceptions in executive bodies and program and budget organizations are considered intervening factors.

Selective coding involves regularly selecting the core category and relating it to other categories,

validating the relationships, and filling the empty spaces with categories that need to be modified and expanded (Bazargan, 2013). This type of coding analyzes the storyline and explains the relationships between extracted categories.

In order to validate the findings, the following steps were taken:

Reliability: Reliability refers to the consistency of research findings. In the present study, retest reliability was used. About one-third of the interviews (i.e., six interviews) were randomly selected, and each of them was conducted twice in a 2-week interval by the researcher and supervisors, as well as three independent people, including two random interviewees (participants) and one A statistical analyst (outside of the participants) coded.

Validity: To increase the reliability of the research findings, the interview protocol included starting the interview, entering the discussion, and examining the questions. The researcher was a guide during the interviews, so there was no scattering and fluctuation. On the other hand, by specifying the main points of the interview, the researcher was free to ask his questions. Therefore, the validity of the research has been preserved in each axis. The researcher's independence from the research subject and eliminating bias and unnecessary presuppositions are the most essential elements of reliability in qualitative research. The validity of the research was done on two levels after extracting the primary codes. First, the contributors, the collected data, analyses, interpretations, and conclusions were presented to 6 participants and independent foreign people who had the most knowledge about the subject according to the interview method, and they were asked to judge its authenticity and validity. Review by external audit: The opinions of respected professors and advisors who are experts in the field of research were reviewed, and the results were announced and modified in different time frames to ensure the necessary validity.

In the second research stage, a questionnaire containing 36 items extracted from the first stage was compiled and distributed among more than 400 people with the guidance of supervisors, advisors, and some experts active in the research process. Among the received questionnaires, 340 had the required accuracy and reliability in the exploratory analysis process, 53% of which were completed by men (180 out of 340 correct questionnaires) and 47% by women. Table 3 shows the sociological status of the active people in the correct questionnaires regarding occupation, level of education, and level of activity in the capital market.

Table 3. Sociological quantitative research stage

Occupation	Description	no.	Education	Description	no.	Activity in the capital market	Description	no.
	University professor	52		Bachelor's degree or less	92		Less than 5 years	24
	the manager	24		Master's degree	160		Between 5 and 10 years	82
	Official accountant	65		Doctoral student	66		Between 10 and 20 years	100
	Capital market expert	87		PhD	22		Over 20 years old	134
	Financial Expert	112		Total	340		Total	340
	Total	340						

According to the above paradigm model, they designed a questionnaire with 36 items to identify the key factors and provide them to the community. To check the validity of the research questions, the opinions of four respondents who were experts in the above field, as well as the opinions of supervisors and advisors, were used. The results obtained from the exploratory analysis and the assumptions are presented below.

4. Findings

4.1 Cronbach's alpha test

According to Table 4, In the present study, to determine the reliability of the questionnaire, Cronbach's alpha was calculated, and its value was (0.906). The closer Cronbach's alpha index is to one, the higher the internal correlation between the questionnaires will be, and, as a result, the questions will be more homogeneous.

Table 4. Determining the reliability of the questionnaire

No. of questions	Cronbach's Alpha
340	0.906

The exploratory factor analysis method was used to analyze the data in the present study. The purpose of the factor analysis method is to obtain a set of variables based on a smaller number of hypothetical variables. In other words, in factor analysis, many variables are expressed in terms of a small number of dimensions or structures. The mentioned structures are called agents. In this situation, factor analysis can be used to reduce the amount of data as much as possible and achieve the lowest factors that can explain the observed covariance. It is also a tool to reduce the amount of data as much as possible. This factor analysis method is exploratory, called exploratory factor analysis (Pourghaffar et al., 2023).

4.2 Data adequacy test

Before doing the factor analysis, ensure the available data is suitable. For this purpose, we use KMO indices and Bartlett's test. According to the value of the significance level, we conclude that the desired data are suitable for sampling. According to Table 5, The KMO test shows whether the number of sample data is suitable for factor analysis or not. The value of this index is variable in the range of zero to one. If the value of the index is close to one (at least 0.6), the desired data are suitable for factor analysis. Otherwise (usually less than 0.6), the factor analysis results are unsuitable for the data (Pourghaffar et al., 2023).

Table 5. KMO sampling adequacy test

Kaiser, Meyer Olkin and Bartlett test		
The value of the Kizer, Mir and Olkin sampling adequacy test		0.653
Bartlett test value	Chi-square statistic value	7270.103
	Degrees of freedom	630
	Significant level	0.000
a. Based on the correlation coefficient		

Considering that the result of the KMO test is equal to (0.723), it shows that the number of data is sufficient and suitable for factor analysis.

4.3 Bartlett's test

Bartlett's test tests the hypothesis that the "correlation matrix of observed variables is unity." This test confirms that the variables are unrelated, which is obtained through the significance of the chi-square test. Suppose the significance level in Bartlett's test is less than 5%. In that case, the correlation matrix will not be the same, which means there is a relationship between the variables, and the statistical null hypothesis will be rejected (Pourghaffar et al., 2023). According to Table 6, the significance level of the test is (0.000), which means that the null hypothesis is rejected and there is a significant relationship between the variables.

Table 6. The results of extracting components using the principal component method

How to communicate with foundation data approach questions	Question	component	Initial extraction			Extraction after varimax rotation		
			total	variance percentage	density percentage	total	variance percentage	density percentage
Effective factors	1	Investors' conservatism and overconfidence are factors influencing the attention to the behavioral finance approach in the financial crisis of the capital market.	8.847	24.576	24.576	8.847	24.576	24.576
	2	The prominence effect of a share is one of the factors influencing attention to the behavioral finance approach in the financial crisis of the capital market.	2.667	7.435	32.011	2.677	7.435	32.011
	3	Time limitations are one of the most effective factors in paying attention to the behavioral finance approach in the capital market during a financial crisis.	2.407	6.687	38.698	2.407	6.687	38.698
	4	Intellectual biases are one of the most effective factors in paying attention to the behavioral finance approach in the capital market during a financial crisis.	2.299	6.387	45.085	2.299	6.387	45.085

5	Risk aversion and loss aversion of investors are effective factors for paying attention to the behavioral finance approach in the capital market during a financial crisis.	1.98 0	5.500	50.585	1.98 0	5.500	50.585
6	Selective desirability is one of the factors influencing attention to the behavioral finance approach in the financial crisis of the capital market.	1.67 4	4.650	55.236	1.67 4	4.650	55.236
7	Limited rationality and emotional tendencies are effective factors in paying attention to the behavioral finance approach in the financial crisis of the capital market.	1.49 4	4.150	59.386	1.49 4	4.150	59.386
8	Mental accounting is one of the effective factors in paying attention to the behavioral finance approach in the financial crisis of the capital market.	1.36 7	3.798	63.184	1.36 7	3.798	63.184
9	Culture is one of the factors influencing attention to the behavioral finance approach in the capital market during a financial crisis.	1.22 3	3.398	66.582	1.22 3	3.398	66.582

10	People's gender can be one of the effective factors in paying attention to the behavioral finance approach in the financial crisis of the capital market.	1.17 6	3.268	69.850	1.17 6	3.268	69.850
11	People's age can be one of the effective factors in paying attention to the behavioral finance approach in the financial crisis of the capital market.	1.02 1	2.836	72.686	1.02 1	2.836	72.686
12	The investors' experience can be an effective factor in paying attention to the behavioral finance approach in the financial crisis of the capital market.	0.97 4	2.705	75.391			
13	Investors' financial knowledge can be one of the effective factors for paying less attention to the behavioral finance approach in the financial crisis of the capital market.	0.94 3	2.620	78.012			
14	Ambiguity avoidance of investors is one of the effective factors for paying attention to the behavioral finance approach in the financial crisis of the capital market.	0.86 0	2.389	80.401			

	15	Investors' individualism is one of the factors influencing attention to the behavioral finance approach in the capital market during a financial crisis.	0.69 6	1.934	82.335			
	16	Information asymmetry and quality of information can be effective factors for not paying attention to the behavioral finance approach in the financial crisis of the capital market.	0.65 3	1.813	84.148			
	17	The development of financial institutions and investment is one of the effective factors in paying attention to the behavioral finance approach in the financial crisis of the capital market.	0.61 6	1.712	85.860			
Background factors	18	Investors' misperceptions and conservatism, including the importance of stocks, can be one of the background factors for paying attention to the behavioral finance approach in the capital market.	0.57 7	1.602	87.462			

	19	Incomplete rules of the capital market, including the lack of licensed financial analysts, current rules, and the lack of a comprehensive investment plan, can be one of the background factors in considering the behavioral finance approach in the capital market and its crisis.	0.51 2	1.422	88.884			
	20	The type of ownership, both governmental and the presence of institutional investors in a company, can create the foundation for attention and movement towards behavioral finance.	0.49 3	1.368	90.252			
	21	The country's economy, including the unfavorable economic instability and business models, can be the basis for moving towards behavioral finance in the capital market.	0.42 0	1.167	91.420			
Interfering factors	22	Stock exchange policies in reporting and mandatory regulations can be an intervening factor in paying attention to behavioral finance.	0.39 7	1.102	92.522			

	23	The characteristics of industries and competition in the product market can be intervening factors that need to be considered in behavioral finance.	0.349	0.969	93.491			
	24	Government policies in the discussion of investment can be one of the factors that interfere with paying attention to behavioral finance.	0.307	0.853	94.344			
	25	Political factors, including interaction with the world and sanctions, can interfere with investors' attention to behavioral finance.	0.280	0.778	95.122			
	26	Society and its beliefs can be one of the intervening factors in paying attention to the behavioral finance approach and financial market crises.	0.269	0.747	95.869			
	27	Uncertainty of economic policy can be one of the intervening factors in paying attention to the behavioral finance approach and financial market crises.	0.248	0.689	96.558			
Strategies	28	Proper education is one of the factors that can affect the capital market's financial crisis.	0.209	0.581	97.139			

	29	Governance attitudes towards the stock market and investment can be based on using behavioral finance as a threat and an advantage in the capital market.	0.190	0.528	97.668			
	30	The investment culture of a society can be one of the strategies for optimizing the behavioral finance approach in the capital market.	0.169	0.468	98.136			
	31	The presence of consultants and financial analysts can strengthen the behavioral finance approach in the capital market.	0.158	0.439	98.574			
	32	Professional supervision can strengthen the behavioral finance approach in the capital market.	0.150	0.418	98.992			
Consequences	33	Behavioral finance has favorable and unfavorable consequences for investors.	0.118	0.327	99.319			
	34	Behavioral finance leads to a loss of trust in macroeconomics.	0.106	0.296	99.614			
	35	Behavioral finance affects the economy of households and society.	0.093	0.258	99.872			
	36	Behavioral finance will affect capital market management.	0.046	0.128	10.000			

The above Table shows a table of commons in the state without rotation. The commonality of a

variable is the square of multiple correlations for the corresponding variable using factors, so it is a proportion of the desired test variance estimated by the common factors extracted in factor analysis. For example, in the extracted values column of question 11, it can be seen that 72% of the variance of the scores of question 11 is the variance of the common factor. The column of initial values reports all the shares before extraction, so all of them are one.

At this stage, using the principal components analysis method, 11 critical factors were identified in Table 7, and these 11 factors explain 72.686% of the total variance. The first factor, with a value of 24.576, shows the highest variance, and the eleventh factor, with a value of 2.836, shows the lowest variance.

In the following, the relevance of the main findings of the research is examined.

Table 7. Correlation of the main findings with all items

Question	1	2	3	4	5	6	7	8	9	10	11
1	0.597	0.095	0.002	0.074	0.526	0.034	0.040	-0.107	0.056	-0.080	-0.021
2	0.555	0.243	-0.145	0.195	0.260	0.307	0.115	-0.144	0.114	-0.041	-0.172
3	0.625	-0.111	-0.007	-0.226	0.088	0.0254	0.034	0.104	0.243	-0.204	0.143
4	0.557	-0.114	-0.219	0.118	0.246	-0.346	-0.203	-0.147	-0.037	-0.220	-0.035
5	0.506	0.098	-0.196	0.040	0.363	-0.280	-0.330	-0.168	-0.363	0.137	0.065
6	0.489	-0.235	-0.128	0.346	-0.215	-0.280	0.231	-0.031	0.024	0.106	0.125
7	0.566	-0.321	-0.270	-0.357	0.091	0.146	0.080	-0.189	-0.008	0.137	-0.088
8	0.459	-0.287	-0.091	-0.478	0.138	0.269	0.212	-0.110	-0.125	-0.095	0.154
9	0.243	0.014	0.579	-0.397	0.099	0.025	0.292	0.071	0.025	-0.062	0.314
10	0.419	-0.261	0.520	0.240	0.153	0.253	0.005	-0.129	-0.002	-0.238	-0.255
11	0.415	-0.295	0.393	0.340	0.298	0.316	0.010	-0.021	-0.028	0.122	0.089
12	0.329	0.485	-0.181	0.081	0.422	-0.186	0.057	0.087	0.314	-0.134	0.241
13	0.242	-0.020	0.246	0.009	0.276	-0.408	0.434	0.227	0.031	0.178	-0.083
14	0.623	-0.084	-0.211	0.007	0.010	0.185	-0.028	0.442	-0.283	-0.152	0.105
15	0.476	-0.344	-0.055	-0.347	0.124	0.049	-0.289	0.345	-0.260	0.008	0.011
16	0.455	-0.075	-0.068	-0.341	-0.226	0.233	-0.096	-0.300	0.174	0.349	0.320
17	0.323	-0.287	-0.088	0.365	0.047	0.238	0.026	-0.066	0.072	-0.010	0.177
18	0.565	-0.210	0.339	-0.141	-0.027	-0.250	-0.213	-0.288	0.045	-0.055	0.176
19	0.593	0.225	-0.388	-0.161	0.128	-0.142	-0.150	-0.129	-0.084	-0.128	-0.114
20	0.524	0.118	0.128	-0.371	0.037	0.347	-0.101	0.099	0.029	-0.016	-0.315
21	0.311	0.373	-0.405	0.265	-0.023	0.285	0.215	-0.111	-0.358	0.090	-0.041
22	0.454	0.211	-0.143	0.235	-0.494	-0.094	0.056	0.102	0.013	-0.378	0.322
23	0.545	-0.062	0.227	0.273	-0.291	-0.101	-0.016	-0.204	-0.310	-0.342	0.089
24	0.497	0.267	0.334	0.068	-0.206	-0.161	-0.475	-0.120	0.139	0.155	-0.129
25	0.422	0.388	0.108	0.366	-0.001	0.237	-0.202	-0.218	0.238	0.228	0.162
26	0.567	0.158	0.348	0.174	0.035	-0.102	0.225	0.195	-0.268	0.168	0.113
27	0.413	0.422	0.299	0.221	-0.351	0.294	-0.063	0.257	-0.170	0.164	-0.037
28	0.417	0.625	-0.118	-0.147	0.163	-0.127	0.173	0.170	0.030	0.202	-0.113
29	0.594	0.158	0.027	-0.291	-0.339	-0.040	-0.303	0.266	0.101	-0.158	-0.122
30	0.614	0.290	0.431	-0.295	-0.080	-0.244	0.103	-0.077	-0.059	0.076	-0.112
31	0.563	0.191	-0.276	-0.259	-0.286	0.154	0.342	-0.187	0.065	-0.148	-0.145
32	0.394	0.002	-0.072	-0.242	-0.367	-0.205	0.354	-0.215	0.118	0.009	-0.185
33	0.458	-0.327	-0.123	0.108	-0.159	-0.251	0.054	-0.030	-0.214	0.402	-0.100
34	0.597	-0.420	-0.011	0.279	0.077	-0.080	0.126	0.010	0.151	0.001	-0.273
35	0.568	-0.255	-0.084	0.283	0.013	-0.057	-0.062	0.378	0.405	0.008	-0.160
36	0.480	-0.280	-0.363	0.027	-0.122	0.066	-0.088	0.255	0.196	0.276	0.174

Pearson's correlation component matrix shows the relationship between observations and components. These correlations are called factor loading. The factor loadings of 11 confirmed variables show that column one, with the title of conservatism and overconfidence of investors, is

one of the influential factors in paying attention to the behavioral finance approach in the financial crisis of the capital market, which has a direct relationship with all the items, while in the analysis of the item 2 Accounting conservatism can lead to a reduction of intellectual prejudices and risk aversion in the share.

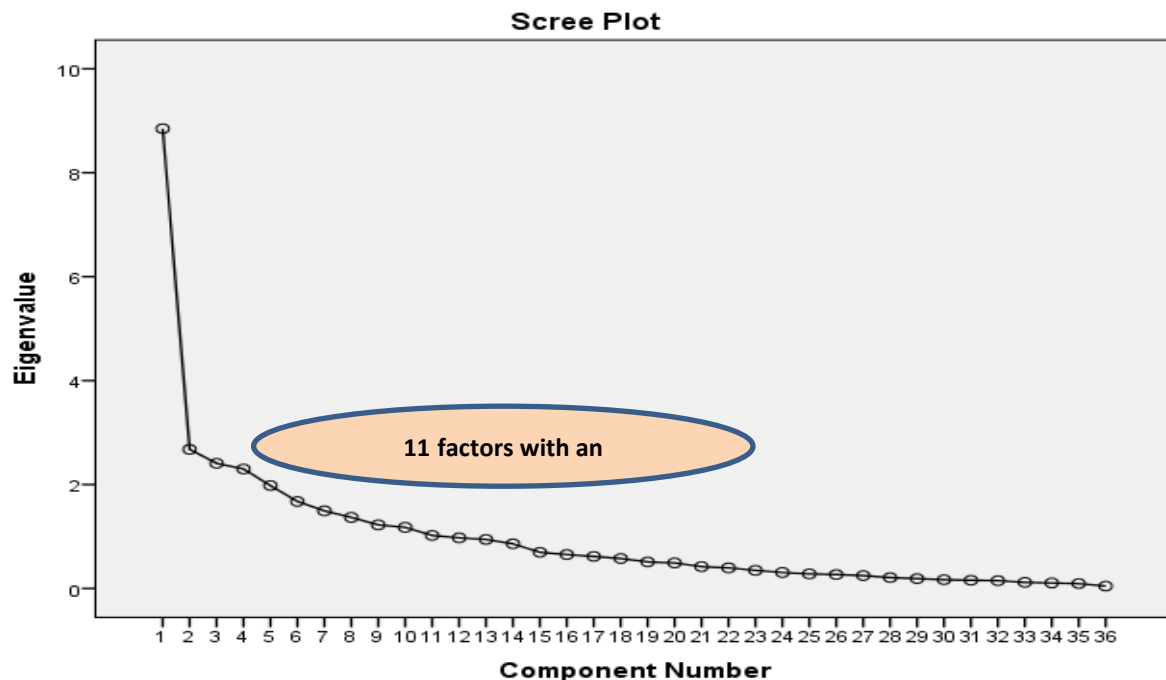


Figure 2. Gravel diagram (scree plot)

According to Figure 2, This rock diagram (pebble) shows the eigenvalue image in each extracted component. It starts from the largest eigenvalue and is always a descending one. The eigenvalue drops rapidly when the following factors are extracted. The eigenvalue of the tenth factor is less than 1.

According to Table 8, According to the obtained results, the model of effective behavioral financial indicators with an emotional-cognitive approach and its role in the capital market crisis (11 factors) is as follows:

5. Conclusion and recommendations

Anticipation and appropriate handling of financial crises in the capital markets has always been the concern of shareholders, analysts and financial advisors of the capital market. In this research, according to the fundamental role of behavioral financial components in the financial crisis, investors' emotional and cognitive dimensions were identified. It was determined that psychological dimensions play an essential role in modern financial decision-making. Since cognitive errors and deviations affect investment theories, they also affect financial options. Today, thinking about the utterly rational behavior of investors (who constantly seek to maximize utility) is not enough to justify the behavior and reaction of the markets, so behavioral finance can be considered a paradigm by which financial markets are affected. Behavioral finance abandons the traditional paradigm's two central and limiting assumptions, i.e., maximization of expected utility and complete rationality. Also, the confrontation of these two theories in price bubbles in the market has revealed the existence of excessive fluctuations in stock prices and more (less) reaction of investors to new

information. Even behavioral finance is opposed to modern finance. Modern financial theory states that the stock market is efficient and stock prices reflect all available information. In contrast, behavioral finance theory claims that psychological and emotional factors can influence stock prices. Behavioral finance claims that sometimes, to find answers to empirical puzzles in finance, it is necessary to accept the possibility that some economic factors are not subject to investors and market agents.

Table 8. The effective indicators of behavioral finance with an emotional-cognitive approach and its role in the capital market crisis

Behavioral and individual tendencies such as conservatism and overconfidence of investors, salience effect, time limitations, thought biases, risk aversion and loss aversion of investors, favoritism of limited rationality and emotional tendencies, mental accounting and culture are effective factors. It is cognitive-emotional on the financial crisis in Iran's capital market.
Cognitive-emotional factors such as gender, age of people, investors' experience, financial knowledge of investors, ambiguity avoidance, and individualism are cognitive-emotional effective factors in the financial crisis in Iran's capital market.
Information and its features, such as information asymmetry and the quality of information provided by companies, are cognitive-emotional factors affecting the financial crisis in Iran's capital market.
The misperception and misperception of investors, such as excessive conservatism of investors, salience effect and emotional feelings, can be the basis for moving towards the financial crisis of the capital market from the emotional-cognitive dimension.
Laws and regulations, including the lack of licensed analysts in the market, momentary decisions of the legislator, and the lack of a comprehensive plan of the legislature can be the basis for moving towards the financial crisis of the capital market from an emotional-cognitive perspective.
The type of ownership, such as the presence of institutional investors and government ownership, can be the basis for moving towards the financial crisis of the capital market from an emotional-cognitive perspective.
The country's economic conditions, including the unfavorable and unstable situation and the patterns of earning in the economy, should be the basis for moving towards the financial crisis of the capital market from the emotional-cognitive dimension.
The policies of the stock exchange organization can be one of the intervening factors in the capital market crisis from the emotional and cognitive dimensions.
The characteristics of industries can be one of the intervening factors in the capital market crisis from the emotional and cognitive dimensions.
Government policies can be one of the intervening factors in the capital market crisis from the emotional and cognitive dimensions.
Political factors can be one of the intervening factors in the capital market crisis from the emotional and cognitive dimensions.

Proponents of behavioral finance firmly believe that one of the influential factors in the emergence of behavioral finance is the discussion of financial crises. Financial crisis refers to a wide range of situations where some financial resources lose a large part of their nominal value. So, the financial crisis 2008 and the Great Recession are still fresh in many investors' memories. Hibti and Zandieh (2018) showed that instead of rational behavior in markets affected by the financial crisis and severe bearish markets, investors will be associated with an overreaction bias (occurs when stock prices increase more than what is rationally expected concerning new information) is going to change and is usually accompanied by a price reversal) Moreover, investors are making things worse instead of being rational with more excitement. On the other hand, many panicked investors are forced to sell their assets at a lower price, and a small group of patient investors consider the stock market's fall as an opportunity. They can benefit from more profit by investing at the price floor. One of the reasons for the different approaches of investors in this situation is the emotional and cognitive approaches that lead to their wrong decisions. In this regard, in the second stage of the research, by designing a researcher-made questionnaire (taken from the extracted

concepts of the qualitative model) consisting of 36 items and distributed among more than 400 financial experts active in the capital market and receiving 326 responses that met the validity and reliability criteria. It was concluded that the following criteria are the most explanatory in the behavioral financial sector of Iran's environment. These criteria are:

- Behavioral and individual biases such as conservatism and overconfidence of investors, salience effect, time limitations, thought biases, risk aversion and loss aversion of investors, preference selection of limited rationality and emotional tendencies, mental accounting, and culture are among the cognitive-emotional factors on the crisis Finance is in Iran's capital market.

Cognitive-emotional factors such as gender, age of people, investors' experience, financial knowledge, ambiguity avoidance, and individualism are influential cognitive-emotional factors in the financial crisis in Iran's capital market.

- Information and its characteristics, such as information asymmetry and the quality of information provided by companies, are cognitive-emotional factors affecting the financial crisis in Iran's capital market.

- Investors' incorrect knowledge and perception, such as the excessive conservatism of investors, the effect of salience, and emotional feelings, can be the basis for moving toward the financial crisis of the capital market from the emotional-cognitive dimension.

Laws and regulations, including the lack of licensed analysts in the market, momentary legislative decisions, and the legislator's lack of a comprehensive plan, can be the basis for moving toward the financial crisis of the capital market from an emotional-cognitive perspective.

From an emotional-cognitive perspective, the type of ownership, such as the presence of institutional investors and government ownership, can be the basis for moving toward the capital market's financial crisis.

- The country's economic conditions, including the unfavorable and unstable situation of the economy and the patterns of earning money in the economy, should be the basis for moving towards the financial crisis of the capital market from an emotional-cognitive perspective.

- The policies of the stock exchange organization can be one of the intervening factors in the capital market crisis from the emotional and cognitive dimensions.

Therefore, after receiving the Nobel Prize from Richard Thaler in behavioral finance, it can be concluded that behavioral finance is an integral part of the capital market. A severe competitor to the efficient market hypothesis is raised, which should be considered in decisions. Therefore, the following proposals are presented to the beneficiaries.

Potential investors:

In the past decades, investors have been the central pillar of the capital market. No one can argue that investors' behavior has little effect on the market and the components introduced by elites are suggested to potential investors because they will only be meaningful with investment. After receiving the Nobel Prize from Kahneman and Tversky (2013), financial science has bowed its head and accepted that human behavior should be investigated before behavioral finance and the investigation of human behavior in the investment environment. The behavior of capital market activists in the environment is affected by various factors, and based on the findings of the current research, attention should be paid to the sanctioned and inflationary economy, the lack of dynamics of capital market rules, the incorrect knowledge and perception of investors, the type of ownership of stock companies by investors to avoid behavioral distortions. Moreover, be able to have a reliable investment.

Analysts:

Capital market analysts need information that can also measure investor behavior. In this regard, using the findings of the current research, they are emphasized to examine all aspects of the environment and actors of the capital market using the extracted qualitative criteria so that they can provide a suitable platform for investment.

Capital market legislator:

Investors need reliable rules for safe investment; they show a risk-averse attitude when investing and prefer more uniform and stable risk. Due to low-risk perception, market participants tend to herd behavior, negatively affecting their investment decisions. Also, investors tend to overreact to negative news and underestimate the likelihood of rare events leading to inefficient markets and adverse investment decisions. All these and other factors require the legislator to adopt laws so that investors are examined psychologically when they enter the capital market, and their behavioral results are evaluated for entering the capital market to create a healthier environment for investment. It is suggested that the fields of investment be introduced according to the individual-cognitive criteria of people, which is necessary to use the opinions of psychology, sociology, and finance experts in the investment process. This importance can be more effective in block and collective investments. To create the necessary awareness, investors should be prepared for optimal investment through media and university education.

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RESEARCH ARTICLE

Comprehensive Identification and Ranking of Factors Affecting the Credibility of Financial Reports in Iran in the Light of Stakeholder Theory and Organizational Legitimacy Theory

Ali Mostafaei, Ali Akbar Nonahal Nahr*, Fazel Mohammadi Nodeh

Department of Accounting, Qazvin Branch, Islamic Azad University, Qazvin, Iran

Department of Accounting, Bostan Abad Branch, Islamic Azad University, Bostan Abad, Iran

Department of Management, Lahijan Branch, Islamic Azad University, Lahijan, Iran

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Abstract

Financial reports are essential for illustrating social realities and providing a solid informational foundation to meet the demands of financial markets and assess market economic performance. However, financial reports do not fulfill their intended role due to quality, stability, and dynamics issues, and existing literature has yet to offer a suitable framework to address these issues. This study introduces a new concept aimed at enhancing the credibility of financial reports, both now and in the future. Adopting a comprehensive approach, we identify and rank the factors that influence the explanation and realization of this concept. The theoretical framework supporting this new concept includes stakeholder and organizational legitimacy theories. The research methodology comprises two parts: the first involves theme analysis based on interviews with 18 experts, and the second uses the fuzzy Delphi method to analyze and rank components through a questionnaire administered to 60 participants. The four expert groups involved in the study were accounting information providers, accounting information users, independent and internal auditors, and financial and accounting researchers, all carefully selected via snowball sampling for their expertise and insights. The research was conducted in the latter half of 2022. Findings reveal that the factors affecting the credibility of financial reports, ranked by their influence, include profit quality, audit report content, stock status, market performance, the quality of the accounting information system, organizational culture, specific non-financial company characteristics, financial ratios, corporate governance, audit quality, mandatory and optional disclosures, and risk analysis.

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*Corresponding Author: Ali Akbar Nonahal Nahr
 Email: dr.anonahal@gmail.com
 Tel: 09144024859
 ORCID:

1. Introduction

The outcome of the financial accounting process is the delivery of financial information to various users, both internal and external, primarily through financial statements. Specifically, financial reporting encompasses those financial reports created and presented to meet the informational needs of external users. Financial reports aim to address these external users' informational needs and demands. According to the accounting standards drafting board, financial reporting extends beyond financial statements to include informational tools or methods that handle data provided by the accounting system, either directly or indirectly. Financial reports aim to be useful for decision-making (Amir Azad et al. 2019). Statement of Financial Accounting Concepts No. 1 (SFAS1) highlights "significance and effectiveness" and "reliability" as key characteristics that enhance the usefulness of information for decision-making. These features are essential for transforming information into a more valuable product. Without these characteristics, the information is not helpful. Ideally, the accounting method should yield information that possesses both features to be considered beneficial. Reliability is relative and depends on the accuracy of the information, which is determined by how well a measure or figure in the financial statements can be reviewed and verified. This concept is an "honest measurement criterion". Financial market participants require financial information to make economic decisions and are more likely to invest in a unit when this information is deemed valid and of high quality. The primary objective of financial reporting is to facilitate capital exchange between investors and companies. The degree of investor confidence in financial reports is contingent on their validity. Typically, companies ensure the credibility of their financial statements through independent audits, which verify the accuracy of the disclosures. The main aim of auditing financial statements is to validate their credibility. However, the effectiveness of the audit in enhancing financial statement credibility depends on the auditor's independence and the audit's thoroughness. Improved credibility of financial reports can boost investor and creditor confidence, aiding in debt contracts and informing investors about company performance. Consequently, enhanced credibility can improve a company's access to external financial resources, increasing its investment potential for new projects. The validity of financial reports documents and quantifies the capital allocation process. Assessing the economic impact of credit is challenging since, like quality, it is not inherently observable and is an internal and external estimate revealed through financial and non-financial effects (Shroff, 2020). quality as the extent to which financial statements reflect the underlying economic performance of a company, and reporting credibility as the faith investors have in the accuracy of the financial statements presented to them. Theoretically, one of the primary purposes of financial reporting is to facilitate capital allocation by increasing contracting efficiency and reducing information asymmetry among capital market participants (Watts and Zimmerman1978; Kothari et al., 2010). Improvements in reporting quality serve to provide investors with more accurate information and thus can reduce information asymmetry and increase contracting efficiency. Thus, improvements in reporting credibility can increase a company's access to external finance and ultimately increase investment and investment efficiency (Shroff, 2020). Managers and policymakers can provide stakeholders with more transparent information about sustainable development accounting factors by formulating appropriate policies and standards in sustainable development accounting, which leads to social welfare and environmental protection. For future generations, the growth of the capital market and increasing the credibility of financial reports (Abbasi et al., 2021). The literature on accounting and finance frequently discusses the need for distortion-free financial reports (Farouk and Isa, 2018). The rise in accounting scandals globally during the early 21st century highlighted the weaknesses in financial reporting credibility. The surge in fraud cases, compounded by the bankruptcies of major companies like Enron, WorldCom, Adelphi, Cisco, Lucent, and Xerox, raised significant concerns

about financial report reliability. In response, the accounting and auditing professions sought solutions, including shifting from rules-based to principles-based accounting standards, enhancing auditor independence and corporate governance to protect shareholder interests, and regulating the accounting and auditing professions to rebuild public trust (Nikoumaram and Badavar Nahandi, 2009). Opportunistic behavior by managers has further eroded confidence among actual and potential investors. Recent financial scandals have intensified worries about the effectiveness of independent auditors in preventing financial report manipulation, exacerbated by rising audit failures in the capital markets, which has heightened concerns about audit quality (Velury, 2005). Nevertheless, external monitoring mechanisms, such as auditing, are crucial for restoring stakeholder trust (Abdoli and Royae, 2012). However, relying solely on audits for trust in corporate accounting information is insufficient. A comprehensive approach is necessary to assess the credibility of financial reports, considering both quantitative and qualitative factors, including monetary and non-monetary aspects. Measuring financial report quality often involves assessing accrual items and other optional components. Still, credibility can also be gauged through factors such as audit quality, corporate governance, accounting information system quality, stock and market performance, financial ratios, risk analysis, audit report content, organizational culture, profit quality, specific non-financial and financial characteristics of the company, and mandatory and optional disclosures. The accounting and financial literature indicates that assessing financial report credibility needs to be more adequately addressed, revealing a significant gap. Thus, this research aims to develop a suitable model to explain and rank these factors comprehensively. This will advance the accounting and financial literature and open new practical research avenues in accounting, auditing, and finance. Identifying these factors is crucial as they influence investor decisions and other financial report users, enhancing trust in the financial reporting system, leading to more informed decisions, and optimizing resource allocation. Given the importance of financial reporting, the main research question is: What are the indicators and influencing factors in determining the credibility of financial reports, and what is the importance and priority of each?

Top of Form

2. Theoretical literature

To grasp the concept of credibility, one must first understand the concept of truth, which underpins the accounting profession's reputation. Truth in accounting is emphasized in ethical codes, accounting regulations, authoritative texts, and the auditor's issuance of a "true and fair opinion." His classic critique highlighted the crucial role of truth in accounting. Accounting serves as the language of commerce, with accounting professionals acting as translators relied upon by many for accurate information. If these translators fail to convey the truth or present information mixed with partial truths, users may be misled in their decision-making, potentially resulting in significant losses (Nørreklit et al., 2007). The absence of truth or doubt surrounding its presence can profoundly impact the accounting profession, its practice, and its regulation. Truth is a practical and urgent concern in accounting. The primary purpose of financial statements (or financial reports in general) is to deliver financial information based on reliable evidence helpful to existing and potential stakeholders for various purposes, such as management, decision-making, and investment. Thus, truthfulness is essential to financial reports (FASB). Validity is a crucial characteristic of useful accounting information. Information is considered valid when: (1) it is verifiable, (2) it accurately reflects the outcomes of financial and non-financial activities and the financial and non-financial status of a company, (3) its monetary value is significant enough to impact user decisions, and (4) it is objective.

Reliable reports significantly impact stakeholders' decisions and resource allocation. However, the validity of financial reports involves a subjective evaluation of financial and non-financial factors. In other words, the report should be free from manipulation and distortion, accurately reflecting the company's financial status and performance, which enhances its usefulness for forecasting and predicting future cash flows (Damagum et al., 2014). The greater the value and credibility of financial reports, the more reliable the financial statements are for investors, strengthening the connection between financial statement items and stock prices, thereby reducing risk and increasing stock returns. Credibility means financial reports offer reliability and trust, relying on relative assurance rather than absolute certainty. The role of the independent auditor and audit is to enhance the credibility of the financial reports presented by company management for users' benefit (Hasase Yeganeh and Khaleghi Beighi, 2013). Creditors and investors evaluate the creditworthiness of an organization's financial reports before granting loans or investments, considering the type of audit report and the quality of the reports themselves. While financial reports are helpful through auditing, this usefulness depends on the quality of auditing institutions, corporate governance mechanisms, disclosure and transparency levels, and the application of accounting standards, as creditors do not rely solely on audited information (Sheikhi et al., 2022). To ensure desirable financial reporting, it is necessary to have an independent auditor's report, practical cooperation and oversight from internal and independent audit committees, and a solid corporate governance system. Such mechanisms enhance the monitorability of the financial reporting process and help maintain quality and reliability. Corporate governance supports expertise, independence, and a balance of power among board members and committees, acting as the board's supervisory arm and overseeing all aspects of the economic unit. Important corporate governance characteristics and mechanisms related to accountability, transparency, and monitoring include the board members' financial knowledge, the audit committee's presence and independence, and internal and independent audits. The significance of these mechanisms is reflected in the principles and guidelines of corporate governance from regulatory authorities and academic studies (Peyvandi and Khorram, 2014). In the face of competitive pressure and environmental instability, mistakes impacting stakeholders can threaten a business's survival. Focusing on stakeholders can help avoid the costs of conflicting decision-making processes, as comprehensive approaches in stakeholder theory and organizational legitimacy mitigate such conflicts (Bagheri and Sadeghian Nodoushan, 2015).

2.1 Theory of organizational legitimacy

This theory states that an organization is legitimate when its value system is formed according to the accounting system and as a part of society, and where there is a mismatch, the organization's legitimacy is threatened. According to the assumptions of this theory, organizations must be responsive to external demand and society's expectations to maintain their legitimacy (Mehrani Vakrami, 2015). Establishing legitimacy leads to understanding the organization's responsibility and the reliability and trustworthiness of reports (Martens and Bui, 2023). Legitimacy depends on time. What is considered legitimate now may not be regarded as legitimate in the future due to changes in social values (Hoque, 2018); companies must continuously adapt to the needs of society. According to the legitimacy theory, increasing organizational transparency shows that the organization has the same goals as society. When companies strategically use corporate social responsibility reporting, society often considers it credible (Ellerup Nielsen and Thomsen, 2007). According to the legitimacy theory, corporate disclosure responds to environmental forces (economic, social, and political), and disclosures give legitimacy to the relevant actions.

2.2 Theory of organizational legitimacy and credibility of financial reports

Martens and Bui (2023), from the theoretical perspective of the relationship between the legitimacy theory and the credibility of financial reports, state that the application of the legitimacy theory in financial reporting by highlighting the environmental consequences of business increases the awareness of users and ultimately helps the credibility of the company (Martens and Bui, 2023). The information about the organization that is potentially unavailable to the public constantly threatens the company's credibility. As a result, it is reasonable to assume that this information, which was not made public, becomes a time bomb for the organization's reputation and threatens its credibility (Buallay and Ajmi, 2020). According to the theory of legitimacy, disclosing information in annual reports and other methods to legitimize companies' decisions and performance directly affects society's concerns and improves the company's legitimacy. Legitimacy theory explains corporate social responsibility disclosure (Martens and Bui, 2023). Legitimacy theory suggests that businesses must operate within the boundaries of socially acceptable behavior for businesses to succeed. Otherwise, they risk their future profitability. Those with this point of view believe that the voluntary disclosure of a company's social initiatives in its annual report can legitimize that company in the eyes of the public, and the public accepts the credit reports presented by the companies. This helps the managers to shape public opinion. Although financial reporting is mainly based on existing laws and standards, the validity of financial reports based on legitimacy theory can create public trust in companies. This way, organizational legitimacy is expected to increase the company's credibility, and financial reports should be made available to the public.

2.3 Stakeholder theory

Stakeholder theory shows that business entities disclose and report voluntary information to satisfy stakeholders' interests and obtain more information (Buallay and Ajmi, 2020). Since companies and financial institutions have diverse and abundant stakeholders and their stakeholders are more comprehensive than other economic sectors, they must obtain social acceptance, adhere to social contracts with society, and fulfill their stakeholders' expectations. There is also much pressure. Harrison and Van der Laan Smith (2019) believe that the dual application of stakeholder theory in accounting research includes (1) an explanation for reporting the content of financial statements or sustainability reporting and (2) a means to expand accounting practice beyond the priority of stakeholders (holistic view); In other words, it expresses the increase of usefulness in financial reports. Clarke (2014) states that the traditional accounting theory that reflects the rights of the company and the theory of property rights and the maximization of shareholders' wealth are assumed to be synonymous with maximizing the company's value. Still, by paying attention to the theory of stakeholders, it is beyond its traditional position. The theory of stakeholders meets a wide range of needs in accounting that uses models of capital circulation and stakeholders, including social, environmental, public sector, and non-profit disclosures, to increase the usefulness of financial reports.

2.4 Stakeholder theory and credibility of financial reports

Harrison and Van der Laan Smith (2019) state that although the priority of shareholders remains the dominant paradigm, the lack of convergence between the cognitive structure and the cultural and social characteristics of accounting is felt as a kind of backwardness of the stakeholder theory in financial reporting compared to other theories. The goal of financial reporting is to be closely related to the information needs of users, including economic decision-making (in line with the priority of shareholders) and stewardship (in line with the stakeholder theory), has been strongly disputed by the accounting profession, because the presentation of reports based on the perspective

of stewardship has somehow regressed and economic decision-making (aligned with the priority of shareholders) has become the dominant paradigm. Freeman introduced the stakeholder theory in 1984 and considered the principal value of this theory to be social responsibility. For a company to reduce information asymmetry, social responsibility reporting should balance stakeholders and financial reporting. Therefore, stakeholder theory should be applied to companies to facilitate stakeholder communication. Stakeholder theory is essential to corporate social responsibility so the company can maintain its position and reputation in society. The more voluntary disclosures and reports are, the more the stakeholders' trust in the (financial and non-financial) reports is strengthened and ultimately gives credit to the financial reports. Harrison and Van der Laan Smith (2019) state that the flow of financial accounting research shows that stakeholder theory provides a more prosperous and inclusive explanation than economic theories in examining the impact of stakeholders on standard setting, profit management, and voluntary disclosure. Pressure to minimize information asymmetry, reduce transaction costs, reduce unwanted scrutiny by stakeholders, and legitimize actions after a reputational breach, research shows that adopting a strategic stakeholder orientation requires more significant levels of accountability, quality, Higher profits, higher levels of voluntary disclosure and adoption of more conservative accounting; As a result of adopting the theory of beneficiaries, the predictability and reliability of profit and social benefits and these factors increase the credibility of financial reports in the capital market.

2.5 Related studies

Ibikunle Jide and Okoh (2023) examined the impact of independent auditor quality on the credibility of financial reporting in Nigerian banks, analyzing data from 16 banks over a decade, from 2012 to 2021. Their findings indicate that the audit firm's size, tenure, and the auditor's industry expertise significantly affect the credibility of financial reporting in Nigerian banks. However, auditor independence did not have a significant effect on this credibility. Among the statistically significant factors, only the size of the audit firm and audit independence negatively impacted financial reporting credibility. To ensure auditor independence, it is recommended that audit fees be increased, as lower fees compared to the industry average can lead to compromised service delivery and standards.

Yusran (2023) explored the factors influencing the quality of accounting information in stock companies in Indonesia. They used a targeted sampling method to research 126 prominent financial managers and accountants and employed multiple linear regression analysis. Their results, grounded in agency theory, demonstrate that the internal control system, information technology, adherence to accounting standards, and the role of internal auditors positively and significantly impact the quality of financial information. While the competence of human resources also positively affects financial report quality, this effect was insignificant. These findings suggest that improvements in internal control systems, information technology, accounting standards application, and internal auditing enhance financial information quality. Better financial report quality reduces information asymmetry and improves company performance. In contrast, transparency in information, as emphasized by agency theory, aids in managing and holding managers accountable, contributing to overall organizational performance.

Sutrisna et al. (2022) explored the factors influencing the credibility of financial reporting. They found that the competence of human resources, information technology, internal control systems, and adherence to accounting standards all impact financial reporting credibility.

Dachi et al. (2019) revealed that information technology does not enhance or diminish the effect of human resources competence on financial statement desirability. However, it does weaken the influence of the internal control system on financial statement desirability.

Tontiset and Kaiwinit (2018) conclude that accountants' professional ethics, the quality of the accounting information system, an influential audit committee, and the audit firm's quality are crucial for reliable financial reporting. They identified a positive and significant relationship between financial reporting reliability, the audit committee's effectiveness, and the audit firm's quality.

Stein et al. (2017) concluded that the demand for transparency varies among stakeholders. Transparency is essential for public accountability and increasing trust in financial reports. Their study identified transparency factors such as accurate application of standards across the organization, compliance with higher quality standards, principles-based rules, reliability, comparability, fair value reporting, and access to disclosed information. These factors include complete and detailed information, voluntary recognition, openness, and simplicity. They found that transparency factors boost trust by enhancing the credibility of financial reports, improving market performance and investor confidence, creating a level playing field, aligning managerial and agent interests, enhancing decision-making, reducing surprises, and ultimately increasing the credibility of financial statements.

Mehrani et al. (2021) Identifying the components of financial reporting based on the concept of a business model (BM) in this research using the opinion of experts and the method of theme analysis of the following components: 1-Transparency and validity, including full disclosure of information in all business sectors 2- Social accountability, including corporate social responsibility, corporate governance, environmental accounting and sustainable development 3- Justice and fairness in the distribution of social, economic and political reports; 4- Key drivers including the cost structure of income streams and value statement and drivers of assets, liabilities, and equity 5- Presenting and disclosing the reengineering of financial statements and using the SWOT analysis method in business; and 6- Stakeholder management including analysis, participation, interests and expectations of stakeholders were identified.

VafaeiPour et al. (2022) showed that tone management has a significant and opposite effect on the readability of financial reporting. Providing a comprehensive model to measure the readability of financial reporting can increase the understanding and knowledge of investors and researchers in capital markets.

Mohammadian et al. (2022) showed the amount of ownership of institutional investors, the number of company resources from debt, the company's size and age. Among the above 12 indicators ranked using the ordinal priority method (OPA), The indicators of corporate governance, profit management, the accuracy of management forecasts, the amount of ownership of institutional investors, and financial criteria received the top ranks.

Barzideh et al. (2023) have studied the model of disclosure improvement in financial reporting. The research findings are presented using theme analysis in three sections on disclosure platforms in Iran, current problems of disclosure in financial reporting, and solutions to improve disclosure. The existing challenges in implementing standards, reducing the quality of some audit reports, not providing some relevant information, and, in some cases, the existence of information overload are among the existing problems. Improving the process of developing and implementing standards, providing guidelines on disclosure, and improving audit quality can improve disclosure and thus improve the effectiveness of financial reporting.

3. Research methodology

From the point of view of the implementation process (and the type of data), the present research

is qualitative because it collects information about the factors affecting the credit of financial reports through interviews. From the point of view of the result of implementation, it is of a fundamental type, which is done to discover the nature of phenomena and testing theories and expand the existing knowledge. In fact, it creates a conceptual framework so that the factors affecting the credibility of financial reports can be recognized in a comprehensive and grouped manner; From the point of view of execution logic (or reasoning type), it is inductive type; Because in this research, the interviewees, according to their experiences regarding the results of the phenomena, raise the factors affecting the credibility of financial reports, and the researcher compiles the model of financial reports by examining the relationships between these factors; From the point of view of the time dimension, it was temporary; because the interviews were conducted in the last quarter of 2022; From the objective point of view, it is exploratory for three reasons: firstly, less researches have been done on the subject of the research, secondly, this research has led to the presentation of a theory and framework for the credit of financial reports, and thirdly, it has led to the expansion of concepts in accounting texts. There are different methods of theme, each of which follows specific processes. In this research, the proposed 6-step method of Brown and Clark has been used by Hashemi and Ghasemi et al. (2020). This method's theme analysis process is designed in six steps: 1. Getting to know the data; 2. creating primary codes; 3- searching for themes; 4. Revision of themes; 5. Defining and naming themes; and 6. After reviewing the texts and in-depth and semi-structured interviews to analyze the data (interviews), the researcher became familiar with the depth and scope of the data content and began to repeatedly read the data and the data actively (searching for meanings and patterns). Three stages of open, axial, and selective coding were used. This method for analyzing qualitative data is one of the clusters of methods that focuses on identifying the semantic pattern in a data set. This analysis is the process of identifying patterns or themes in qualitative data. The goal of thematic analysis is to identify themes, that is, patterns in important or exciting data, and use these themes to answer research questions or to tell something about an issue (Clarke, 2014). Considering that the principles and rules governing the validity of financial reports reflect the interaction between the four main groups of accounting information producers, accounting information users, the auditing profession and researchers, and annual financial reports are the result of the interaction and interaction between the performance of these four groups, and this research using theme analysis Through interviews with these four groups. He presented a model, so based on this, the statistical community of the research consists of these four groups. Considering the size of the statistical community, to select the statistical sample of the index members of each of these four groups as representatives of these four groups, respectively: 1- Accountants, representatives of accounting information providers; 2- auditors, members of the profession; 3- Shareholders, investors, etc., representing users of accounting information; and 4- University professors and faculty members are assumed to be accounting researchers. In theme analysis, samples are generally selected purposefully. For the research, the snowball or chain sampling method was used for the interview. Snowball or chain sampling is the selection of connected participants that guide the researcher to other people in the same community (Sajjadi, Kazemi, 2016). They were selected by the topic, and at the end of the interview, they were asked to introduce other informed and knowledgeable people to the research topic. In cases where there was a need to get the opinions of people with unique experiences to complete the model and create a theory, or in a particular field, the interviewees were asked to introduce experts with appropriate experiences. According to the above explanations, for the richness of the research, an effort was made to interview people who have personally experienced the subject of the research and have high knowledge and experience in this field (Mashaikhi et al.,2013). After conducting 18 interviews with experts, the collected data reached saturation, and there was no need to conduct new

interviews. The average duration of each interview was 45 minutes. Table 1 shows the profiles of the experts who were interviewed.

Table 1. Profile of interviewees

	PhD	Master's degree
Accountant or financial manager	3	1
Auditor (internal and independent)	1	2
Faculty members and academics	9	0
Shareholder or investor and creditor	1	1

The researcher's analytical model and selected analytical approach are crucial in determining the analysis method. This model dictates what information will be analyzed and the method of analysis. The study's objectives, hypotheses, and analytical model guide the choice of research analysis methods. Additionally, using different tools in the analysis can enhance the accuracy of the chosen method. It is essential to pair the best method with the most suitable tool, as the effectiveness of both the method and tool significantly impacts the analysis results (Ezati, 2018). After identifying the main and sub-themes, the second step involves collecting expert opinions through a semi-structured Delphi questionnaire and screening indicators using the fuzzy Delphi method. Subsequently, factors are prioritized using the L-hour pairwise comparison questionnaire with a 9-point scale and the Fuzzy Network Analysis Process (FANP) method. Delphi method experts are not randomly selected but chosen for their expertise in specific areas related to the research topic. Four groups were used to assess the importance of indicators: university faculty members, accountants, financial managers, internal and independent auditors, and investors and creditors, each consisting of 15 experts for a total of 60 experts, as illustrated in Table 2 below.

Table 2. Profile of interviewees

	PhD	Master's degree
Accountant or financial manager	9	6
Auditor (internal and independent)	2	13
Faculty members and academics	11	4
Investor and creditor shareholding	2	13

Therefore, a mixed methodology with an exploratory research plan has been used in this research. In this research, the following two main questions have been answered: A- What factors affect the credibility of financial reports in Iran? B- What is the prioritization of factors affecting the credibility of financial reports in Iran?

4. Research findings

This research to identify and screen the main indicators obtained through theme analysis, including 254 sub-themes and 13 main themes (profit quality, audit report content, stock status, and market performance, quality of accounting information system, organizational culture, specific non-financial characteristics of the company, financial ratios, corporate governance, audit quality, specific financial characteristics of the company, mandatory and optional disclosure) are effective for crediting financial reports. The conceptual model of the main indicators of the research from the point of view of the extracted experts is presented in Figure (1) below.

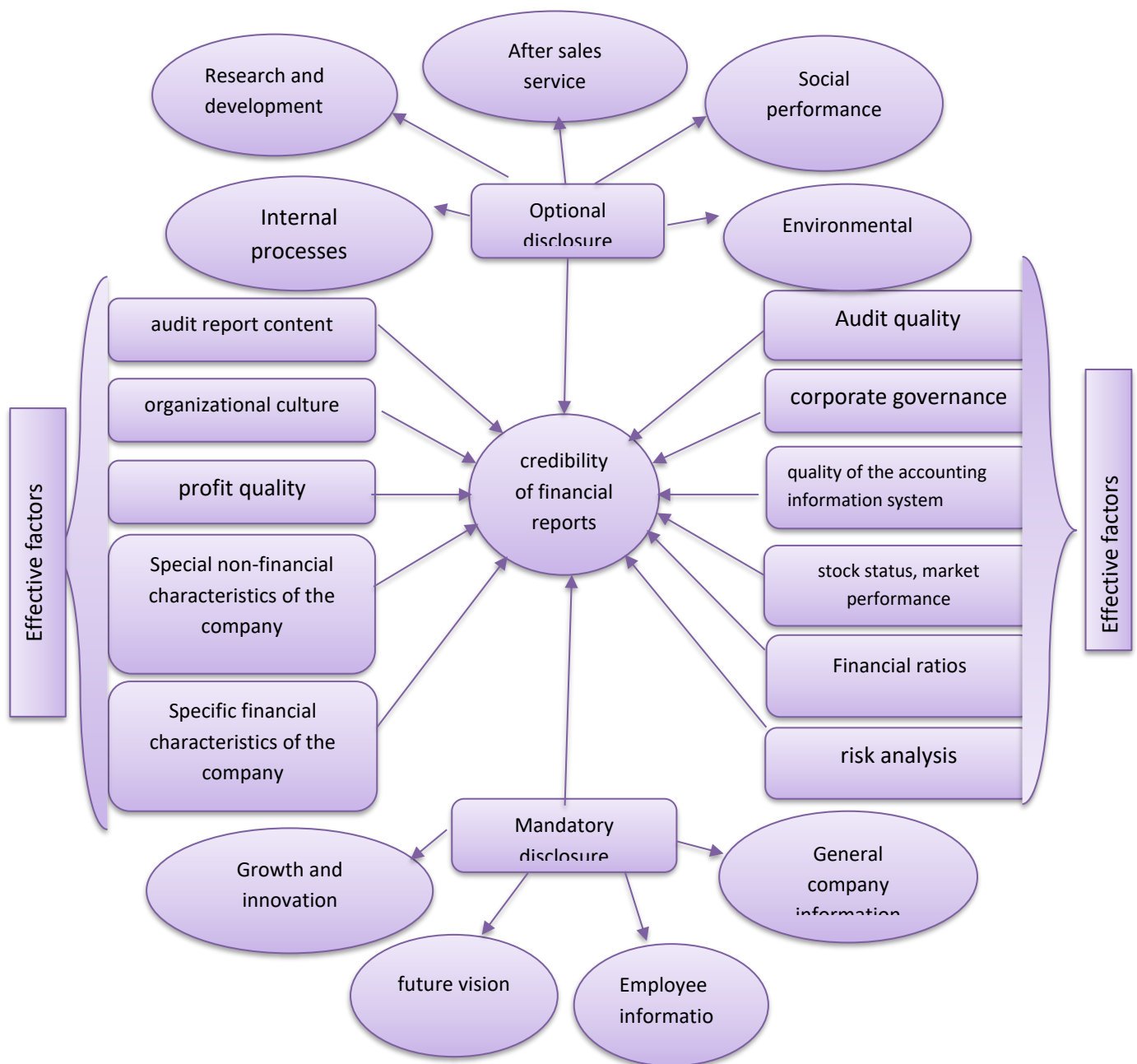


Figure 1. The conceptual model of the main indicators

4.1 Identifying the final indicators in explaining the comprehensive model for assessing the credibility of financial reports

In the first step, the fuzzy method was used to screen and identify the final indicators of the research. Based on the expert interviews conducted and the results of the qualitative analysis through theme analysis, a total of 254 factors were identified in the form of 13 main themes, and the fuzzy Delphi approach was used to screen the indicators and identify the final indicators. Although experts use their mental skills and abilities to make comparisons, it should be noted that the traditional process of quantifying people's views cannot fully reflect the human thinking style. In other words, fuzzy sets are more compatible with linguistic and sometimes ambiguous human explanations. Therefore, it is better to use fuzzy sets (using fuzzy numbers) to make long-term

predictions and decisions in the real world (Kahraman and Kaya, 2010). In this study, triangular fuzzy numbers have been used to fuzzify the experts' points of view. Experts' opinions about the importance of each index have been collected with a 9-degree phase spectrum. It is shown in Table 3.

Table 3. 9-degree fuzzy spectrum for valuing indicators

1 (completely unimportant)	Fuzzy value	Triangular fuzzy equivalent
2	$\tilde{1}$	(1,1,1)
3	$\tilde{2}$	(1,2,3)
4	$\tilde{3}$	(2,3,4)
5	$\tilde{4}$	(3,4,5)
6	$\tilde{5}$	(4,5,6)
7	$\tilde{6}$	(5,6,7)
8	$\tilde{7}$	(6,7,8)
9 (quite important)	$\tilde{8}$	(7,8,9)
1 (completely unimportant)	$\tilde{9}$	(9,9,9)

Various methods have been proposed to gather the opinions of n respondents. These aggregation methods are experimental methods presented by different researchers. For example, a conventional method for consolidating a set of triangular fuzzy numbers is the minimum l, the geometric mean m, and the maximum u (Cheng and Lin, 2002; Hsu et al., 2010). Habibi et al (2015)

Equation 1

$$F_{AGR} = (\min\{l\}, \prod\{m\}, \max\{u\})$$

Equation 2

$$F_{AGR} = \left(\min\{l\}, \left\{ \frac{\sum m}{n} \right\}, \max\{u\} \right)$$

Equation 3

$$F_{AVE} = \left(\left\{ \frac{\sum l}{n} \right\}, \left\{ \frac{\sum m}{n} \right\}, \left\{ \frac{\sum u}{n} \right\} \right)$$

Each triangular fuzzy number resulting from the aggregation of experts' views for the Jam index is shown below:

$$\begin{aligned} \tau_j &= (L_j, M_j, U_j) \\ L_j &= \min(X_{ij}) \\ M_j &= \sqrt[n]{\prod_{i=1}^n X_{ij}} \\ U_j &= \max(X_{ij}) \end{aligned}$$

In the above relationships, the index i refers to the expert. So that:

- X_{ij} : the evaluation value of the ith expert from the jth criterion
- L_j : the minimum number of evaluations for the jth criterion
- M_j : the geometric mean of the experts' assessment of the performance of the jth standard
- U_j : the maximum number of evaluations for the jth criterion

The fuzzy average method (Relation 1) is used in this study.

4.2 De-fuzzification of values

Usually, summing the averages of triangular and trapezoidal fuzzy numbers can be summarized by a cutoff value that is the best corresponding average. This operation is called de-fuzzification. There are several methods for defuzzification. In most cases, the following simple method is used for defuzzification (Cheng and Lin, 2002; Hsu et al., 2010):

Equation 4

$$x_m^1 = \frac{L + M + U}{3}$$

Another simple method for defuzzifying the mean of triangular fuzzy numbers is as follows:

Equation 5

$$F_{ave} = (L, M, U)$$

$$x_m^2 = \frac{L+2M+U}{4}; x_m^3 = \frac{L+4M+U}{6}; x_m^1 = \frac{L+M+U}{3};$$

$$\text{Crisp number} = Z^* = \max(x_{max}^1, x_{max}^2, x_{max}^3)$$

The values of x_{max}^i do not differ much and are always close to M. M means the mean obtained by summing the possible values of m from different triangular fuzzy numbers. However, the deterministic value of the largest calculated x_{max}^i is considered. In this study, the above relation 5 is used for de-fuzzification. The fuzzy average and the de-fuzzified output of the values related to all the main variables and their indicators have been calculated. However, the limitation of the volume of the article does not allow presenting all of them, so in Figure 4 below, these findings are an example of the main variables (a) audit quality, (b) corporate governance mechanisms, and (c) the quality of the accounting information system is presented. In addition, it should be mentioned that the general figures of these findings for the main variables of the research are presented in Table 4 below.

Table 4. Findings for the main variables of the research

Variable	Indicator	Min.	Geometric mean	Max.	Fuzzy average	De-fuzzifying	Result	Rank
Audit quality	Identification and appropriate management of audit risk	5	7.685	9	(5,7,68,9)	7.450	acceptance	54
	Audit opinion based on evidence and without consideration of pressures	5	7.290	9	(5,7,29,9)	7.190	acceptance	123
	Type of ownership of the auditing firm	5	7.800	9	(5,7,8,9)	7.580	acceptance	34
	Using the opinions of non-financial experts in the audit process	5	7.765	9	(5,7,76,9)	7.510	acceptance	42
	Evaluating the employer's internal control structure before accepting the job	5	7.800	9	(5,7,8,9)	7.580	acceptance	36
	The quality rating of the audit institute	5	7.620	9	(5,7,62,9)	7.370	acceptance	73
	Absence of claims related to audit malpractice	5	7.610	9	(5,7,61,9)	7.405	acceptance	68
	Being a trustee of the stock exchange, the audit institution	4	7.220	9	(4,7,22,9)	7.020	acceptance	175
	The age of the audit institution	4	7.310	9	(4,7,31,9)	7.120	acceptance	154

Corporate governance mechanism	A good reputation of the auditing firm	3	7.300	9	(3,7,3,9)	7.030	acceptance	171
	The level of education of auditors and their relevance to the field of auditing	5	8.180	9	(5,8,18,9)	7.830	acceptance	16
	Risk taking of auditors	4	7.510	9	(4,7,51,9)	7.220	acceptance	116
	The number of certified accountants employed by the auditing firm	5	7.475	9	(5,7,47,9)	7.310	acceptance	96
	Absence of unusual fees	5	7.370	9	(5,7,37,9)	7.200	acceptance	120
	Failure to provide non-audit services	4	7.430	9	(4,7,43,9)	7.200	acceptance	121
	Use of information technology in auditing	5	7.720	9	(5,7,72,9)	7.480	acceptance	47
	The appropriateness of the audit fee	3	7.390	9	(3,7,39,9)	7.130	acceptance	147
	Absence of time budget pressure	6	8.250	9	(6,8,28,9)	7.960	acceptance	8
	Audit market share	5	7.300	9	(5,7,3,9)	7.160	acceptance	136
	Independence and impartiality of the auditor towards the management of the unit under review	6	8.090	9	(6,8,09,9)	7.900	acceptance	12
	Mastering the laws and regulations related to auditing	5	7.480	9	(5,7,48,9)	7.320	acceptance	93
	The structure and composition of the board of directors in terms of expertise and work experience	5	7.730	9	(5,7,73,9)	7.530	acceptance	38
	Ownership concentration ratio	6	7.645	9	(4,7,64,9)	7.510	acceptance	41
	Institutional ownership ratio	4	7.620	9	(4,7,62,9)	7.370	acceptance	75
	Financial knowledge of the board of directors	5	7.870	9	(5,7,87,9)	7.540	acceptance	37
	Evaluation, management and continuous control of risk in the business unit	5	7.670	9	(5,7,67,9)	7.440	acceptance	59
	The existence of an audit committee and effective internal audit unit	4	7.620	9	(4,7,62,9)	7.330	acceptance	90
	The composition and expertise of the members of the audit committee and the internal audit unit	4	7.620	9	(4,7,62,9)	7.330	acceptance	89
	The size of the audit committee	5	7.680	9	(5,7,68,9)	7.450	acceptance	52
	Composition or independence of the board of directors	5	7.670	9	(5,7,67,9)	7.400	acceptance	67
	Effective internal control structure	5	7.460	9	(5,7,46,9)	7.300	acceptance	98
	Tenure of senior managers	4	7.540	9	(4,7,54,9)	7.320	acceptance	92
	Punitive measures for managers who engage in fraudulent reporting	5	7.350	9	(5,7,35,9)	7.230	acceptance	114
	The number of annual meetings of the board of directors and the attendance of members	5	7.380	9	(5,7,38,9)	7.250	acceptance	108
	The power of the CEO	6	8.075	9	(6,8,07,9)	7.880	acceptance	13
	The amount of accrual items	5	7.520	9	(5,7,52,9)	7.350	acceptance	82
	Financial staff skills and expertise	5	7.600	9	(5,7,6,9)	7.400	acceptance	69
Accounting information system quality	Professional ethics of financial report preparers	4	7.840	9	(4,7,84,9)	7.475	acceptance	50
	Compliance with international financial reporting standards	3	7.880	9	(3,7,88,9)	7.500	acceptance	43
	Use of fair value criteria	6	8.280	9	(6,8,28,9)	8.025	acceptance	7
	Moving towards intelligent information systems	4	7.310	9	(4,7,31,9)	7.120	acceptance	153
	Short reporting focusing on important issues	4	8.180	9	(4,8,18,9)	7.750	acceptance	22

Paying attention and following forward information (future prediction)	3	7.606	9	(3,7,66,9)	7.360	acceptance	79
Full compliance with the qualitative characteristics of financial information	5	8.000	9	(5,8,9)	7.750	acceptance	21
Establishment of a suitable system for calculating the cost of products	4	8.285	9	(4,8,28,9)	7.900	acceptance	11
Using an extensible financial reporting language	5	7.270	9	(5,7,27,9)	7.145	acceptance	146
Interim financial reporting	5	7.260	9	(5,7,26,9)	7.175	acceptance	133
Measuring intellectual capital disclosure	5	7.580	9	(5,7,58,9)	7.340	acceptance	84
Proper connection to legal financial and tax systems	5	7.720	9	(5,7,72,9)	7.480	acceptance	47
The existence of an approved and valid accounting software system	5	8.560	9	(5,8,56,9)	8.120	acceptance	4

In this test, the de-fuzzified value greater than 7 is accepted, and any index with a score less than 7 is rejected (Cheng and Lin, 2002; Hsu et al., 2010). It should be noted that 75 indicators had an average value of less than 7 and were therefore removed from Table 5, and 179 indicators were approved. Figure 5 shows the 13 main indicators for ranking the important indicators for assessing the credibility of financial reports.

Table 5. De-fuzzification of the main criteria for assessing the credibility of financial reports

The standard is original		Deffuzy	Rank
Audit quality		7.380	9
Corporate governance mechanism		7.420	8
Accounting information system quality		7.520	4
Stocks and market performance (status of transactions and stock prices)		7.570	3
Financial ratios (analysis of the company's financial status and performance)		7.440	7
Risk analysis		7.190	18
Content of the audit report		7.690	2
The state of organizational culture		7.500	5
Profit quality		7.760	1
Special non-financial characteristics of the company		7.460	6
Specific financial characteristics of the company		7.370	10
Mandatory disclosure	General company information	7.250	15
	Information about employees	7.190	18
	Growth and innovation	7.090	20
	Expressing vision, goals and strategy	7.250	15
	Social performance	7.250	15
Optional disclosure	Environmental activities	7.270	12
	research and development	7.150	19
	Information about internal processes	7.300	11
	Activities related to after-sales services	7.260	13

5. Conclusion

Reliable financial and non-financial reports that greatly impact users' decisions on resource allocation depend on these reports' credibility (Piri et al., 2014). However, the credibility of financial reports is essentially a subjective evaluation that the reports are free from manipulation and distortion and accurately represent the financial status, conditions, and operational performance of a business entity. This credibility encompasses the company's reported financial statements' accuracy and usefulness in forecasting future cash flows.

The purpose of this research is to identify and rank the factors affecting the credibility of financial reports by recognizing that the quality of financial reports is different from the credibility of financial reports. According to the opinion of financial experts and the review of accounting and financial literature, credit reports are not only a financial element that only includes the impact of accounting figures on market parameters but also include non-financial factors that are based on the theory of stakeholders and the theory of legitimacy and emphasis on behavioral accounting factors (such as Organizational culture) and other non-financial and non-monetary variables affecting financial statements have been identified and explained in order to be a beginning for the development of capital market research and the decision model approach for investors and lenders regarding the assessment of financial statements in accounting and financial literature. The research findings show that 13 main components affect the credibility of financial reports, but the amount and how these affect them are different. Based on the ranking done with the fuzzy Delphi method, respectively, the components of profit quality, the content of the audit report, stocks and market performance (status of transactions and stock prices), the quality of the accounting information system, the state of the organizational culture, the specific non-financial characteristics of the company, financial ratios (analysis of the situation and performance corporate finance), corporate governance mechanism, audit quality, company's financial characteristics, and discretionary disclosure affect financial statements. In addition to matching the scientific and theoretical foundations of the research, the above results are consistent with the current literature's relevant research. Therefore, investors and creditors are advised to pay attention to all the existing parameters identified and explained in the current research, which are the basis of the credibility of financial reports in their economic decisions. The components identified in this research are not only financial components, but many non-financial components also affect the credibility of financial reports. These findings confirm that accounting information and components are not used in isolation, as professional investors give significant weight to financial accounting alternatives, including qualitative and quantitative non-financial sources. Information about the name of the company and its management, information about the industry and its competitors, information about the company's product markets, and even information about corporate governance and the general state of the country's macroeconomics affects the credibility of financial reports. Finally, it can be said that auditors enter the credit of financial reports as exogenous shocks. In this research, earnings quality was the most important issue for investors and creditors. Because investors and creditors pay more attention to the company's performance than the financial situation. This is because the company's profitability is the first priority for these two.

6. Recommendation for further research

For future studies, considering that operationalizing and measuring the credibility component of financial reports has been proposed for the first time in the present research, this new research area will require more and deeper investigations. Among them (1), it is suggested that valid scientific approaches be used to extract and formulate appropriate quantitative and qualitative models to measure the credibility of financial reports. (2) Considering that the present research was carried out following the theories of organizational legitimacy and stakeholders, it is suggested that future studies extract effective components on the credibility of reports based on the theory of representation because in the context of the theory of representation, the reliability of financial statements It is seen as a tool to fulfill the duties and responsibilities of managers and the board of directors towards external users, while the stakeholder theory considers the advantages of financial statement disclosure in terms of profit (Quoc et al. 2024).

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RESEARCH ARTICLE

The Effect of Performance Evaluation System Dimensions on Organizational Results: A Financial Approach and Organizational Capabilities

Seyedeh Raja Ghalebi, Shokrollah Khajavi *, Ali Mahmoodi

Department of Accounting, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran

Faculty of Commerce and Trade, University of Tehran, Tehran, Iran

Department of Accounting, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran

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Abstract

The comprehensive Performance Measurement System (PMS) clearly emphasizes the managers' role by explaining strategic purposes and various dimensions of performance. The present study aims to analyze empirical evidence about the effect of managers' emphasis on a particular type of function and complexity levels of PMS on its benefits and organizational performance based on Levers of Control (LOC) and Contingency Theory (CT). The study was conducted in 46 companies active in Persian Gulf Petrochemical Holding in 2022. Results from data modeling using partial least squares structural equations indicate that a higher emphasis on the interactive function of PMS increases its benefits in the studied sample, with no influence from the complexity level of PMS. In other words, the effect of diagnostic and interactive functions of PMS on its benefits have no significant difference in simple and complex systems. Results from the model's sensitivity analysis show the stability of findings based on different assumptions.

Keywords:

Diagnostic and Interactive Functions, Performance Measurement System, Complexity Level of Performance Measurement System

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*Corresponding Author: Shokrollah Khajavi
Email: shkhajavi@ut.ac.ir
Tel: 09173090599
ORCID: 0000-0002-4889-1135

1. Introduction

In the management literature, performance management systems (PMSs) are classically viewed as tools whose primary objective is to understand and monitor performance and ensure alignment and stability within the organization (Bititci et al., 2018; Henry and Wouters, 2020; Lucianetti et al., 2018); performance measurement system (PMS) is ‘a system for tracking performance metrics’. It is essential to implementing a corporation; it helps translate strategy into actions and desired results, track progress, provide feedback, and encourage workers through rewards and penalties. Moreover, the measuring system must be based on the organizational strategy, assist in putting the plan into action, and provide feedback on whether the organization is ‘on track’ or whether adjustments in the course are required; organizations also require a balanced selection of measurements (Khourshed and Beshr, 2024). From another perspective, PMSs are a mechanism senior management adopts to link strategy and operations and promote behaviors and actions in line with the organization's goals (Bedford et al., 2023a; Mura et al., 2021). Essentially, PMSs fall under the ‘levers of control’ (LOC). According to Simons (1995), PMSs and other management control systems can be implemented as belief, boundary, diagnostic, or interactive systems (Pešalj et al., 2018; Daowadueng et al., 2023). Although the roles of all four levers are critical, researchers have generally focused on diagnostic and interactive use (Heinicke et al., 2016; Henri, 2006a; Koufteros et al., 2014; Mura et al., 2021). The former refers to monitoring results against prespecified goals and modifying deviations, and the latter refers to assessing performance by facilitating dialogue and promoting learning in line with the development of new strategic goals (Heggen and Sridharan, 2021; Sarstedt et al., 2020). The establishment of a PMS aims to improve accountability. The output components of the PMS consist of performance feedback, which improves internal performance and ensures transparency in external performance (Mahmoudi Yekebaghi et al., 2025).

In recent years, there has been increasing focus on PMS use and its effects (Bedford et al., 2023a; Bisbe and Malagueno, 2012; Bedford et al., 2023b; Bititci et al., 2018; Dubey et al., 2017; Heinicke et al., 2016; Simons, 2014). Review papers have generally highlighted the positive effects of PMSs (Hoque, 2014); however, there is ambiguous and sometimes contradictory empirical evidence regarding the effects of PMSs. As a noticeable study in this field, Endrikat et al. (2020) detected 25 experimental articles using a meta-analysis approach to examine the effect of PMSs on organizational performance (OP). They reached unique findings in terms of their high heterogeneity due to differences in design (sophistication level) and type of PMS use. Moreover, OP appraisal based on organizational capabilities reported a larger effect size than performance appraisal based on financial measures, indicating the significance of the appraisal method for organizational output in PMSs. Accordingly, combining all three variables determines the extent to which PMS benefits are realized (Endrikat et al., 2020).

Regarding the empirical evidence, it can be inferred that more detailed studies are required to examine the effects of the fit between sophistication level and PMS use on PMS benefits and OP. From another viewpoint, because the development and implementation of PMSs is time-consuming and costly, many companies implement such systems to align the company more efficiently with its strategy and control important performance metrics. In line with CT, the potential variables affecting the design and use of PMSs and their impact on OP should be explored (Franco-Santos et al., 2012).

This study addresses this research gap by concurrently examining the relationships between the design, functionality, and OP of PMSs.

In pursuit of the objectives of this research:

- I. Experimental studies on the design and functionality of PMSs have recommended different

conceptual frameworks; however, this study specifically focuses on the LOC framework proposed by [Simons \(1994, 1995, 2014\)](#), considering explicit controls (interactive and diagnostic) as integral management controls (MCs), in addition to boundary and belief systems.

- II. Methodologically, empirical studies on PMS are primarily grounded in agency theory ([Franco-Santos et al., 2012](#); [Heinicke et al., 2016](#); [Hoque, 2014](#); [Lucianetti et al., 2018](#); [Mura et al., 2021](#)). Accordingly, this study also adopts this approach to explore the relationship between structural variables (design and functionality of PMSs) and OP.
- III. The research sample encompassed Gulf Holding, which provides a diverse range of small and large enterprises with heterogeneous structures due to its economic operations, ownership structure, and unique economic position in Iran.
- IV. Previous studies have predominantly adopted financial metrics, such as return on assets (ROA), to assess OP (as PMS benefits) ([Hoque, 2014](#)). In contrast, this study employed a combination of financial metrics (Return on Capital Employed (ROCE), Return on Sales (ROS), ROA) and a more precise 17-item measure based on management perceptions of PMS benefits ([Heinicke et al., 2016](#); [Speckbacher and Wentges, 2012](#)), including net benefits and the costs of PMS implementation and usage.

2. Theoretical and experimental foundation

2.1 Theoretical foundations

2.1.1 Design and sophistication levels of PMS

PMS are integral to organizational management, providing a structured approach to evaluating and improving performance. PMS encompasses various dimensions, including financial, operational, and strategic aspects, collectively contributing to achieving organizational goals. The comprehensive nature of PMS allows managers to align performance metrics with strategic objectives, ensuring that all organizational activities are directed towards common goals ([Heinicke et al., 2016](#); [Alamri, 2019](#)).

PMSs encompass a set of financial and non-financial metrics that aid in quantifying information about a company's operations and provide an overview of its performance ([Heinicke et al., 2016](#)). They are essentially a part of the management systems exploited as quantitative criteria for the efficiency and effectiveness of operations. The effective implementation of PMSs plays a vital role in gaining a competitive advantage within an organization and is strongly correlated with OP ([Alamri, 2019](#)).

Organizations believe that they utilize PMSs by employing a combination of financial and non-financial measures. [Kaplan and Norton \(2002\)](#) suggest that the concept of PMS goes beyond using such measures. Therefore, to investigate existing differences in design, using a continuous scale in the deployment of PMS, it is imperative to consider the impact of the sophistication levels of PMSs on design effectiveness ([Heinicke et al., 2016](#)). The term sophistication level of PMS refers to the breadth of essential design features, use, or processes of a specific PMS within a company ([Agostino and Arnaboldi, 2012](#)). In other words, the sophistication level of PMSs indicates their technical quality based on design features such as perspectives on financial and non-financial indicators, strategic maps, operational plans, and relationships with incentive systems. This implies that significant differences in the sophistication level of PMSs can be observed in the degree of correlation between performance indicators and strategy, the explicit description of strategy using causal relationships, and the correlation of management performance with incentive systems ([Heinicke et al., 2016](#)).

The theoretical literature proposes two approaches to the sophistication level of PMSs. According to [Speckbacher and Wentges \(2012\)](#) approach, PMS is generated across a continuous time spectrum (sequential sophistication levels), emphasizing the consideration of developmental stages in PMSs ([Speckbacher and Wentges, 2012](#)). Regarding the second approach, [Franco-Santos et al. \(2012\)](#) rejected the necessity of a linear relationship between the sophistication levels of the PMSs. Both approaches describe the design elements of PMSs to inform managerial decision-making and evaluate OP, and they agree that the content, implementation, and expected PMS benefits may vary based on their types ([Heinicke et al., 2016](#)). As [Alamri \(2019\)](#) asserts, implementing management accounting system approaches in results-oriented (diagnostic) organizations is not limited to financial functions, and managers have incentives to implement management accounting approaches in other functions. [Endrikat et al. \(2020\)](#) conducted a meta-analysis of 25 empirical articles to detect the impact of PMSs on OP. They reported high heterogeneity in the findings of the studies, attributed to the type of PMS design and functionality. Furthermore, when PMSs are based on organizational capabilities, the effect size is larger than the financial criteria, indicating the importance of the OP measurement method for capturing the impact of PMSs ([Heinicke et al., 2016](#)).

2.1.2 Types of PMS use

In addition to the design (sophistication level) of PMSs, different types of use also affect the outcomes of PMSs ([Bedford et al., 2023a](#); [Bedford et al., 2023b](#); [Heinicke et al., 2016](#); [Koufteros et al., 2014](#)). For Example, [Bedford et al. \(2023b\)](#) suggest that the design features and differentiation of PMS use affect an organization's operational outcomes. They reported that a PMS with a broad scope led to more pleasant outcomes, while an integrated PMS lowered OP. Another study documented PMS design's effective and potential impact on organizational outcomes ([Bedford et al., 2023a](#)). [Cupertino et al. \(2023\)](#) state that the type of function and complexity of the PMS positively affect the organization's performance and sustainability in the short term and firms could be concurrently sustainable and profitable in the short run. In this context, the distinction between interactive and diagnostic use within the LoC framework ([Simons, 1995, 2014](#)) facilitates a more precise understanding of the relationships between different uses, various sophistication levels, and PMS benefits.

[Simons \(2014\)](#) defined cyber-logic-based diagnostic controls (how to control complex systems) as any formal information system used to set goals, measure outputs, calculate and evaluate performance deviations, and provide feedback to adjust inputs or processes to align performance with prespecified objectives and standards. Thus, the diagnostic use of PMSs represents a control mechanism for tracking, examining, and achieving predictable goals ([Mura et al., 2021](#)). As measurement systems are generally designed to monitor and modify deviations from predefined objectives and implement desired strategies, this function acts as traditional feedback ([Bititci et al., 2018](#); [Heinicke et al., 2016](#); [Mura et al., 2021](#)). In this regard, several researchers have argued that the diagnostic use of PMS is a restraining force because it focuses on errors and negative deviations through single-loop learning ([Mura et al., 2021](#); [Henri, 2006](#)). In contrast, diagnostic use facilitates a better understanding of processes and current performance, contributing to cost and time reduction and continuous improvement ([Mura et al., 2021](#)). In this case, preliminary evidence suggests a positive effect of diagnostic PMSs on the performance of companies that exploit existing market opportunities and technological capabilities ([Bedford et al., 2023a](#)). More specifically, diagnostic use enables the achievement of goals such as promoting the quality of existing products and current processes by posing limitations, setting continuous improvement through single-loop learning, and contributing to innovative process management ([Müller-Stewens et al., 2020](#)).

In contrast, interactive controls are "formal information systems that managers use to participate personally in employees' decision-making activities of employees" (Simons, 2014), with a focus on identifying new strategies. In other words, interactive PMSs address strategic uncertainty and facilitate the emergence of new strategies, whereas diagnostic PMSs concentrate on critical performance criteria and contribute to implementing existing strategies (Simons, 2014). This researcher believes in the association between achieving goals and incentives through diagnostic controls, as it enables the attainment of goals set by management (Bedford et al., 2023a).

As most MC studies rely on the LOC framework to distinguish between various PMS uses (Agostino and Arnaboldi, 2012; Franco-Santos et al., 2012; Heinicke et al., 2016; Henri, 2006; Mura et al., 2021), some researchers propose that a combination of different PMS uses can help organizations balance competitive goals; Mura et al. (2021), for example, mentioned that diagnostic control, aiming to ensure the achievement of predetermined goals by the organization, may positively affect the efficiency of new product development processes in Research and Development (R&D) enterprises, while interactive control, aiming to seek opportunities (searching for behaviors among individuals and operations), may positively affect creativity. In their meta-analysis, Bellora-Bienengräber et al. (2023) proved using a combination of PMS use types by enterprises. Moreover, they found that their types of use are linked to performance through organizational capabilities. Given the mutual dependence between levers, Bedford et al. (2023a) claimed that both diagnostic and interactive use have joint effects on performance depending on the enterprise's desired innovation.

Mura et al. (2021) suggested that diagnostic PMSs positively reduce the total costs and time spent performing activities, introduce new products, and expand the diverse range of products. According to their study, the diagnostic PMS is more appropriate if an organization primarily pursues operational goals. Diagnostic-interactive PMS is more effective if the organization's goals are simultaneously operational and exploratory. In another study, Rajnoha et al. (2016) indicated that diagnostic use has a positive impact on financial performance criteria and the interactive use of non-financial performance criteria concerning strategic management innovations and in the other study Dubey et al. (2017) said to achieve sustainable performance the organization must embrace hybrid orientation which is a fine blend of interactive and diagnostic systems. In contrast, Henri (2006a) found a negative relationship between monitoring (i.e., diagnostic PMS) and measurement diversity (i.e., measuring the sophistication levels of PMS), arguing that diagnostic control is strongly correlated with financial information and budget control and is only required at the high sophistication level of PMS to a limited extent. He also suggests that interactive PMSs, focusing on strategic priorities and dialogue, reinforce strategic choices and that diagnostic PMSs impose constraints to ensure compliance with regulations and apply negative pressure on strategic choices. Some of his findings also illustrate the effect of dynamic inconsistency resulting from the balanced use of diagnostic and interactive PMSs on performance. Similarly, Micheli and Manzoni (2010) asserted that improperly implementing a PMS can be highly destructive for OP and that PMSs can be both effective and ineffective for companies, with the PMS design and its implementation procedure determining organizational outcomes. This highlights the need to examine the exclusive effects of diagnostic and interactive use and their fit on OP. According to the foundations mentioned above, the distinction between diagnostic and interactive use is a suitable solution for examining the sample and analyzing the outcomes; hence, the present study took advantage of this method.

2.2 Research hypotheses

The organizational control theory (CT) suggests that the diagnostic function of PMS enables managers to accurately assess employee performance and identify strengths and weaknesses. This precise evaluation can improve overall OP, as managers can make better resource allocation and employee development decisions. Empirical studies have shown that using PMS for accurate performance evaluation can increase employee motivation and productivity. For instance, [Sarstedt et al. \(2020\)](#) found that organizations using PMS for precise performance assessment significantly improved employee productivity and job satisfaction.

Organizational learning theory emphasizes that the interactive function of PMS facilitates the exchange of information and knowledge between employees and managers; these interactions can lead to improved work processes and innovation, as employees can benefit from each other's experiences and knowledge, finding more creative solutions to problems. Empirical studies have also shown that positive interactions between employees and managers can increase job satisfaction and reduce turnover rates. For example, a study by [Johnson et al. \(2019\)](#) found that organizations using interactive PMS had lower turnover rates and higher employee job satisfaction.

Organizational complexity theory posits that more complex systems can provide more accurate information, helping managers make better decisions. These systems can process more data and offer more detailed analyses, allowing managers to evaluate employee performance comprehensively. Empirical studies have shown that more complex systems can improve the accuracy of evaluations and increase managers' confidence in decision-making. For instance, [Brown et al. \(2021\)](#) found that organizations using more complex PMS made better employee development and resource allocation decisions.

Open systems theory suggests that more complex systems can facilitate greater interactions between different parts of the organization, leading to improved coordination and collaboration. These systems can share more information across departments, enabling employees to work together more effectively. Empirical studies have shown that more complex systems can lead to increased innovation and improved work processes.

Organizational scale theory suggests that in larger companies, the complexity and diversity of tasks are greater, and the diagnostic function of PMS alone may not cover all aspects of performance. Larger companies require more comprehensive and multidimensional systems to evaluate performance accurately. Empirical studies have shown that larger companies need more comprehensive and multidimensional systems for performance evaluation. For instance, a study by [Mura et al. \(2021\)](#) found that simpler PMS could not adequately assess employee performance in larger companies, necessitating more complex and comprehensive systems.

Organizational network theory posits that interactions between different departments and units in larger companies are more critical, and the interactive function of PMS can help improve these interactions. Larger companies require more coordination and collaboration between departments and units, and interactive PMS can help enhance this coordination and collaboration. Empirical studies have shown that in larger companies, interactive systems can improve coordination and collaboration between units, leading to greater benefits. For example, a study by [Alamri \(2021\)](#) found that interactive PMS improved coordination and collaboration between units in larger companies, resulting in greater benefits.

Underpinned by the theoretical foundations and raised ambiguities, the following research hypotheses were proposed to address the research questions:

H₁: The diagnostic use of PMS significantly affects its benefits.

H₂: The interactive use of PMS significantly affects its benefits.

H₃: The sophistication level of PMS significantly affects the benefits of its diagnostic use.

H₄: PMS's sophistication level significantly affects the benefits of its interactive use.

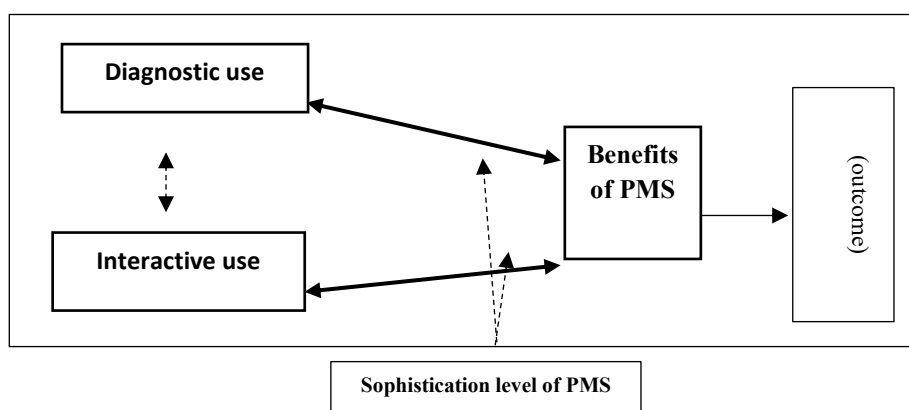


Figure 1. The conceptual model used in this study

According to Figure 1, the proposed model focuses on the relationships between different types of PMS use with benefits and OP, the effect of PMS sophistication levels on this relationship, and the relationships between types of PMS use. Moreover, multi-group analysis and control variables were considered to examine the effects of contingency factors as contextual variables.

3. Research methodology

3.1 Research model

PMS benefits can be explained by its type of use and sophistication levels (Heinicke et al., 2016).

$$Benefit = \beta_0 + \beta_1(diagnostic\ use - PMS\ sophistication\ level)^2 + \beta_2(interactive\ use - PMS\ sophistication\ level)^2 + \varepsilon \quad (1)$$

If all relationships among the direct, intervening, and squared variables are considered in the proposed model, the following equation is obtained:

$$Benefit = \beta_0 + \beta_1 diagnostic\ use + \beta_2(diagnostic\ use)^2 + \beta_3 interactive\ use + \beta_4(interactive\ use)^2 + \beta_5 PMS\ sophistication\ level + \beta_6(PMS\ sophistication\ level)^2 + \beta_7(diagnostic\ use * PMS\ sophistication\ level) + \beta_8(interactive\ use * PMS\ sophistication\ level) + \sum controls + \varepsilon \quad (2)$$

where,

Benefit: Benefits of PMS

diagnostic use: diagnostic use of PMS

interactiveuse: Interactive use of PMS

PMS sophistication level: PMS sophistication levels

First, data collection instruments were assessed, the conceptual model was estimated, and then the diagnostic and interactive uses of PMSs and PMS benefits were quantitatively validated. To this end, exploratory factor analysis was employed for the preliminary validation of the diagnostic and interactive use of PMSs using SPSS software version 26. Confirmatory factor analysis was performed using Smart PLS 3 software to confirm the findings of the exploratory factor analysis.

Finally, a structural model for the diagnostic and interactive use of PMSs was validated.

In the next phase, the conceptual research model was estimated. Structural equation modeling (SEM) based on partial least squares was used to test the research hypotheses. The conceptual model estimation coefficients and their significance were assessed, including second-order factors. Furthermore, a conceptual model without second-order factors was estimated to test the model's robustness, and the coefficients' significance was evaluated. The validity of the estimated model was explored before testing the research hypotheses. Subsequently, a multi-group analysis was run.

Multi-group analysis was run using Smart PLS software to detect significant differences in the coefficients obtained for the two groups.

In the final phase, the reliability of the results was assessed by examining the conceptual research model without second-order factors under different conditions. Table 1 shows the measurements of the research variables.

Table 1. Measurement of research variable

Variable	Symbol	Instrument and scoring scale	Reference
Benefits PMS	BePMS	1. The OP questionnaire with 17 items scored on a five-point Likert scale: Participants are asked to report the expected PMS benefits on a five-point Likert scale, with the obtained score (benefits) indicating the weighted average importance (agreement level) of each section of the mentioned benefits. 2. Confirmatory factor analysis with a second-order structure consisting of three factors (ROCE, ROS, and ROA) was used to measure the reliability of the items.	Heinicke et al. (2016)
Diagnostic use of PMS	InPMS	A five-point Likert scale questionnaire: The items determine classical indicators such as supervision, inspection, and comparison.	Henri (2006a)
Interactive use of PMS	DPMS	A five-point Likert scale questionnaire: The interactive use items determine focused attention.	Henri (2006b)
Sophistication levels of PMS	SoPMS	A five-point Likert scale questionnaire: Participants are asked to fill in a four-part questionnaire that determines various types of PMSs and encompasses key performance measures in different dimensions, causal relationships, defined goals, operational plans, and links to incentives. They are also supposed to determine the extent of their PMS's effectiveness on a five-point Likert scale with regard to the four mentioned components.	Heinicke et al. (2016); Speckbacher and Wentges (2012)

3.2. Research population and sample

The research population encompasses all employees and specialist managers in Gulf Petrochemical Holding, including CEOs, deputies, consultants, financial managers, and budget managers, of which 46 petrochemical companies were selected as the research sample (see Appendix). Subsequently, 384 questionnaires were randomly distributed among the participants, and 295 were completed and returned. Table 2, presents descriptive statistics of the participants' demographic characteristics.

4. Findings

4.1 Inferential statistics, validation of data collection instruments, and conceptual model estimation

4.1.1 Quantitative validation of research variables

Factor analysis was run to validate the diagnostic and interactive use of PMSs.

4.1.1.1 Exploratory factor analysis of research variables

To measure the diagnostic and interactive use of PMSs, a 9-item scale was employed to extract

PMS benefits, including 17 items in the questionnaire. Exploratory factor analysis using principal component analysis (PCA) was performed to classify the indicators. In the first phase of the exploratory factor analysis, the Kaiser-Meyer-Elkin (KMO) criterion and Bartlett's test of sphericity were used to assess sampling adequacy, indicating acceptable sampling adequacy for all variables ($p < 0.01$) (Table 3).

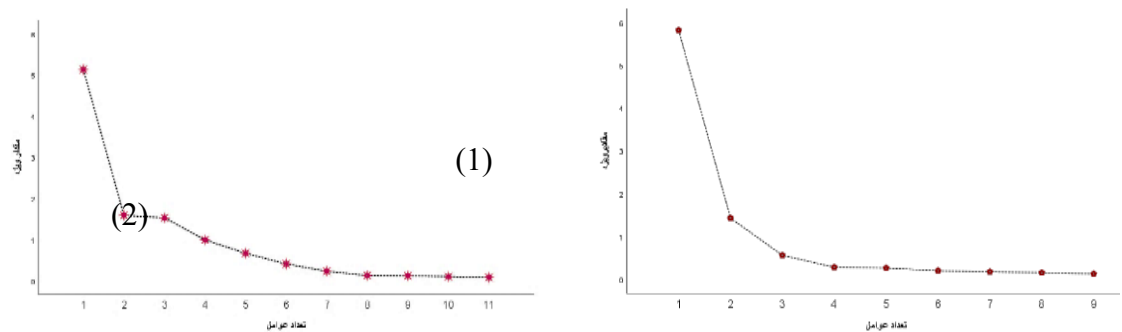
Table 2. Demographic characteristics of participants

Characteristic	Classification	Frequency
Work experience (years)	<5	5
	5-10	27
	10-15	64
	15-20	117
	20-25	49
	>25	33
Education level	Diploma	5
	BA	85
	MA	112
	PhD	92
	Missed data	1
Organizational position	Manager	22
	Head	64
	Supervisor	84
	Specialist	123
	Missed data	2
Field of study	Accounting	81
	Finance Management	50
	Chemical Engineering	61
	Other Engineering disciplines	102
	Missed data	1

The number of hidden factors was determined regarding eigenvalues (Table 4). Regarding diagnostic and interactive use, two factors have eigenvalues >1 , suggesting that the proposed model contains two hidden factors explaining approximately 80.5% of the variance. According to Figure 2, Considering PMS benefits, there are three factors with eigenvalues >1 , indicating the number of hidden factors in the proposed model ($n=3$), which explains approximately 82% of the total variance. Table (5) shows the hidden factors of the research variables obtained using PCA and varimax rotation.

Table 3. Sampling adequacy test of research variables

diagnostic and interactive use of PMSs	KMO	0.896
	Chi-square	2441.093
	Bartlett's test Df	36
	Sig.	0.000
PMS benefits	KMO	0.948
	Chi-square	5546.891
	Bartlett's test df	136
	Sig.	0.000

**Figure 2.** Scree Plots for diagnostic and interactive use (1) and PMS benefits (2)**Table 4.** Total variance explained by factors extracted from research variables

variable	Factors	eigenvalues		
		sum	Variance (%)	Cumulative variance explanation %
diagnostic and interactive use	1	5.822	64.688	64.688
	2	1.429	15.879	80.566
	3	0.560	6.217	86.784
	4	0.279	3.104	89.887
	5	0.261	2.902	92.790
	6	0.199	2.211	95.001
	7	0.173	1.922	96.923
	8	0.152	1.690	98.613
	9	0.125	1.387	100.000
benefits PMS	1	10.369	60.994	60.994
	2	2.167	12.749	73.743
	3	1.405	8.264	82.007
	4	0.508	2.985	84.993
	5	0.319	1.878	86.870
	6	0.298	1.750	88.620
	7	0.276	1.622	90.242
	8	0.265	1.557	91.800
	9	0.234	1.376	93.176
	10	0.194	1.140	94.316
	11	0.186	1.095	95.410
	12	0.169	0.994	96.404
	13	0.139	0.816	97.220
	14	0.133	0.781	98.001
	15	0.125	0.734	98.735
	16	0.117	0.686	99.420
	17	0.099	0.580	100.000

Tables 5 and 6 present the final structure of the factors in the rotated matrix for the different research variables. The results in this matrix establish the foundation for grouping the variables, according to which some variables with factor loadings >0.6 are assigned to each factor. Then, the extracted factors were developed based on the compiled items and classified according to indicators

and theoretical literature.

Table 5. Matrix of rotated factor loadings for diagnostic and interactive use

	Factors	
	interactive use	Diagnostic use
PMS1	0.186	0.896
dPMS2	0.300	0.900
dPMS3	0.336	0.857
inPMS1	0.736	0.289
inPMS2	0.832	0.279
inPMS3	0.880	0.274
inPMS4	0.860	0.260
inPMS5	0.863	0.205
inPMS6	0.879	0.230

Table 6. Matrix of rotated factor loadings for PMS benefits

	Factors		
	Supporting strategy implementation	supporting Stakeholder communication	Supporting operational processes
rbePMS1	0.857	0.363	0.165
rbePMS2	0.809	0.316	0.188
rbePMS3	0.846	0.338	0.146
rbePMS4	0.789	0.384	0.142
rbePMS5	0.798	0.355	0.120
rbePMS6	0.851	0.170	0.193
rbePMS7	0.852	0.083	0.270
rbePMS8	0.814	0.229	0.271
rbePMS9	0.823	0.116	0.256
rbePMS10	0.852	0.085	0.289
rbePMS11	0.285	0.859	0.177
rbePMS12	0.220	0.867	0.129
rbePMS13	0.209	0.865	0.216
rbePMS14	0.271	0.863	0.236
rbePMS15	0.296	0.344	0.805
rbePMS16	0.221	0.304	0.790
rbePMS17	0.311	0.083	0.883

4.1.1.2 Confirmatory factor analysis of research variables

Confirmatory factor analysis ensured the factor structure fits well with the extracted data. Before examining the factor loadings, Cronbach's alpha, average variance extracted (AVE), and composite reliability were used for the model assessment.

In Table (7), Cronbach's alpha index for the extracted hidden diagnostic and interactive use factors is >0.7 for all research variables, suggesting their appropriateness. The composite reliability for diagnostic and interactive use of the proposed PMS was >0.6 , confirming its appropriateness. Moreover, AVE was >0.5 .

The goodness of fit (GOF) and the root mean square of the residuals were used to assess the whole model. $GOF >0.4$ and $SRMR <0.08$ suggest the model is well-fitted. Table (7) confirms the acceptable fit of all models.

Cross-validation was also used to check the quality of the model fit, confirming its acceptable

quality, as all variables are positive. Accordingly, the relevant models have acceptable and appropriate reliability.

Table 7. Main quality criteria of research variable measurement models

Variable		Cronbach's alpha	Composite reliability	Mean variance extracted	Cross-validation	GOF	SRMR
Interactive and diagnostic use	diagnostic	0.918	0.948	0.858	0.673	0.4646	0.052
	Interactive	0.942	0.954	0.776	0.682		
PMS benefits	communication	0.942	0.958	0.851	0.729	0.491	0.054
	Strategy	0.970	0.974	0.789	0.738		
	process	0.892	0.933	0.823	0.608		

The Fornell-Larker index was also employed to check for divergent validity. As shown in Tables 8 and 9, the square root of AVE (located in the main diameter of the matrix) for each hidden variable exceeded the maximum correlation of the hidden variable with other hidden variables, indicating the acceptable validity of the proposed PMS.

Table 8. Divergent validity index for interactive and diagnostic use

	diagnostic	interactive
diagnostic	0.926	
interactive	0.564	0.881

Table 9. Divergent validity index for PMS benefits

	communication	strategy	process
communication	0.923		
strategy	0.560	0.888	
process	0.520	0.569	0.907

4.1.2 Conceptual model estimation

The next step involves evaluating the research hypotheses and examining their confirmation or rejection using partial least squares SEM (PLS-SEM) to assess the hypothetical model.

Before testing the hypotheses, we examined the accuracy of the estimated model. Table 10 shows that the Cronbach's alpha for both models' components was >0.7 , suggesting their acceptability. The composite reliability for both models was >0.6 , confirming their appropriateness. AVE is also > 0.5 . The Fornell-Larcker criterion was used to examine divergent validity, demonstrating the appropriateness of the proposed PMS model (Tables 11 and 12).

Table 10. Main quality indices of conceptual model measurement

	Cronbach's alpha	Composite reliability	Ave	Cross validation
Diagnostic use	0.918	0.948	0.858	0.673
Interactive use	0.942	0.954	0.776	0.684
Benefits	0.977	0.979	0.737	0.703
Sophistication	0.800	0.873	0.639	0.431

Table 11. Divergent validity index

	Diagnostic use	Interactive use	benefits	Sophistication
Diagnostic use	0.926			
Interactive use	0.563	0.881		
benefits	0.438	0.670	0.858	

Sophistication	0.542	0.707	0.726	0.799
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Table 12. Summary of structural model estimation results

Independent Variable	Dependent Variable	Hypothesis	Expected Relationship	Model with Second-Order Factors Coefficient	Statistics- t	Model without Second-Order Factors Coefficient	Statistics- t
Diagnostic use	benefits	First	positive	-0.184	0.555	-0.016	0.266
Interactive use	benefits	Second	positive	0.637	2.136	0.313	6.098
Diagnostic use - Second Order	benefits			0.186	0.550		
Interactive use - Second Order	benefits			-0.345	1.228		
Interaction between Diagnostic use and Sophistication	benefits	third	positive	0.040	0.584	0.048	0.975
Interaction between Interactive use and Sophistication	benefits	Fourth	Positive	0.065	0.832	-0.035	0.799
Diagnostic use	Interactive use			0.536	13.463	0.563	14.209
Diagnostic use	Sophistication level			0.210	3.649	0.210	3.614
Interactive use	Sophistication level			0.589	12.527	0.589	12.389
Sophistication level	benefits			0.939	2.876	0.508	9.765
Sophistication level - Second Order	benefits			-0.480	1.376		
Benefits	OP			0.205	3.753	0.205	3.339
Coefficient of Determination				0.368		0.367	
GOF				0.4787		0.4779	
SRMR				0.071		0.063	

4.2 Testing research hypotheses

H₁ and H₂: Diagnostic (interactive) use of PMS significantly affects its benefits.

The results of the conceptual model estimation in Table (12) indicate the path coefficient between the diagnostic use of PMS (interactive use of PMS) and their benefits to be -0.184 (0.637) in the model with a second-order factor. Regarding the significance of the coefficient, $t=0.555$ (2.136), indicating no significant effect of PMS diagnostic use on its benefits. By contrast, the interactive use of PMS has a significant and positive effect on its benefits. Accordingly, the first hypothesis was rejected, and the second research hypothesis was confirmed. Similar results were obtained for the research model estimation without second-order factors and model estimation with second-order factors.

H₃ and H₄: The sophistication level of PMS significantly affects the benefits of its diagnostic (interactive) use.

Table (12) shows that the path coefficient representing the interaction between diagnostic (interactive) use and sophistication level with PMS benefits is 0.040 (0.065). Moreover, $t=0.584$ (0.832), less than the critical t-statistic values at $p=0.1$, $p=0.05$, and $p=0.01$, implies that the

sophistication levels of PMS have no significant effect on the relationship between diagnostic and interactive use and their benefits. Accordingly, the third and fourth research hypotheses are rejected. Similar results were obtained for the research model estimation without second-order factors and model estimation with second-order factors. The other results for the conceptual model estimation indicated a positive and significant relationship between diagnostic and interactive use (e.g., path coefficient=0.563 and $t=14.209$ in the model without a second-order factor). A positive and significant relationship exists between diagnostic use and sophistication level (e.g., path coefficient=0.210 and $t=3.614$ in the model without a second-order factor). There is also a positive and significant relationship between interactive use and sophistication levels (e.g., path coefficient=0.589 and $t=12.389$ in the model without a second-order factor) and between sophistication levels and PMS benefits (e.g., path coefficient=0.508 and $t=9.766$ in the model without a second-order factor). Moreover, a positive and significant relationship exists between benefits and performance (e.g., path coefficient=0.205 and $t=3.339$ in the model without a second-order factor).

4.3 Sensitivity analysis and results stability assessment

To assess the stability of the obtained results, the conceptual research model was estimated without second-order factors in the different scenarios (Table 13). As shown in this table, Model 1 is the same as the conceptual research model without second-order factors, with the difference that a second-order factor structure supporting strategy implementation, stakeholder communications, and operational processes are used for benefits.

Model 2 is the same as the conceptual research model without second-order power factors, with the difference that the strategy dimensions are not included for PMS benefits.

Model 3 is the same as the conceptual research model without second-order factors, with the difference that the strategy dimensions are not considered for the sophistication levels of PMS.

Model 4 is the same as the conceptual research model without second-order power factors, with the difference that the strategy dimensions are not assumed for both sophistication levels and PMS benefits.

As can be observed, almost in each of the four models, the results are similar to those of the original model, that is, the conceptual research model without second-order power factors, thereby confirming the stability of the results in different scenarios.

Furthermore, the conceptual model without second-order power factors was estimated by using additional independent variables (Table 14). The added independent variables are corporate size (number of employees) in Model 5, corporate size (logarithm of company sales) in Model 6, OP based on the second-order factor structure in Model 7, and OP based on ROS in Model 8. In Table 14, almost in each of the four models, the results are similar to the original model, that is, the conceptual research model without second-order power factors, thereby confirming the stability of the results in different scenarios.

Table 13. Model estimation in different scenarios

Independent Variable	Dependent Variable	Model without Second-Order Factors		Model1		Model 2		Model 3		Model 4	
		Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Diagnostic Use	Benefits	-0.000	0.260	-0.016	0.275	-0.055	0.924	-0.024	0.416	-0.064	1.110

Interactive Use	Benefits	0.310	6.090	0.312	6.119	0.283	5.121	0.354	6.799	0.332	5.530
Interaction between Diagnostic Use and Sophistication	Benefits	0.040	0.970	0.048	1.036	0.034	0.722	0.068	1.502	0.046	0.970
Interaction between interactive Use and Sophistication	Benefits	-0.030	0.790	-0.03	0.780	-0.01	0.234	-0.01	0.39	0.02	0.450
Diagnostic Use	interactive Use	0.560	14.20	0.563	14.42	0.563	14.44	0.563	15.00	0.56	13.600
Diagnostic Use	Sophistication	0.210	3.610	0.210	3.620	0.206	3.594	0.246	4.52	0.24	4.150
interactive Use	Sophistication	0.580	12.30	0.589	13.07	0.592	12.71	0.548	12.13	0.55	11.480
Sophistication	benefits	0.500	9.760	0.509	9.436	0.541	9.674	0.45	8.36	0.47	8.150
benefits	OP	0.200	3.330	0.204	3.167	0.193	3.583	0.20	3.29	0.19	3.300
<i>Coefficient of determination</i>		0.367		0.475		0.361		0.359		0.352	
<i>GOF</i>		0.477		0.543		0.475		0.450		0.448	
<i>SRMR</i>		0.063		0.068		0.069		0.066		0.073	

5. Discussion and conclusion

The present study contributes to the relevant literature by expanding empirical evidence on the effect of managers' emphasis on a specific type of PMS and its design on the consequent benefits and OP. The required data were collected in 2022 using a questionnaire and analyzed based on the Line of Control (LOC) and CT in 46 companies affiliated with the Petrochemical Holding of the Persian Gulf. The findings reveal that managers' emphasis on the interactive use of PMS significantly positively affects its benefits. This means that PMS benefits are enhanced as managerial controls shift towards social controls based on dialogue, creativity, and innovative strategies. A positive and significant relationship exists between interactive use and the sophistication levels of PMS; however, greater emphasis on interactive use does not necessarily result in greater benefits, implying that the benefits of emphasis on interactive use are not contingent on the sophistication level of PMS.

Table 14. Conceptual model estimation with added independent variables

Independent Variable	Dependent Variable	Model 5		Model 6		Model 7		Model 8	
		Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Diagnostic Use	Benefits	-0.013	0.219	-0.016	0.258	-0.028	0.465	-0.023	0.398

Interactive Use	Benefits	0.309	5.771	0.305	6.065	0.313	6.224	0.309	6.404
Interaction between Diagnostic Use and Sophistication	Benefits	0.044	0.907	0.048	0.949	0.043	0.921	0.041	0.883
Interaction between interactive Use and Sophistication	Benefits	-0.039	0.878	-0.029	0.674	-0.019	0.444	-0.019	0.443
Diagnostic Use	interactive Use	0.563	14.378	0.551	13.638	0.555	13.018	0.550	13.945
Diagnostic Use	Sophistication	0.210	3.720	0.211	3.681	0.205	3.523	0.207	3.539
interactive Use	Sophistication	0.588	12.618	0.585	12.136	0.586	12.307	0.583	13.09
Sophistication	benefits	0.511	9.467	0.504	9.597	0.495	9.740	0.497	9.521
benefits	OP	0.205	3.276	0.205	3.211				
	Sophistication	-0.006	0.166	0.017	0.504	0.044	1.066	0.043	1.207
added independent variable	benefits	-0.049	1.236	0.045	1.202	0.089	2.029	0.309	1.969
	Diagnostic Use	-0.008	0.135	0.089	1.787	0.157	2.438	0.146	2.297
	interactive Use	-0.057	1.205	0.113	2.785	0.050	0.760	0.088	1.910
<i>Coefficient of determination</i>		0.368		0.372		0.366		0.366	
<i>GOF</i>		0.478		0.481		0.476		0.477	
<i>SRMR</i>		0.063		0.064		0.063		0.060	

Since diagnostic use had no effect on PMS benefits and given the significant relationship between sophistication levels and interactive and diagnostic use, and because one component of sophistication links key performance measures to incentives, the present study's findings are consistent with the LOC framework. Similarly, Simons (2014) explained the relationship between diagnostic use and reward systems. In the present study, although the impact of diagnostic use on PMS benefits was not statistically confirmed, the significant relationship between diagnostic and interactive use indicates an overlapping effect. Considering the significant effects of the sophistication levels of PMS on its benefits, the emphasis on a specific use may bring about effective or ineffective outcomes in terms of PMS benefits, possibly explaining the ambiguous and contradictory results. [Bellora-Bienengraber et al. \(2023\)](#) and [Cupertino et al. \(2023\)](#) reported the same findings; however, the findings contrast with those of [Bedford et al. \(2023b\)](#) and [Heinicke et al. \(2016\)](#) regarding the relationship between diagnostic (interactive) use and PMS benefits. Given the compatibility of the sophistication level with the effect of PMS benefits, the findings align with Alamri (2019) findings and contrary to [Heinicke et al. \(2016\)](#).

Irrespective of the significance of PMS for organizational benefits, given that the emphasis on interactive use is associated with greater benefits, the nature of the interactive use of PMS focuses on strategic uncertainty, facilitates the emergence of new strategies, and positively promotes creativity by offering opportunities (searching behavior among individuals and activities), petrochemical managers should consider both types of use in the pursuit of greater benefits and promote OP. They can also adopt the present findings, focusing more on interactive use to gain benefits and enhance OP. This recommendation is in line with the nature of the operations in such companies, where new competitive strategies and employee creativity underpin their success and

competitive advantage. Moreover, given the insignificant effect of diagnostic use on benefits, managers are recommended to adjust for such an effect by linking diagnostic goal achievement to incentives. As Simons (2014) argues, incentive systems support diagnostic use within the LOC framework. Because diagnostic use focuses on crucial performance metrics, there is mutual dependence between levers, and both types of use have some interactive effects on OP. In this case, this finding can help managers achieve predetermined goals. Furthermore, senior management can further train supervisors in effective communication and interpersonal relationships, implement transparent damage compensation plans, and highlight the significance of nurturing corporate culture, thereby opening an avenue for achieving set goals.

Managers should emphasize the interactive function of Performance Management Systems (PMS), as findings indicate that this function significantly enhances the benefits of PMS. This includes using social controls, dialogue, creativity, and innovative strategies. Emphasizing the interactive function can facilitate the emergence of new strategies and create new opportunities for the organization. The benefits of emphasizing the interactive function are not contingent on the complexity level of the PMS. Therefore, managers can focus on the interactive function without concern for system complexity. Given the lack of confirmed effects of the diagnostic function on PMS benefits, managers can create more positive impacts by linking the achievement of diagnostic goals with incentives. This approach can help improve OP. The findings show that emphasizing the interactive function is equally effective in both large and small companies. Therefore, managers of any company size can benefit from this approach. Senior management can improve OP by allocating more resources to training supervisors in effective communication and interpersonal relationships, implementing transparent compensation schemes and performance evaluation systems, and promoting corporate culture. These implications can help managers in the Persian Gulf Petrochemical Holding leverage the present study's findings to gain more benefits from their PMS and enhance OP.

Besides survey research limitations, this study, like other cross-sectional studies, suffered from some limitations, as it only addressed the relationships and disregarded causality. Moreover, the sampling and analysis of the results were conducted in full accordance with the methodological standards; however, the generalization of the findings to companies operating in other industries or with different legal natures is limited due to the quality of the collected data and the limitations of questionnaires.

In conclusion, researchers have explored the effect of other contextual variables, such as type of ownership, corporate governance, structure, and organizational context, on the relationships of the aforementioned variables within the framework of CT in combination with other theories, such as Giddens' structuration theory. Finally, future researchers may detect the synergies of economic control mechanisms (e.g., the LOC framework) and the effectiveness of other control levers in companies operating in different industries or the context of the digital economy using suitable methodologies, such as quantitative approaches.

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RESEARCH ARTICLE

The Effects of Familiarity and Assertions of the RPT Violator on Internal Auditors' Credibility and Reporting Judgments

Marzieh Tohidinejad*

Faculty of Management and Accounting, Allameh Tabataba'i University, Tehran, Iran

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Abstract

A 2×2 full factorial experiment is designed by manipulating participants' exposure to the positive behavioral information of a Chief Financial Officer (CFO) as a violator of Related Party Transactions (RPT) (high versus low exposure) and his related assertions (combined versus denial assertion). These manipulated variables can influence internal auditors' credibility and reporting judgments in accordance with the mere-exposure effect and the benefit of the doubt. This study included 80 Iranian internal auditors as participants. The results suggest that exposure to the violator's positive behavioral information enhances internal auditors' perceived credibility of the violator, leading to a decreased likelihood of reporting the RPT. Furthermore, the findings demonstrate that when internal auditors are exposed to the positive behavioral information of the RPT violator, the combined assertion of the RPT violator reduces the probability of reporting the RPT by internal auditors. The results underscore the significance of professional judgment and skepticism among internal auditors.

Keywords:

Credibility Judgment, Mere-Exposure Effect, Reporting Judgment, Related Party Transactions, Violator's Assertions



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*Corresponding Author: Marzieh Tohidinejad

Email: mtohidinejad@yahoo.com

Tel: 09106169068

ORCID: 0000-0001-6045-4299

1. Introduction

A Related Party Transaction (RPT) transfers resources, services, or obligations between an entity and a related party, regardless of whether a price is charged. According to internal audit standards worldwide, such as the Standard on Internal Audit (SIA), internal auditors are required to perform audit procedures and related activities to gather information relevant to evaluating internal controls associated with RPTs. Furthermore, internal auditors must obtain sufficient and appropriate audit evidence regarding management's assertion that a RPT was conducted under terms equivalent to those prevailing in an arm's length transaction.

This study examines whether internal auditors' credibility and reporting judgments are affected by (1) exposure to the CFO's positive behavioral information and (2) the CFO's assertions regarding the RPT. Both factors are essential components of the internal audit process. Familiarity with the CFO relates to auditor-client staff interactions, which form an inseparable part of the internal audit process with potential unintended consequences. Considering the CFO's assertions (including admissions, denials, etc.) about the RPT is also a crucial element of evidence gathering in the audit process.

The combined influence of the two factors on internal auditors' credibility and reporting judgments has not been explored, yet it holds significance for several reasons. Familiarity arising from exposure to the violator's positive behavioral information alone (i.e., without any claims regarding the detected RPT) serves as an irrelevant cue; however, psychological research indicates that this can adversely impact internal auditors' reporting judgments. According to the mere-exposure effect, a well-known heuristic, individuals often develop a preference for things simply because they are familiar with them. Psychological studies reveal familiarity predicts liking, goodness, attractiveness, and pleasantness (Orive and Gerard, 1987; Clark and Watson, 1988; Bornstein and D'Agostino, 1994; Lee, 2001; Denrell, 2005). Consequently, familiarity is recognized as a threat to internal auditors (IIA, 2001). It may cause an auditor to lose perspective and prejudge a client based on past issues (or lack thereof), adopting a stance aligned with that prejudgment instead of approaching the situation with a fresh and objective viewpoint (Mutchler, 2003). Furthermore, the violator's assertions may influence the judgments of internal auditors. Psychoanalytic theory suggests that denial effectively helps repair trust after integrity-based violations (Kim et al., 2004, 2006; Ferrin et al., 2006), possibly because acknowledging violations triggers an unpleasant emotional response in those affected by a breach of trust. In practice, a third category of assertions also exists, which we refer to as a combined assertion in this study. Assertions that are appropriately combined convey both loyalty and innocence signals simultaneously. Consequently, a combined assertion may foster more favorable perceptions than a denial assertion. In the context of exposure to the violator's positive behavioral information, the violator's combined assertion may lead to further decreased objectivity in internal auditors' judgment while reporting the RPT, which poses a significant concern.

Various surveys and experiments illustrate the impact of external auditors' familiarity with clients on the audit process (Asare and McDaniel, 1996; Hussey, 1999; Wilson et al., 2018). For example, Bamber and Lyer (2007) noted that auditors tend to identify with their clients, and those who identify more strongly are more likely to conform to the client-preferred position. Cefaratti and Barkhi (2013) explored the effects of communication media and client familiarity on auditors' confidence in detecting deception. Asare and McDaniel (1996) analyzed the influence of familiarity with the preparer and task complexity on reviewers' effectiveness in identifying errors. Their study revealed that reviewers of unfamiliar preparers performed more of the preparers' work but did not identify more classification errors. In contrast, interactively, preparer familiarity and task complexity influenced effectiveness in detecting conclusion errors. Wilson et al. (2018) conducted

an experiment to assess whether increased audit firm tenure and auditor familiarity lead to greater trust, which enhances the willingness to whistle-blow. They found evidence that auditor familiarity boosts trust, positively affecting an employee's intentions to whistle-blow. While these studies emphasize external audit and client-related issues, our investigation in this study focuses on internal auditors and reporting issues concerning the client staff, specifically the CFO.

An experiment is conducted to investigate the related issues. The primary advantage of the experimental approach is that it allows us to manipulate the participants' exposure to the CFO's positive behavioral information and assertions. Furthermore, employing the experimental approach enables us to control other factors, such as pressures imposed on auditors and audit tenure, which influence internal auditors' reporting judgment in this study.

In this study, we conceptualized a CFO as a violator, an RPT as a violation, and the internal auditors' perceived credibility of the CFO and their decision to report or not report the RPT as the two dependent variables. We conducted a 2×2 full factorial between-subject experiment, manipulating two independent variables: prior exposure to the violator's positive behavioral information (low vs high exposure) and the violator's assertion regarding the RPT (combined vs denial assertion). The study participants consisted of Iranian internal auditors with professional experience in the internal audit departments of parent companies.

Our findings indicate that exposure to the violator's positive behavioral information enhances internal auditors' perceived credibility of the violator, leading to a decreased likelihood of reporting the RPT. Furthermore, the results demonstrate that when auditors are presented with the violator's positive behavioral information, this combined assertion boosts the perceived credibility of the violator and lowers the probability of internal auditors reporting the RPT.

This investigation adds to the existing body of knowledge in two significant ways. Firstly, we find that when internal auditors are presented with the violator's positive behavioral information, the perceived credibility of the violator is greater when they encounter the combined assertion rather than the denial assertion. Secondly, the increased credibility of the violator through high exposure, along with the combined assertion, reduces the likelihood of RPT reporting.

In the following section, we examine the relevant literature and formulate the hypotheses. Next, we outline the research design and experimental procedure, analyze the experimental results, and conclude the paper.

2. Hypotheses development

The familiarity principle is a cognitive shortcut through which individuals tend to develop a preference for things simply because they are familiar with them. [Zajonc \(1968\)](#) defines the familiarity principle as the mere exposure effect. The mere exposure effect is a heuristic by which individuals tend to favor things merely due to familiarity ([Zajonc, 2001](#)). In a meta-analysis, [Bornstein \(1989\)](#) documents a significant mere exposure effect concerning various types of stimuli: sounds, ideographs, nonsense words and symbols, drawings, photographs, words and names, polygons, objects, and people. Evaluating the mere exposure effect with people as stimuli has led to a research stream focused on interpersonal relationships. [Moreland and Beach \(1992\)](#) conducted a seminal study. Four female confederates entered a classroom in a manner visible to other students either zero, five, ten, or fifteen times over a semester; they did not interact with the students. Afterwards, students were asked to rate the confederates on various dimensions. The more often a confederate was seen by students, the more she was liked and rated positively across different dimensions. Other studies indicate that the more frequently another person is seen, the more participants rate that person positively and desire to interact with her/him ([Brockner and Swap,](#)

1976); the longer participants are exposed to another person's ideas, the more they appreciate that person (Brickman et al., 1975); and the more familiar participants are with a negotiation partner, the more willing they are to reach compromise solutions (Druckman and Broome, 1991).

Four general explanations clarify why familiarity predicts liking, goodness, attractiveness, and pleasantness. First, since most social experiences are mildly positive in affective tone, or at least not aversive (Clark and Watson, 1988; Denrell, 2005), individuals encountered more frequently become associated with positive effects. Second, novel stimuli evoke uncertainty and cautious reactions (Orive and Gerard, 1987; Lee, 2001), which diminish once repeated exposure, revealing the novel stimulus as benign. Third, familiarity creates opportunities for interactions. Positively toned interactions are more prevalent than aversive ones, suggesting that such opportunities are more likely than not to lead to rewarding social experiences and favorable impressions (Denrell, 2005). Fourth, familiar stimuli are processed perceptually and cognitively with greater fluency, and fluency is typically experienced in relatively positive affective ways (Mandler et al., 1987; Jacoby et al., 1992; Bornstein and D'Agostino, 1994). All four explanations indicate that prior exposure will similarly positively influence credibility assessments.

The positive effects of the familiarity principle enhance efficiency in executing various social tasks; however, these effects can backfire in certain situations. According to the framework of internal auditors (IIA, 2001), internal auditors perceive familiarity as a potential threat. This threat may arise from an auditor's relationship with the client or if the auditor has previously worked within the client unit. Familiarity can cause an auditor to lose perspective on an audit by making them overly sympathetic to the client. Conversely, familiarity may lead an auditor to prejudge a client based on past issues (or lack thereof) and adopt a stance aligned with that prejudgment rather than approaching the situation with a fresh, objective perspective (Mutchler, 2003).

Prior studies in the auditing and accounting literature have focused on the impacts of frequent exposure to decision-relevant information, such as repeated individual presentations of financial statement errors (Butt, 1988), financial statements alongside voluntary disclosures containing the same information (Joe, 2003), and redundancy in financial performance information (Hugon, 2004), as well as decision-irrelevant information, like the frequency of an analyst's name appearing (Bonner et al. 2007; Chen and Tan, 2013), on various types of judgments. While these studies investigate the effects of repeating individual decision-relevant and decision-irrelevant information, a variety of irrelevant information is often present simultaneously in more realistic situations.

Specifically, internal auditors are consistently exposed to various pieces of information (such as appearance, name, age, marital status, number of children, work experience, education level, skills, attitude, behavior, mood, etc.) about the employees of the company, particularly the CFO, which creates a mental sense of familiarity. Thus, there is always some degree of familiarity with the CFO. The lowest level of familiarity is confined to personal information, such as appearance, name, age, marital status, number of children, work experience, and education level, resulting from human resource process auditing. Conversely, familiarity at the highest level evolves into intimacy due to the long-term relationship. However, the most common level of familiarity is where internal auditors gather some behavioral information, such as attitude and mood, along with personal information through observation, interaction, and document review during the audit process.

Accordingly, we anticipate that exposure to both personal and positive behavioral information about the RPT violator will lead to a higher perception of the violator's credibility and, consequently, a lower likelihood of internal auditors reporting the RPT. We define low exposure as the auditor being exposed solely to personal information, while the high exposure condition refers to the scenario in which the auditor is exposed to both personal and positive behavioral information about the RPT violator.

In addition to exposure and familiarity, the judgment of internal auditors appears to be influenced by the violator's assertions. The claims regarding the identified violations are compelling and appealing in this context, particularly when paired with the positive effects of the familiarity principle. Two straightforward assertions in this scenario involve admitting versus denying the violations. Psychoanalytic theory posits denial as a defense mechanism whereby an individual confronts a fact that is too uncomfortable to accept and rejects it, insisting it is untrue despite potentially overwhelming evidence (Vaillant et al., 1986).

Research has shown that denial can be a more effective response in repairing trust after integrity-based violations (Kim et al., 2004, 2006; Ferrin et al., 2006), possibly indicating that admitting violations triggers a more unpleasant emotional reaction in those harmed by a trust breach. According to Kim et al. (2004), denial, which explicitly asserts that accusations of guilt are false, aids in trust repair by encouraging the betrayed individual to extend the transgressor the benefit of the doubt¹. It may be that acknowledging culpability by admitting to the violations, rather than allowing for doubt about responsibility through denial, results in more negative emotions (Kim et al., 2004). Some studies indicate that denying culpability in the transgression while expressing empathy significantly increases the violator's perceived integrity (Bagdasarov et al., 2019). People may be more inclined to repair trust after an integrity-based violation when the violator denies responsibility and responds with an empathetic display.

Although previous research has focused on comparing behavioral reactions to denial and admission, we also encounter combined assertions in the real world. In our study, the CFO might use a combined assertion such as "Although I was aware of the RPT, I was unable to prevent the transaction." While the initial admission ("I was aware of the RPT") demonstrates the CFO's loyalty, the subsequent denial ("I was unable to prevent the transaction") conveys innocence. Consequently, a combined assertion may foster even more positive perceptions compared to a denial assertion ("I was not aware of the transaction"). Combined assertions (denial following admission) may elicit stronger positive feelings.

Accordingly, we anticipate that the content of the combined assertion will lead to a higher perceived credibility of the violator and, consequently, a lower likelihood of internal auditors reporting the RPT. Hypotheses one through four are formally stated below.

H1: Exposure to both personal and positive behavioral information about the RPT violator has a more favorable impact on internal auditors' assessments of the violator's credibility when the violator employs a combined assertion rather than a denial assertion.

H2: A combined assertion utilized by the RPT violator has a more favorable impact on internal auditors' assessments of the violator's credibility when the internal auditor is exposed to both personal and positive behavioral information about the RPT violator compared to exposure to only personal information.

H3: Exposure to both personal and positive behavioral information about the RPT violator results in a higher likelihood of not reporting the RPT violation when the violator employs a combined assertion rather than a denial assertion.

H4: A combined assertion utilized by the RPT violator results in a higher likelihood of not reporting the RPT violation when the internal auditor is exposed to both personal and positive behavioral information about the RPT violator compared to exposure to only personal information.

¹ According to the Merriam-Webster dictionary, the benefit of the doubt is defined as the state of accepting something or someone as honest or deserving of trust even though there are doubts.

3. Method

3.1 Participants

We experimented with Iranian internal auditors in 2023. After reviewing LinkedIn user profiles over sixty days, we identified approximately 187 internal auditors with experience in the internal audit units of parent companies. LinkedIn is an American business and employment-oriented online service that enables members (both employees and employers) to create profiles and connect in an online social network that reflects real-world professional relationships. Given LinkedIn's popularity among Iranian professionals and the absence of a professional survey institution in Iran to assist researchers in locating relevant professional participants, we selected it as the most effective tool for identifying internal auditors.

We sent connection requests to all 187 internal auditors. Approximately 155 internal auditors accepted our invitation. After randomly sending online experiment links through LinkedIn messaging, 93 internal auditors participated in our study. According to G*Power output, a sample size of around 80 participants is sufficient for testing our hypotheses. Each participant is compensated with a certain amount for their involvement in the experiment.

3.2 Design

We utilize a 2×2 full factorial (exposure to the RPT violator's information; RPT violator's assertion) between-subjects design to test four hypotheses. The first independent variable is the exposure to the RPT violator's personal information (including age, marital status, work experience, and the number of children) and positive behavioral information (including general attitude and collaborative mood). Only the violator's personal information is presented to the participants in the low exposure condition. In the high exposure condition, however, participants are exposed to both personal and positive behavioral information of the violator. The second independent variable is the assertion made by the violator regarding the RPT. In the combined assertion condition, the violator admits he was aware of the RPT but denies his ability to prevent it. In the denial assertion condition, the violator claims he was unaware of the RPT.

3.3 Procedure

Participants are randomly assigned to the four conditions. Each condition consists of three main sections: (1) context description, (2) judgmental questions, and (3) demographic questions. The first section sets the scenario within an internal audit firm established by a parent company to periodically audit its associated companies. Following this, a specific case study is presented. One month has elapsed since the commencement of auditing at one of the associate companies in the construction industry. According to the parent company's internal regulations, no staff member's relatives are permitted to engage in transactions with the company where they are employed. It is then explained that the participant discovered evidence that the CFO's brother-in-law had purchased an apartment from the company through the bidding process. In odd conditions 1 and 3, only the CFO's personal information (including the photo, name, age, marital status, number of children, education level, and work experience) is provided. In even conditions (conditions 2 and 4), both personal information (including the photo, name, age, marital status, number of children, education level, and work experience) and positive behavioral information (including general attitude and collaborative mood) of the CFO is presented to the participants. Behavioral information in conditions 2 and 4 was conveyed to the participants through the following sentence: "The CFO is an affable and accommodating person who provides all the information and documents that you need". According to the majority of male CFOs in Iran, we used the same photo and full name of a man across all four conditions. To test the hypotheses, we also shared the CFO's assertions regarding his

RPT in two statements: (1) Although I was aware of this transaction, I was unable to prevent it (conditions 1 and 2); and (2) I was not aware of this transaction (conditions 3 and 4). Finally, we added the sentence "the conditions of the RPT (such as price) are the same as a normal transaction" to complete the context description and make the case more analogous to an ethical dilemma. This final sentence also mitigates the effects of the violator's potential financial incentives in RPT on internal auditors' reporting judgments. Figure 1 serves as a guide for manipulating independent variables across four conditions.

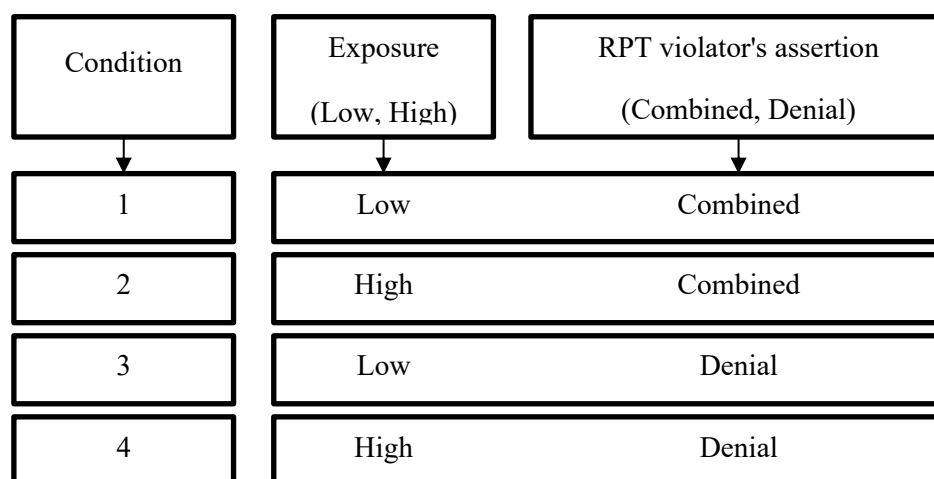


Figure 1. Manipulating independent variables in four conditions

In the second section, three identical judgmental questions were posed across all four conditions. Following prior research (e.g., Barton and Mercer, 2005; Mercer, 2005; Cianci and Kaplan, 2010; Chen and Tan, 2013), the credibility of the CFO is evaluated using a 9-point scale (0 = extremely low and 8 = extremely high) to test Hypotheses 1 and 2 in the first question. The second question is designed to capture participants' reporting judgments by providing two options: (1) to report the RPT or (2) to refrain from reporting the RPT. After selecting an option, participants encounter the third question, which assesses their confidence in their judgments on a 9-point scale (0 = extremely low and 8 = extremely high). Internal auditors were asked the final two questions to evaluate the likelihood of reporting the RPT to test Hypotheses 3 and 4. The data from the reporting judgment question (with a value of 1 for reporting and a value of 0 for not reporting the RPT) and the confidence question (measured on a 9-point scale, where 0 = Extremely low and 8 = Extremely high) are integrated using the following formula to determine the probability of reporting the RPT: [If the reporting judgment value is 1, then the probability of reporting the RPT is $((\text{confidence level}/8) \times 1)$; if the reporting judgment value is 0, then the probability of reporting the RPT is $((1 - (\text{confidence level}/8)) \times 1)$]. The research instrument across four experimental conditions is presented in Appendix A.

In the next section, participants responded to four demographic questions: age, gender, education level, and work experience as internal auditors. Appendix B contains the demographic questions.

4. Results

4.1 Manipulation checks

Participants are also asked to respond to two questions to verify their understanding of the key elements of the independent variables. One question is included to ensure that participants have accurately recognized the extent of exposure to the RPT violator's personal and positive behavioral

information. Another question is posed to confirm that participants correctly understood the CFO's assertion regarding the RPT. A total of 80 participants answered the manipulation check questions correctly. We excluded 13 participants who did not answer the manipulation checks accurately. Appendix B contains the manipulation check questions.

4.2 Descriptive statistics

The descriptive statistics are shown in Table 1. The average age of the 80 participants was 32.22 years. Among the 80 participants, 64 were male (80%) and 16 were female (20%). A total of 40 participants (50%) were randomly assigned to conditions 1 and 3, while 40 individuals (50%) took part in conditions 2 and 4. Regarding work experience, 11 (55%), 11 (55%), 12 (60%), and 10 (50%) participants had over 6 years of internal auditing experience in conditions 1 to 4, respectively. The majority of male participants were also evident in all conditions, with 16 (80%), 15 (75%), 16 (80%), and 17 (85%) participants in conditions 1 to 4, respectively.

Table 1. Descriptive statistics

Demographic Questions	Low Exposure		High Exposure		All Participants
	Combined Assertion	Denial Assertion	Combined Assertion	Denial Assertion	
	Condition 1	Condition 3	Condition 2	Condition 4	
No. of Participants:	20	20	20	20	80
Work Experience:					
Less than 3 years	5	6	4	5	20
3 to 5 years	4	3	4	5	16
6 to 10 years	6	5	5	6	22
More than 10 years	5	6	7	4	22
Gender:					
Male	16	15	16	17	64
Female	4	5	4	3	16
Mean Age:	33.68	32.94	30.33	31.94	32.22
Education Level:					
Bachelor degree	4	5	6	5	20
Master degree	13	12	13	12	50
Ph.D.	3	3	1	3	10

4.3 Test of Hypotheses

Table 2 presents the results regarding participants' perceived credibility of the RPT violator. The ANOVA results indicate a significant main effect of exposure to the RPT violator information ($p = 0.039$), an insignificant effect of the RPT violator's assertion ($p = 0.075$), and an insignificant interaction effect ($p = 0.452$; Panel B Table 2).¹ Figure 2 offers a graphical summary of ANOVA results related to testing Hypotheses 1 and 2.

The ordinal interaction suggested in Hypotheses 1 and 2 is examined through a contrast test with a weight of -3 in the "high exposure + combined assertion" condition and +1 in the "low exposure + combined assertion," "high exposure + denial assertion," and "low exposure + denial assertion" conditions (Buckless and Ravenscroft, 1990; Rosnow and Rosenthal, 1995). The results indicate that the contrast test is significant ($F = 63.459$, $p < 0.05$; Panel C Table 2).

1- We run several robustness tests. First, we transform data to ranks (as shown in Panel A, Tables 2 and 3) and run the two-way ANOVA using ranked dependent variables. Second, we run the non-parametric Kruskal-Wallis H test. Results from these tests were similar to those in our main analyses.

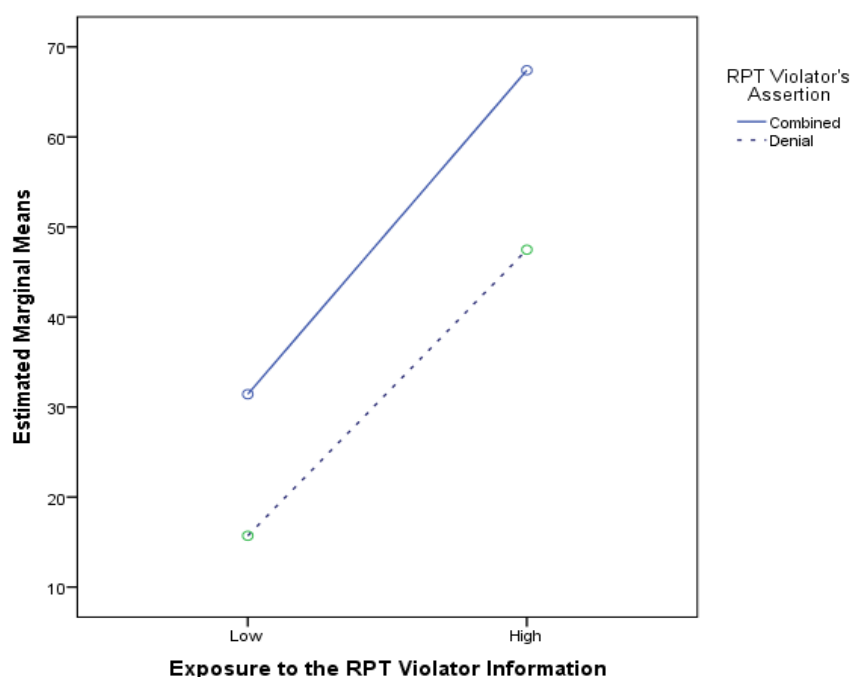


Figure 2. Estimated marginal means of perceived credibility of the RPT violator

Table 2. Credibility of the RPT Violator

Panel A: Mean perceived credibility of the RPT violator (standard deviation) [rank]				
Exposure to the RPT Violator Information	RPT Violator Assertion			Row Mean
	Combined	Denial		
Low	5.00 (0.86) [31.43] N= 20 [Condition 1]	3.75 (1.16) [15.70] N= 20 [Condition 3]		4.38 (1.19) [23.56] N= 40
High	7.30 (0.66) [67.40] N= 20 [Condition 2]	6.00 (0.86) [47.48] N= 20 [Condition 4]		6.65 (1.00) [57.44] N= 40
Column Mean	6.15 (1.39) [49.41] N= 40	4.88 (1.52) [31.59] N= 40		
Panel B: ANOVA results				
Source	df	Mean square	F	p-Value
Intercept	1	131220.000	4.491	0.208
Exposure	1	22950.312	260.208	0.039
Assertion	1	6354.612	72.048	0.075
Exposure × Assertion	1	88.200	0.571	0.452
Panel C: Contrast tests for testing H1 and H2				
Source	df	Mean square	F	p-Value
Contrast: [H1 & H2: +1/-3/+1/+1]	1	9797.708	63.459	0.000
Contrast: Condition 1 vs. Condition 2	1	12942.006	100.112	0.000
[H1: Effect of exposure in the presence of a combined assertion]				
Contrast: Condition 3 vs. Condition 4	1	10096.506	56.244	0.000
[H1: Effect of exposure in the presence of a denial assertion]				
Contrast: Condition 1 vs. Condition 3	1	2472.756	14.980	0.000
[H2: Effect of an assertion in the low exposure]				
Contrast: Condition 2 vs. Condition 4	1	3970.056	27.625	0.000
[H2: Effect of an assertion in the high exposure]				

To test Hypothesis 1, we conducted two contrast tests using the participants' perceived credibility data. Both contrast tests yielded significant results ($F = 100.112$, $p < 0.05$; $F = 56.244$, p

< 0.05). These findings support Hypothesis 1. Specifically, participants in the high exposure condition rated the CFO's credibility higher (mean = 6.65) compared to those in the low exposure condition (mean = 4.38).

Two additional contrast tests were conducted to evaluate Hypothesis 2. In line with Hypothesis 2, the outcomes of these contrast tests are also significant ($F = 14.980$, $p < 0.05$; $F = 27.625$, $p < 0.05$; Panel C, Table 2). Specifically, participants in the combined assertion condition perceive the CFO's credibility as higher (mean = 6.15) compared to the denial assertion condition (mean = 4.88).

4.4. Test of hypotheses 3 and 4

Table 3 summarizes the results of participants' RPT reporting probabilities. The ANOVA results indicate insignificant main effects of exposure to the RPT violator information ($p = 0.063$), the RPT violator's assertion ($p = 0.079$), and the interaction effect ($p = 0.718$). Figure 3 presents a graphical summary of the ANOVA results related to testing Hypotheses 3 and 4.

A planned contrast test utilizing weights comparable to those employed in the contrast test of Hypotheses 1 and 2 is conducted to examine the ordinal interactions outlined in Hypotheses 3 and 4. The result of the planned contrast test is significant ($F = 7.357$, $p < 0.05$; Panel C Table 3).

To test Hypothesis 3, we conducted two contrast tests. The first contrast test, which compares conditions 1 and 2, was significant ($F = 8.600$, $p < 0.05$), while the second contrast test, comparing conditions 3 and 4, was not significant ($F = 2.847$, $p = 0.069$). Specifically, participants in the combined assertion condition were less likely to report the RPT when they were highly exposed to the RPT violator's information (mean = 0.35) compared to when they were not (mean = 0.64).

Two additional contrast tests related to hypothesis 4 indicate that while the probability of participants RPT reporting in low exposure conditions remains unchanged regardless of whether the violator employs a combined or a denial assertion ($F = 3.174$, $p = 0.083$), in high exposure conditions, it increases when the violator uses a combined assertion compared to a denial assertion ($F = 5.462$, $p < 0.05$, Panel C, Table 3).

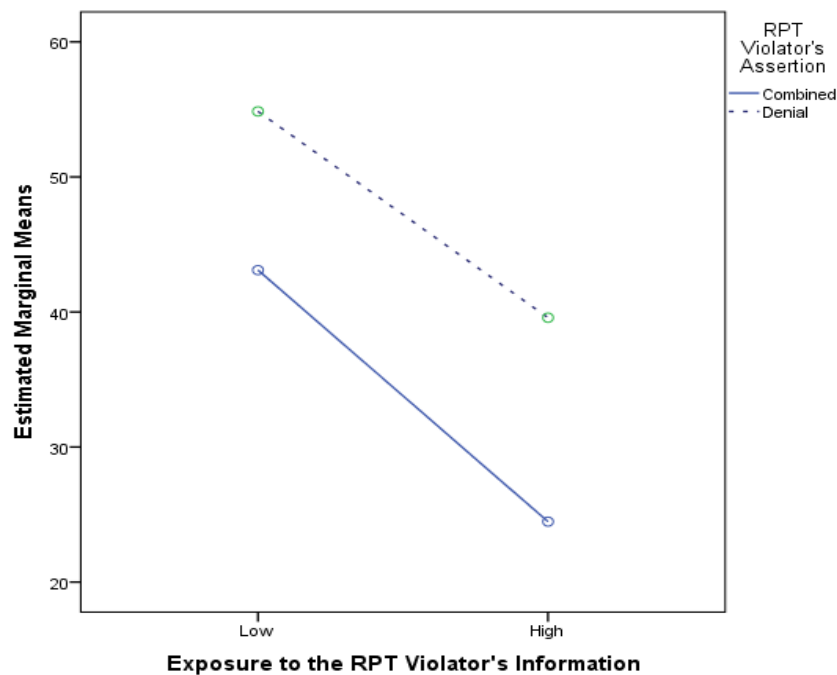


Figure 3. Estimated marginal means of probability of reporting RPT by auditors

Table 3. Internal Auditors' Reporting Probability

Table 3: Internal Auditors' Reporting Probability				
Panel A: Mean internal auditors' reporting probability (standard deviation) [rank]				
Exposure to the RPT Violator Information	RPT Violator Assertion			
	Combined	Denial	Row Mean	
Low	0.64 (0.28) [31.43] N= 20 [Condition 1]	0.78 (0.29) [15.70] N= 20 [Condition 3]	0.71 (0.29) [23.56] N= 40	
High	0.35 (0.29) [67.40] N= 20 [Condition 2]	0.58 (0.31) [47.48] N= 20 [Condition 4]	0.47 (0.32) [57.44] N= 40	
Column Mean	0.50 (0.32) [49.41] N= 40	0.69 (0.31) [31.59] N= 40		
Panel B: ANOVA results				
Source	df	Mean square	F	p-Value
Intercept	1	131220.000	14.118	0.071
Exposure	1	5746.05	102.402	0.063
Assertion	2	3604.612	64.239	0.079
Exposure × Assertion	2	56.112	0.132	0.718
Panel C: Contrast tests for testing H3 and H4				
Source	df	Mean square	F	p-Value
Contrast: [H3 & H4: +1/-3/+1/+1]	1	3135.592	7.357	0.000
Contrast: Condition 1 vs. Condition 2 [H3: Effect of exposure in the presence of a combined assertion]	1	3468.906	8.600	0.006
Contrast: Condition 3 vs. Condition 4 [H3: Effect of exposure in the presence of a denial assertion]	1	1393.878	2.847	0.069
Contrast: Condition 1 vs. Condition 3 [H4: Effect of an assertion in the low exposure]	1	1380.625	3.174	0.083
Contrast: Condition 2 vs. Condition 4 [H4: Effect of an assertion in the high exposure]	1	2280.100	5.462	0.025

5. Conclusion

This study investigates the combined effect of exposure to the RPT violator's positive behavioral information and the violator's assertions regarding the RPT on the reporting judgments of internal auditors from parent companies. In our experiment, we manipulated whether participants were exposed to the positive behavioral information of the CFO as an RPT violator in Stage 1 and whether the CFO acknowledged being aware of the RPT but was unable to prevent it (combined assertion) or simply denied awareness of the RPT (denial assertion) in Stage 2. Results indicate that while exposure to the RPT violator's positive behavioral information enhances the perceived credibility of the RPT violator, it results in a lower likelihood of internal auditors reporting the RPT. This underscores the familiarity threat faced by internal auditors. Additionally, results indicate that when auditors are presented with the RPT violator's positive behavioral information, the overall assertion of the RPT violator reduces the likelihood of internal auditors reporting the RPT.

Our study has implications for how client staff violators can influence auditors' judgments for their own benefit by enhancing their credibility through a shift in mentality (being friendly and accommodating while providing all necessary information and documents to the auditor) and their assertions regarding the violation (admitting and then denying their control over the violation instead of simply denying it). Consequently, auditors can remain vigilant in making their professional judgments. Our findings underscore the significance of professional judgment and skepticism among internal auditors.

Several limitations of the study should be acknowledged. One limitation is that we focus on the exposure of a male violator. In contrast, a female violator may hold greater credibility in auditors' minds due to the "*women are wonderful effect*". Future research could explore the incremental

impact of a female violator. Another limitation of the current study is our focus on internal auditors in Iran. Due to varying cultural contexts, conducting this research in other countries may yield different results. Other contextual factors may also influence our theoretical predictions and findings. For example, inexperienced auditors might be more susceptible to the exposure and assertion effects than their more experienced counterparts. We leave these questions for future research.

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Appendix A. Experimental conditions (Research instrument)

A.1. Condition 1

Consider an internal audit firm that is established by a parent company to audit associated companies periodically. As an auditor in this firm, you are committed to report all violations in related rules and regulations to your supervisor. In a specific case, one month has passed from the start of the auditing in an associate company in the construction industry. Mr. X is the CFO of the company. Mr. X has a master degree in accounting, he is 32, married, and has two children.

According to the parent company's internal regulation, none of the staff's relatives are allowed to transact with the company which they are working. That is while you have found evidence showing that the Mr. X's brother-in-law has purchased an apartment from the company through the bidding process. Your further investigations show that the transaction's condition (such as price) is the same as other normal transactions. During an interview, Mr. X asserted that although he was aware of this transaction, he was unable to prevent the transaction. Now, you have only two options to choose from:

1. To report the RPT.
2. To not report the RPT.

- How do you assess the credibility of Mr. X?

0	1	2	3	4	5	6	7	8
Extremely Low				Moderately				Extremely High

- Which option is *right* to choose? 1 ☐ 2 ☐

- Determine your confidence in choosing the right option.

0	1	2	3	4	5	6	7	8
Extremely Low				Moderately				Extremely High

A.2. Condition 2

Consider an internal audit firm that is established by a parent company to audit associated companies periodically. As an auditor in this firm, you are committed to report all violations in related rules and regulations to your supervisor. In a specific case, one month has passed from the start of the auditing in an associate company in the construction industry. Mr. X is the CFO of the company. *Mr. X has a master degree in accounting, he is 32, married, and has two children. It seems to you that Mr. X is an affable and accommodating person and has worked well with you by presenting all the information and documents you needed.*

According to the parent company's internal regulation, none of the staff's relatives are allowed to transact with the company which they are working. That is while you have found evidence showing that the Mr. X's brother-in-law has purchased an apartment from the company through the bidding process. Your further investigations show that the transaction's condition (such as price) is the same as other normal transactions. *During an interview, Mr. X asserted that although he was aware of this transaction, he was unable to prevent the transaction.* Now, you have only two options to choose from:

- To report the RPT.
- To not report the RPT.

- How do you assess the credibility of Mr. X?

0	1	2	3	4	5	6	7	8
Extremel y Low				Moderately				Extremel y High

- Which option is *right* to choose? 1 ☐ 2 ☐

- Determine your confidence in choosing the right option.

0	1	2	3	4	5	6	7	8
Extremel y Low				Moderately				Extremel y High

A.3. Condition 3

Consider an internal audit firm that is established by a parent company to audit associated companies periodically. As an auditor in this firm, you are committed to report all violations in related rules and regulations to your supervisor. In a specific case, one month has passed from the start of the auditing in an associate company in the construction industry. Mr. X is the CFO of the company. *Mr. X has a master degree in accounting, he is 32, married, and has two children.*

According to the parent company's internal regulation, none of the staff's relatives are allowed to transact with the company which they are working. That is while you have found evidence showing that the Mr. X's brother-in-law has purchased an apartment from the company through the bidding process. Your further investigations show that the transaction's condition (such as price) is the same as other normal transactions. *During an interview, Mr. X asserted that he was not aware of this transaction.* Now, you have only two options to choose from:

- 1- To report the RPT.
- 2- To not report the RPT.

- How do you assess the credibility of Mr. X?

0	1	2	3	4	5	6	7	8
Extremel y Low				Moderatel y				Extremel y High

- Which option is *right* to choose? 1 ☐ 2 ☐

- Determine your confidence in choosing the right option.

0	1	2	3	4	5	6	7	8
Extremel y Low				Moderatel y				Extremel y High

A.4. Condition 4

Consider an internal audit firm that is established by a parent company to audit associated companies periodically. As an auditor in this firm, you are committed to report all violations in related rules and regulations to your supervisor. In a specific case, one month has passed from the start of the auditing in an associate company in the construction industry. Mr. X is the CFO of the company. Mr. X has a master degree in accounting, he is 32, married, and has two children. It seems to you that Mr. X is an affable and accommodating person and has worked well with you by presenting all the information and documents you needed.

According to the parent company's internal regulation, none of the staff's relatives are allowed to transact with the company which they are working. That is while you have found evidence showing that the Mr. X's brother-in-law has purchased an apartment from the company through the bidding process. Your further investigations show that the transaction's condition (such as price) is the same as other normal transactions. During an interview, Mr. X asserted that he was not aware of this transaction. Now, you have only two options to choose from:

To report the RPT.

To not report the RPT.

How do you assess the credibility of Mr. X?

0	1	2	3	4	5	6	7	8
Extremely Low				Moderately				Extremely High

Which option is *right* to choose? 1 ☐ 2 ☐

Determine your confidence in choosing the right option.

0	1	2	3	4	5	6	7	8
Extremely Low				Moderately				Extremely High

Appendix B. Manipulation checks and demographic questions

B.1. Manipulation Checks:

What information is provided about Mr. X?

Personal information (photo, age, marital status, the number of children, education level, and working experience in the company)

Personal (photo, age, marital status, the number of children, education level, and working experience in the company) and Behavioral information (attitude and collaboration mood)

What was Mr. X's assertion about your findings about his brother-in-law's transaction with the company?

Mr. X asserted that he was not aware of it

Mr. X asserted that he was aware of it but unable to prevent it

B.2. Demographic questions:

Age:

Gender: Male ☐ Female ☐

Education level: Bachelor degree ☐ Master degree ☐ Ph.D. ☐

Work experience as an internal auditor: Less than 3 years ☐ 3 to 5 years ☐ 6 to 10 years ☐ More than 10 years ☐



Ferdowsi University of Mashhad

RESEARCH ARTICLE

The Role of Workforce Support on Financial Restatement: Evidence from Iran

Mahmoud Mousavi Shiri Hassanabadi*, Saeideh Nazari

Department of Management, Economics and Accounting, Payame Noor University, Tehran, Iran

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Abstract

The current study investigates whether the human factors of listed companies on the Tehran Stock Exchange affect financial restatement. The statistical population of this study includes all listed firms on the Tehran Stock Exchange during 2018-2023. The results show a positive and significant relationship between employee support and the occurrence of financial restatements. Further, the results confirm a positive relationship between managers' ability and financial restatement. By the way, there is a negative relationship between the existence of an internal control weakness in financial reporting and the financial restatement obtained. This study evidences that the support of human force, as one of the factors in implementing internal control, contributes to the role of internal control on financial restatement.

Keywords:

Employee Support, Financial Restatement, and Internal Control Weaknesses in Financial Reporting

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*Corresponding Author: Mahmoud Mousavi Shiri

Email: mousavi1973@yahoo.com

Tel: 09151126930

ORCID: 0000-0003-0158-7774

1. Introduction

Financial restatements and correcting accounting mistakes are practically acceptable since financial statements contain false information and have a statutory responsibility for auditors and managers (Kellogg, 1984; Karpoff et al., 2007; Francis et al., 1994). Gertsen et al. (2006) presented a fragmentation of financial restatements, stating that the criterion of this division is the intent of managers and the degree of falsification. According to their beliefs, the first category is the white lies, a situation where managers have not had an irregularity, and the distortion rate is also unimportant. The second category is purple delusion, which is when managers have significant distortions, but the management does not have malevolence. Further, the third is called grey accounting hocus pocus, and the low level of distortion is due to financial restatements. Finally, the fourth category, the most serious type of financial restatements, has been called black magic fraud, and significance distortion has led to financial restatements. Gleason et al. (2008) proved that financial restatements negatively affect the shareholders' wealth and even cause companies that operate in the same industry to experience stock price cuts. The important point is that if the number of financial restatement cases is high, the result is a decline in earning quality the allocation of inefficient resources and inappropriate transfer of wealth (Schipper and Vincent 2003).

This point should not be ignored, as internal controls are not their goals; they are a means to achieve one goal. In fact, with the implementation of the internal control process, we want to obtain reasonable assurance about the effectiveness and efficiency of operations and the ability to rely on financial reporting and compliance with the laws and other vital elements for the company's survival. Individuals heavily influence internal controls, including policies, guidelines, systems and forms, and individuals and their actions. It should be noted that fraud is structurally and behaviorally defined as the iceberg whose structural features are above the surface of the water. In contrast, the behavioral aspects of fraud are hidden underwater. Therefore, in order to detect fraud, in addition to structural factors, particular attention should be paid to behavioral issues, and the auditor must pay particular attention to dealing with the fraud in the motivation of employees and managers and should also check carefully internal controls and with a cursory look, discover the existing weaknesses or ambiguities.

The fourth principle adopted by the Committee of Sponsoring Organization (COSO) refers to commitment and adherence to competence and meritocracy. It states that employees are one of the most important aspects of internal controls, and that organizations must be committed to hiring and maintaining qualified personnel. The remarkable effect of human resources management practices, employment policies, training, evaluation, promotion and determination of the salaries and benefits of employee redundancy over the effectiveness of the control environment should not be neglected. Indeed, to successfully carry out all activities, individuals and their competencies should be considered an empowering factor.

Although the ultimate responsibility for the quality of financial reporting is the responsibility of the board of directors, it should be noted that the entire company's workforce not only contributes to the provision of accounting information but also plays an indirect role in providing raw data, which is the basis for the directors' reporting decisions, and this way they are also effective in financial reporting (Call et al., 2017). Hennes et al. (2008) and Acito et al. (2009) proved that the unintentional mistakes made by accounting staff members in applying accounting principles are the main factor of most financial restatement and they also found evidence that such kind of financial restatement less likely to happen in companies that pay attention to the interests of employees. Allocating costs to improve the quality of personnel, such as the cost of training and retraining, can reduce these unintended errors in gathering and generating data used as inputs to the accounting system. Highly educated employees are more likely susceptible in this regard. The highly educated

employees working in non-accounting sectors also improve the quality of financial reporting by the firm; one of the reasons is that to identify whether a problem is abnormal or not, there is no need to know about generally accepted accounting principles (GAAP) (Call et al., 2017). Dyck et al. (2010) found that in the process of fraud detection, investors, auditors and SEC do not play a crucial role, but it was employees who played the vital role in fraud detection; they documented that about 17 percent of fraud been discovered by the employees, that is, even more than auditors and the SEC (auditors 10 % and SEC 7 %). Weiss (1980), Laffont and Tirole (1988), and Perotti and Spier (1993) Suggest that fair treatment of a company with personnel can improve the company's access to qualified personnel, and by motivating employees, they can reduce the probability of personnel mistakes in performing financial reporting tasks. And according to Call et al. (2017), Hennes et al. (2008), and McGuire et al. (2012), more training for employees leads to higher quality accruals, declines weakness in internal controls and will also lead to a reduction in financial restatements.

Gaurav (2010), referring to the importance of employee satisfaction in organization survival, states that employee attrition is one of the organization's problems. There is a close relationship between employee attrition and employee satisfaction. In this regard, educational organizations intend to provide benefits such as attractive compensation packages, efficient training and flexible work options.

Due to the above discussion and theory of human capital of corporate governance, we can say that research in this field was necessary.

2. Literature review and hypothesis development

Jensen and Meckling (1976) emphasize the role of senior executives. However, it must be said that corporate governance problems at the top of the company pyramid are wrong. We should look more deeply into human resource behavior rather than highlighting the agency problem. In article 4, the internal control guidelines of accepted publishers in Tehran Stock Exchange, one of the requirements for creating an appropriate control environment is the competence of staff and human resources management, and it explains that senior management of the company must hire people who are competent, professional and committed to different categories of employees. To achieve this goal, the company executives must implement formulated methods for continuous education, assessment, rewarding, and disciplinary actions to maintain the competence of managers and staff. In fact, if there is success in financial reporting, it is the result of the whole workforce effort and it should not be considered that the senior executives are the main factor in this regard (Guo et al. 2016). So, it can be said that investing in the welfare of employees is likely to improve the performance of employees in financial reporting activities (Rajan and Zingales 1998; Zingales 2000). Katou and Budhwar (2007) show that human resource management policies related to employment, training, promotion, motivation, benefits, partnerships, health and safety have a positive relationship with organizational performance. Call et al. (2017) show that firms with workforce quality have higher quality accruals, quash fewer internal controls, and have less financial restatement.

In fact, employee behavioral policies can be considered a predictor for financial restatement. Hennes et al. (2008) and Acito et al. (2009) show that the reason for most financial restatements is the unintentional mistakes made by the accounting team's staff in applying the accepted accounting principles, and there has been evidence that such financial restatement has been less in companies that invest in employee benefits. According to Weiss (1980), Laffont and Tirole (1988), and Perotti and Spier (1993), the logic is that if the company has a fair treatment of personnel, it will facilitate access to qualified personnel, and by motivating employees, the risk of employees' mistakes in

performing financial reporting tasks will be reduced. [Cao et al. \(2020\)](#) find that negative abnormal employment changes are associated with a higher likelihood of subsequent financial restatements.

Therefore, paying attention to employees' welfare and pursuing desirable policies is a key factor in reducing financial restatements and correcting weaknesses in internal control. This leads us to our first hypothesis:

H₁: There is a relationship between employee support and financial restatement.

The ability of companies to use and manage intangible assets is much more important than tangible assets because the ability of organizations to use intangible assets is the main strength of the value of these organizations. [Dahmash et al. \(2009\)](#) pointed out that today's companies' highest value of assets is made up of intangible assets. According to [Blair and Wallman \(2000\)](#) human resources are one of the types of intangible assets in companies and maybe we can call it the most valuable intangible assets in the companies and to the point society. Therefore, the past discussions guide us to formulate the second hypothesis:

H₂: The ratio of high investment in manpower towards investment in assets effectively affects financial restatement.

Managers are also part of the human capital that plays a momentous role in turning resources into revenue and creating wealth for shareholders. Managers must understand the company's business operations, control activities, and industry conditions to design and direct the internal control framework; qualified directors are more likely to apply effective and efficient supervision to low-level personnel ([Guo et al., 2016](#)). General Accounting Office (GAO) (2002) considers financial restatement an important event, reflecting the poor quality of financial reporting last year. On the other hand, there is a sign of mismanagement derived from poor corporate governance. [Demerjian et al. \(2013\)](#) found that earnings quality has a positive relationship with managers' ability, and managers' ability has an inverse relationship with financial restatements. [Richardson et al. \(2005\)](#) state that financial restatement due to accounting mistakes includes a financial reporting situation that, contrary to accepted accounting principles, is approved by the management, which is more likely to occur in cases that deliberately and intentionally manipulate profits.

[Andreou et al. \(2013\)](#) believe that managers' ability has a positive and significant relationship with the company's performance. [Jihui and Linlan \(2019\)](#) explore management power's impact on financial restatement. [Kuang et al. \(2022\)](#) show that CFOs' professional ties with senior managers are associated with a lower likelihood of financial restatements.

The above points draw our attention to the following hypothesis:

H₃: There is a relationship between managerial ability and financial restatement.

3. Research methodology

In this research, our sample comprises 103 firms on the Tehran Stock Exchange in 6 years from 2018-2023. We used the Propensity Score Matching-Method (PSM) based on [Rosenbaum and Rubin \(1983\)](#) to test hypotheses. Due to the number of independent variables in each model being more than one, the statistical method is exploratory. In each hypothesis, all independent variables and the independent variable examined in the hypothesis should be meaningful in the model. In the exploratory method for testing each hypothesis, all independent variables must be meaningful alongside the independent variable of the hypothesis; otherwise, the independent variables should be extracted from the model in order of maximum p-value in order to arrive at a model where all independent variables are meaningful, and then we can comment on the result of the hypothesis.

According to the size of the acyclic criterion, in testing from H1 to H3, our chosen logistic regression is the effect of time.

3.1 Model specification and variable description

To test hypotheses, our logistic regression model is as follows (by using the PSM):

$$\begin{aligned}
 \text{PROB}(\text{RES}_t = 1) &= F(\alpha_0 + \alpha_1 \text{EMP}_t + \alpha_2 \text{MA}_t + \alpha_3 \text{MW} + \alpha_4 \text{MW}_{\text{PROCESS}} + \alpha_5 \text{CH}_{\text{EPL}_t} \\
 &+ \alpha_6 \text{MAG}_{\text{ACC}_t} + \alpha_7 \text{CH}_{\text{REC}_t} + \alpha_8 \text{CH}_{\text{INV}_t} + \alpha_9 \text{CH}_{\text{CS}_t} + \alpha_{10} \text{CH}_{\text{ROA}_t} + \alpha_{11} \text{MB}_t \\
 &+ \alpha_{12} \text{LOG}(\text{SEG}_t) + \alpha_{13} \text{FOR}_t + \alpha_{14} \text{RST}_t + \alpha_{15} \text{AQV}_t + \alpha_{16} \text{OUTBD}_t \\
 &+ \alpha_{17} \text{LN_MARKETCAP} + \alpha_{18} \text{AGGREGATE_LOSS} \\
 &+ \alpha_{19} \text{EXTREME_SALES_GROWTH} + \alpha_{20} \text{MERGER} + \alpha_{21} \text{BIG_AUD_FIRM} \\
 &+ \alpha_{22} \text{AUDITOR_RESIGN} + \alpha_{23} \text{BANKRUPTCY_RISK} \\
 &+ \alpha_{24} \text{RETURN_SKEWNESS} + \alpha_{25} \text{RETURN_STD_DEV} + \gamma \text{ industry effects} \\
 &+ \varepsilon_t)
 \end{aligned}$$

In the equation, the dependent variable is RES, which represents financial restatements. If a company discloses financial restatement, we assign it to 1; otherwise, it is 0. The first independent variable in this model is EMP, which represents employee support; in other words, it reflects the criteria of behavioral policies with employees at the company level, whether the company has invested in its personnel welfare compared with the industry in operation. In order to measure this variable, we have prepared a list of all active companies in industries, and for all active companies in the industry in the research years, the information about 17 chapters of expenditures, including personnel training, bonus chords, ben laborer, non-cash contributions to employees, health costs, donate to the employee, rewards, benefits of productivity, handsel, staff welfare, costs of retraining, retirement and innovation, benefits of ending staffing, employee benefits, cash and non-cash benefits of employees, paying per case, right to recruit, was gathered and then we calculated the average cost of personnel support for per person in the industry. If these costs were higher than the average industry, we would assign this value to 1; otherwise, 0. The next independent variable is CH_EPL, which represents a high proportion of investment in human resources relative to the proportion to investment in assets; if the percent change in the cost of personnel support is greater than the percentage of the change in assets, we will assign the value of 1, otherwise 0. The next independent variable is MA, which represents the ability of managers. In this paper, we used the model of [Demerjian et al. \(2013\)](#) to measure the managers' ability; in their view, two components influenced the company's performance, including the company's inherent characteristics and the managers' ability. According to [Ashbaugh-Skaife et al. \(2007\)](#), Firms that have weak internal controls are more likely to face financial restatements and legal actions in the stock market MW, which represents a material weakness in financial reporting if an independent auditor points out at least one material weakness in financial reporting, we assign number 1 to this variable, otherwise 0. The MW_PROCESS variable represents a material weakness in financial reporting at the process level; if the independent auditor pointed out in his comments a weakness in the main operations of the company (for example, a weakness in the firm's cost system), we would give this variable a value of 1 or otherwise 0. The MAG_ACC variable represents the magnitude of accruals; this variable was measured by modeling the research of Richardson, [Sloan et al. \(2005\)](#) Since the mistake in accounts receivable may lead to the company's sales growth fluctuating, we introduce the CH_REC variable in the model, which represents the percentage of changes in accounts receivable at the end of the fiscal year compared to the previous year. Also, because a mistake in inventories may lead to exaggeration in the company's profit margin, we introduce the CH_INV variable in the

model, which indicates changes in the inventory at the end of the fiscal year divided by total assets. To control the effect of the company's performance on the mistakes made in the financial reporting, the variables of CH_CS and CH_ROA have been considered; the former represents the percentage change in cash sales at the end of the fiscal year, the second indicates a change in the ratio of net profit to total assets at the end of the fiscal year. MB variable (to control the effect of company growth) represents the ratio of the market value of equity in proportion to its book value at the end of the fiscal year. The LOG (SEG) variable represents the natural logarithm of the number of subsidiaries, one of the criteria that express the complexity of the company's operations. The variable FOR represents the existence of external sales in the company, which also indicates the criterion of the complexity of the company's operations; if the company had sold export sales during the fiscal year, it would take a value of 1, otherwise 0. The variable RST represents the existence of a restructuring in the company; if a company discloses non-current assets held for sale in the year-end financial statements, the value equals 1; otherwise, 0. The variable AQV represents an increase in the number of subsidiaries. If a company had an increase in the number of subsidiaries during the fiscal year, this variable would be equal to 1; otherwise 0. The investment in subsidiaries would complicate the company's operations, so managers should properly evaluate and calculate these issues, implications, and fields. [Cao et al. \(2012\)](#) have found that the existence of more independent members on the board could act as an effective factor in limiting mistakes in financial reporting. We put the OUTBD variable in the model, indicating the board's independence, which is measured by the percentage of non-executive members of the board. The variable LN_MARKETCAP represents the natural logarithm of the sum of the market capitalization. In order to calculate this variable, the stock market value at the end of the fiscal year is multiplied by the number of shares, and then its natural logarithm is computed. [Xiong \(2006\)](#) also believes that the company's weak profitability motivates the director to refine the presentation of financial restatements, so we put the AGGREGATE_LOSS variable in the model. If a company discloses losses in two successive years, we assign a value of 1 to this variable; otherwise, 0. The EXTREME_SALES_GROWTH variable shows that if the industry's average sales grow from the previous year, we assign 1 to this variable; otherwise, 0. [Kinney et al. \(2004\)](#) believed that the acquisition activities had a positive relationship with the likelihood of restatement. We value the MERGER variable in this way: if the subsidiaries had increased over two consecutive years, we would have assigned 1 to this variable; otherwise, it would have been 0. To measure the effect of the size of an audit firm on financial restatements, we use the BIG_AUD_FIRM variable. In order to measure this variable, it is examined that if the Iranian Association of Certified Public Accountants is an independent auditor of the company, we assign 0 to this variable; otherwise, 1. The variable AUDITOR_RESIGN represents the change in the audit firm. [Mandle and Son \(2013\)](#) believed financial restatements positively correlated with the auditor's rotation. If the company's independent auditor changes, we assign 1 to this variable; otherwise, it is 0. The BANKRUPTCY_RISK variable represents the company's bankruptcy risk, the participation criterion in Article 141 of the Iranian trade law. If the company is covered by Article 141, we assign value 1 to this variable; otherwise, it is 0. When the company has a large bankruptcy risk, there is a sufficient incentive for fraudulent and fraudulent financial reporting. The RETURN_SKEWNESS variable represents the skewness of the firm's stock return calculated from t-5 to t. The RETURN_STD_DEV variable represents the standard deviation of stock returns calculated from t-5 to t.

4. Findings

4.1 Statistical analysis

In Table 1 and Table 2, we describe the descriptive statistics of independent and dependent

variables. The remarkable point is that financial restatements in Iran are frequent; the repeatability of this issue in Iran reduces the reliability of the financial statements and undermines the professionalism of accounting and auditing. About 71.80 percent of companies had financial restatements in our research (RES). Also, about 41.10 percent of companies had good support for their employees in proportion to the industry in which they work (EMP).

Table 1. Descriptive statistics of quantitative variables

Variables	Max	Min	Mean	Standard deviation
MAG_ACC	1.129	-0.659	0.042	0.168
CH_REC	267.900	-0.988	0.721	10.789
CH_INV	0.417	-0.390	0.031	0.083
CH_CS	63.756	-211.093	-	9.602
CH_ROA	0.417	-0.744	-0.013	0.106
MB	121.510	-32.953	2.922	7.300
LOG_SEG	3.401	0.000	1.529	0.823
OUTBD	1.000	0.000	0.673	0.189
LN_MARKETCAP	19.415	10.133	13.796	1.618
RETURN_SKEWNESS	2.235	-2.046	1.031	0.920
RETURN_STD_DEV	280.478	0.000	76.024	50.594
MA	0.578	-.5919	0.000	0.207

Table 2. Descriptive statistics of qualitative research variables

Variables	The number of firm-year, which number 1 was assigned		The number of firm-year, which number 0 was assigned		Missing data		Total
	Number	Percent	Number	Percent	Number	Percent	
RES	444	71.800	167	27.000	7	1.100	618
MW	393	63.600	214	34.600	11	1.800	618
MW_PROCESS	104	16.800	503	81.400	11	1.800	618
EMP	254	41.100	356	57.600	8	1.300	618
CH_EPL	295	47.700	291	47.100	32	5.200	618
FOR	433	70.100	177	28.600	8	1.300	618
RST	85	13.800	533	86.200	0	0.000	618
AGGREGATE_LOSS	58	9.400	560	90.600	0	0.000	618
EXTREME_SALES_GROWTH	467	75.600	151	24.400	0	0.000	618
MERGER	176	28.500	428	69.300	14	2.300	618
BIG_AUD_FIRM	151	24.400	456	73.800	11	1.800	618
AUDITOR_RESIGN	140	22.700	467	75.600	11	1.800	618
BANKRUPTCY_RISK	75	12.100	543	87.900	0	0.000	618

In the meantime, the interesting and important point is that in collecting variable data (EMP), we found that among the companies in the industry, only about 14.80 percent of companies spent their training or retraining costs on their employees, which in terms of amount, the cost of training and retraining accounted for only about 0.61 percent of the total expense incurred to support employees, which indicates that companies are not paying attention to the issue of personnel training. Also, among industry companies, approximately 4.20 percent of companies paid their right to recruit their personnel, which could be explained by the fact that companies have been incapable of recruiting and retaining specialist and meritorious employees or the company has ignored the value of employees' specialities, and they did not pay the right to recruitment, including the salary of qualified personnel, and therefore did not provide support for their valuable and experienced staff. While the importance of these personnel for the firm's survival was a clear issue.

Figure 1 The ROC-axis belongs to the logistic model of the dependent variable of financial restatements, which evaluates the model's hypotheses. The surface area under this curve is (0.9622), indicating that this model is strong in sensitivity.

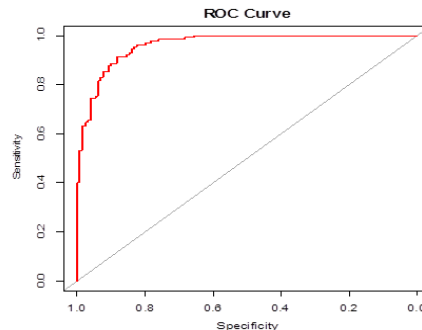


Figure 1. Curve ROC model

The surface area under the curve is equal to 0.9622, which indicates that the model has been a strong model for sensitivity.

4.2 Testing of hypotheses

Table 3 relates to the inferential statistics of the hypotheses, which examines the relationship between independent variables and the dependent variable financial restatements; in the table's columns, the p-value of each hypothesis's independent variables and control variables is presented separately.

Column H₁ belongs to the H1 test. As it is known, the p-value for the support personnel variable is less than 0.05, so H1 is verified. Also, with regard to the sign of the number of statistics, a positive relationship is detected; in other words, the greater the support of the personnel, the more the financial restatements. Column H₂ is related to the H2; as indicated in the table, the p-value for this variable is greater than 0.05, so this hypothesis is rejected; therefore, there is no relationship between the ratio of investment in manpower in proportion to investment in assets and financial restatements. Column H₃ shows the results of the implementation of the H3. As shown in Table 3, the value of the variable for managerial ability is less than 0.05; therefore, the H3 is verified, and according to the statistical sign, the relation is positive. In other words, by increasing managers' ability, financial restatements will also increase.

5. Conclusion

Our findings in Iran confirm that Charan and Colvin (1999) believe that about 90 percent of organizations fail to implement their strategies because only 5 percent of employees understand and only 20 percent of executives see their interests in strategies. All employees must consider their business interests and fate to achieve organizational strategies. The design and implementation of compensation systems linked to the evaluation criteria of strategies can provide an appropriate mechanism for creating more employee alignment with the strategy. In fact, positive workplace cultures in which employees believe they are important to the organization are the key to achieving the objectives of performance appraisal (Cravens et al. 2015). Bentley-Goode et al. (2017) explored the implications of the strategies concept and concluded that business strategies are an indispensable indicator of internal control power. Each person adds unique abilities to their workplace and has different needs and priorities. However, it is not possible to conceal the value of

these differences in innovation and productivity. Still, if individual differences coherence is correct with the entity's objective, it can have a negative effect (COSO, Internal Control-Integrated Framework 2011). Frey (1997) argues that even though economists do not deny the effects of intrinsic motivation, they believe that "everything has its price", but psychologists emphasize the behavioral motives within the person. Still, it must be said that intrinsic and extrinsic motivation are not separable. Frey (1997) also argues, based on Stiglitz (1987) that wage incentives are often addressed to managers and are rarely considered effective for mid-level employees. Another result of this study is a positive relationship between managers' ability and financial restatements. This can be justified in the capital market of Iran, where powerful executives have enough motivation to report revenue exaggeratedly and preserve their reputation and market; because of having such capabilities, they are successful in this field, and in fact, the fourth dimension of the fraud diamond of Wolfe and Hermanson (2004), which is the representation of talent factor, vaunts in the capital market of Iran. According to Francis et al. (2008), the reason can be that companies with a low earning quality are recruiting more reputable directors in this way; the company introduces a company with strong internal controls and reduces the severity of the negative effects on the company. Indeed, the Epic of America theory, expressed by Adams (1931) and Anomic Theory, as expressed by Merton (1938), also partly vaunts in Iran. In reality, the emphasis on monetary success is a factor in increasing the tendency to commit fraud by senior executives (Choo and Tan 2007), and the factor of ability and talent also do so.

Table 3. Results of hypotheses testing

Dependent variable: financial restatements (RES)						
Independent and controllable variable	H ₁		H ₂		H ₃	
	Z statistic	p-value	Z statistic	p-value	Z statistic	p-value
EMP	4.492	< 0.001***	4.526	< 0.001***	4.492	< 0.001***
MA	2.189	0.028*	1.987	0.046*	2.189	0.028*
MW	-3.144	0.001**	-3.159	0.001**	-3.144	0.001**
MW_PROCESS	4.481	< 0.001***	4.49	< 0.001***	4.481	< 0.001***
CH_EPL			-0.956	0.339		
MAG_ACC	-3.278	0.001**	-3.324	0.000***	-3.278	0.001**
CH_REC	2.011	0.044*	2.008	0.044*	2.011	0.044*
CH_INV	1.510	0.131	1.544	0.122	1.510	0.131
CH_CS	-0.048	0.961	-0.098	0.921	-0.048	0.961
CH_ROA	-1.040	0.298	-0.911	0.362	-1.040	0.298
MB	-1.990	0.046*	-2.073	0.038*	-1.990	0.046*
LOG(SEG)	1.077	0.281	1.108	0.267	1.077	0.281
FOR	-3.336	0.000***	-3.325	0.000***	-3.336	0.000***
RST	1.594	0.110	1.569	0.116	1.594	0.110
AQV	-1.821	0.068	-1.904	0.056	-1.821	0.068
OUTBD	-2.670	0.007**	-2.562	0.010*	-2.670	0.007**
LN_MARKETCAP	3.817	0.000***	3.786	0.000***	3.817	0.000***
AGGREGATE_LOSS	-1.577	0.114	-1.55	0.121	-1.577	0.114
EXTREME_SALES_GROWTH	1.770	0.076	1.653	0.098	1.770	0.076
MERGER	3.948	< 0.001***	3.981	< 0.001***	3.948	< 0.001***
BIG_AUD_FIRM	-3.315	0.000***	-3.406	0.000***	-3.315	0.000***
AUDITOR_RESIGN	-3.868	0.000***	-3.942	< 0.001***	-3.868	0.000***
BANKRUPTCY_RISK	4.799	< 0.001***	4.837	< 0.001***	4.799	< 0.001***
RETURN_SKEWNESS	2.438	0.014*	2.545	0.010*	2.438	0.014*
RETURN_STD_DEV	-2.660	0.007**	-2.660	0.007**	-2.660	0.007**

*, **, *** Denote the error level at 5 percent, 1 percent and 0.1 percent.

In the a-model, the PSM-Method is used to test the hypotheses.

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RESEARCH ARTICLE

Robust Portfolio Optimization using LSTM-based Stock and Cryptocurrency Price Prediction: An Application of Algorithmic Trading Strategies

Mehrdad Heydarpour, Hossein Ghanbari, Emran Mohammadi*, Saeed Shavvalpour

School of Industrial Engineering, Iran University of Science and Technology, Tehran, Iran

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Abstract

Algorithmic trading (AT) has become widely used recently because of its high speed and accuracy in implementing diverse and complex strategies. Using algorithms also allows traders to execute their trading strategies in a high volume and numerous transactions without involving human emotions. While AT has many advantages, it also carries some risks due to the uncertain stock market conditions and the impact of news and political, social, and other events. Therefore, forming a stock portfolio and stabilizing against uncertainties, in conjunction with accurate market predictions, can significantly reduce risk. In this paper, for the first time, we proposed a robust portfolio optimization model based on LSTM prediction using the AT strategies based on short-term moving average (MA) techniques. First, we implement the strategies derived from the VLMA, FLMA, EMA, and SMA algorithms based on the LSTM's predicted price. Secondly, we develop a robust portfolio optimization model using the abovementioned algorithms. The results show that moving average strategies will perform better in both stock and crypto portfolios than the benchmark strategy (Buy-and-hold). Also, when the model parameters are deterministic, the robust portfolio constructed stocks and crypto will perform better than Buy-and-hold for all algorithms. However, when the variance from specific models increases, VLMA and FLMA (15-day holding) for stocks and FLMA (30-day holding) for the crypto will not be a suitable investment option. Additionally, portfolios constructed using all AT strategies and all assets outperform the benchmark portfolio in specific and non-certain markets.

Keywords:

Robust portfolio optimization,
Algorithmic trading, Price
prediction, LSTM

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*Corresponding Author: Emran Mohammadi

Email: e_mohammadi@iust.ac.ir

Tel: 09124304053

ORCID:

1. Introduction

In the past few years, the financial industry has experienced significant progress and growth thanks to the rapid development of computer technology. This has paved the way for exciting and valuable opportunities for market participants, with algorithmic trading (AT) emerging as a prominent tool. AT, or algo-trading or automated trading, is a computerized trading system that executes trades based on pre-programmed instructions. Furthermore, it has reduced trading costs, minimized the impact of human emotions on trading decisions, and increased market liquidity, which has made AT popular with many investors and researchers.

Providing a situation with an accurate stock market prediction with the help of machine learning (ML) and deep learning (DL) algorithms is one of the other advantages of developing computer technologies in finance. These advanced algorithms analyze vast amounts of historical data to identify patterns and trends and help predict future market movements. This can be a precious tool for investors and financial professionals looking to make informed decisions about their investments. By leveraging the power of ML and DL Methods, finance professionals can gain a deeper understanding of market trends and make more accurate stock market predictions.

While the stock market offers investors access to innovative investment tools and methods that can yield significant benefits, it is susceptible to fluctuations triggered by dynamic variables such as breaking news, economic developments, and socio-political events like the COVID-19 pandemic and the Russia-Ukraine conflict. These fluctuations increase the risk associated with investments. Thus, forming a well-diversified portfolio that is robust enough is essential to mitigate these risks and improve investment return. For the first time, Markowitz (1952) combined the risk and return concepts in the mean-variance model.

One particularly well-regarded method that has captured the attention of researchers is the LSTM method, known for its accurate forecasting and other associated benefits (Graves and Schmidhuber, 2005; Ta et al., 2020; Rather, 2021; Cipiloglu et al., 2022). Moreover, adopting technical analysis strategies in algorithmic and applied trading has become attractive for researchers and investors (Frattini et al., 2022; Aycel and Santur, 2022; Kalariya et al., 2022). It is worth noting, however, that the implementation of AT strategies based on predicted prices with LSTM has not been widely observed, potentially leading to significant losses. Another critical issue is the underutilization of uncertainty layers to manage uncertainties in portfolios based on LSTM.

The principal objective of this study is to propose a robust portfolio optimization model grounded in prediction established through the algorithmic trading approach. To address the research inquiries, this investigation introduces a three-phase model. The process begins with using the LSTM model to predict stock prices. Then, algorithmic trading techniques are used to implement strategies based on moving averages (MA). After that, each trading algorithm's minimum and maximum return values are determined. In the final stage, a strong portfolio is created for each trading algorithm, and then a diversified, robust portfolio is formed based on all the algorithms. The results show that this approach delivers better performance in stock and crypto portfolios than the benchmark strategy. Additionally, the combined robust portfolio outperforms the buy-and-hold strategy across all levels of uncertainty. The remainder of this paper is organized as follows. Section 2 concisely overviews recent AT methods through a literature review. Section 3 is devoted to mathematical models and strategies. Section 4 presents the experiments performed and the computational results. Section 5 is devoted to the discussion and managerial insights, and Section 6 concludes the paper and provides suggestions for possible future research.

2. Literature review

2.1 Prediction

Price prediction plays a significant role in asset allocation, risk management, and asset valuation (Dai and Zhu, 2020). Therefore, many researchers have focused on this topic in recent years. In this article, we will analyze a few of them. Ariyo et al. (2014) presented a process for building an ARIMA model for forecasting NYSE and Nigeria Stock Exchange (NSE) stock prices. Furthermore, the article asserts that the mentioned model provides better prediction power in the short term than existing methods. Siami-Namini et al. (2019) compare the behavior of LSTM and BILST to discover how useful additional layers of trained data are for adjusting the involved parameters. Finally, they conclude that BILST-based models have better forecasting performance than ARIMA and LSTM-based models due to additional data training. Shahvaroughi Farahani (2021) attempted to forecast interest rates by employing Artificial Neural Networks (ANN) and enhancing the network's performance by utilizing innovative heuristic algorithms such as MFO, CHOA, and TVAC-PSO. Sapankevych and Sankar (2009) use the SVM model to predict stock prices as this method is highly effective in predicting nonlinear, non-stationary, and undefined a priori time series. Mondal et al. (2014) Analyzed the predictive power of the ARIMA model on 56 stocks from different industries in the Indian stock market. The Akaike Information Criterion (AIC) was used in this research to compare and parameterize the ARIMA model. Chen et al. (2021) introduced a novel portfolio construction approach that uses a hybrid ML and mean-variance model. As part of the hybrid model, stock prices are predicted using Extreme Gradient Boosting and IFA, and portfolios are selected using the MV model, which selects stocks with higher potential returns. According to a study on the Shanghai Stock Exchange, the method outperforms traditional methods and benchmarks regarding returns and risks. Sen et al. (2021) present the creation of optimal risk and portfolios in India's four economic sectors using ten significant stocks from web-extracted prices between 2016 and 2020. The paper also evaluates the performance of an LSTM model in forecasting stock prices. It compares the predicted and actual returns six months after the portfolios were constructed. LSTM model performs accurately, demonstrating its capability to forecast stock prices in the Indian market. Imajo et al. (2021) presented two techniques for improving financial prediction algorithms. The first is a technique for efficiently extracting information that can be combined with different prediction models. Second, a novel neural network architecture incorporates biases associated with financial induction, such as fractal dimensions and time scale invariance. U.S. and Japanese stock market data are used to demonstrate their effectiveness. Experimental ablation confirms their contributions. Fu and Wang (2020) developed a multi-period portfolio model that utilizes predictive data to allocate resources efficiently. To optimize resource allocation and predict future stock prices, they employ LSTM neural networks and particle swarm optimization algorithms. The approach they have developed has been validated by empirical research. Ferdiansyah et al. (2019) studied using LSTM modules for Bitcoin forecasting. These modules have gained popularity among researchers and have the same recurrent properties as RNNs. Based on the research, Bitcoin on Yahoo Finance will surpass USD 12600 in the days following the prediction. In Schöneburg (1990), neural networks were used to predict short-term stock prices for three randomly selected German stocks (BASF, COMMERZBANK, and MERCEDES). Within a 10-day prediction period, the researcher achieved promising results with accuracy rates up to 90% using PERCEPTRON, ADALINE, MADALINE, and BACK-PROPAGATION networks. The BACK-PROPAGATION network demonstrated behavior similar to exponential smoothing. These findings suggest that neural networks could enhance stock price prediction. Obthong et al. (2020) examined the challenges associated with stock price forecasting

and the importance of accurate information for effective decision-making. Various methods and algorithms for improving accuracy in stock price prediction are examined in this review. To optimize the problem of stock price prediction, [Lee \(2001\)](#) proposed a reinforcement learning model as a Markov process. As a result of experimental testing on the Korean stock market, this method demonstrated promising performance in improving accuracy in stock price prediction. Although, investors can gain enormous benefits from the novel investment tools and methods available in the stock market. However, considering its nature and the high effectiveness of news, economic parameters change, and political and social events, such as the dollar's removal from global exchanges, the coronavirus epidemic, the Ukraine-Russia war, etc. Investing in the stock market can be risky. Therefore, it is necessary to form a stock portfolio. Novel mean-variance portfolio optimization model that balances risk and return, presented by Markowitz. By using this model, the investor can create his ideal portfolio based on his risk tolerance. Several studies have been conducted to complete and improve the Markowitz model. A mean-variance portfolio selection model with stochastic parameters published by [Lim and Zhou \(2002\)](#) focuses on the continuous mean-variance portfolio selection model with random interest rate and volatility coefficients in a complete market. This problem is solved using the optimal quadratic linear and backward differential equations. Through this quadratic linear equation, the strategies, as well as the efficient frontier of the average variance, are extracted. [Low et al. \(2016\)](#) attempt to answer why mean-variance models work poorly. In response to this question, first, by sampling the multivariate probability model that explicitly includes distributional asymmetry, it estimates the expected return. The study also demonstrates that marginal models of dynamic characteristics, such as volatility clustering and skewness, are effective in reducing estimation errors compared to historical sampling windows. Finally, several models based on average variance exhibit significant statistical performance even after accounting for transaction costs. Due to its simplicity, accessibility, and robustness, mean-variance portfolio theory is usually used in investments. However, one of the gaps in this theory is ignoring the non-Gaussian returns of higher moments [Lassance \(2022\)](#) Provided the updated mean-variance portfolio using non-Gaussian returns, it optimizes the selected high moment criteria. In multi-objective optimization, convergence and diversity are two essential aspects. Researchers have made numerous attempts to design convergent systems in recent decades.

2.2 Algorithmic trading

[Moldovan et al. \(2011\)](#) proposed a trading algorithm that uses multiple technical indicators to increase the accuracy of trading signals. The indicator parameters can be adjusted quickly and reliably with this solution but can also be used to identify new trading rules. Trading rules discovered automatically and by experts' observations could be combined to create an automated trading system. Risk-return balances must be controlled since everyone has different risk tolerance levels. This may lead to the development of evolutionary trading systems. [Lei et al. \(2020\)](#) improved the efficiency of the traditional MACD algorithm based on residual networks. They believe DL networks can analyze the likelihood of a trading point succeeding based on market behavior. The MACD-KURT strategy was tested on the Chinese market based on Residual Networks predictions and analysis of technical indicators. According to the results, a strategy employing residual network forecasting and indicators analysis together is more effective than a strategy based exclusively on technical analysis. This is both in terms of risk and returns. [Shavandi and Khedmati \(2022\)](#) present an agent-based deep reinforcement learning framework that utilises multiple agents' collective intelligence. It works in a hierarchical structure where knowledge flows from high-timeframe agents to low-timeframe agents. This makes them highly robust to financial

time series noise. Results indicate that the developed multi-agent framework, based on several return-based and risk-adjusted performance measures, outperforms individual agents and benchmark trading strategies in all investigated trading timeframes. Multi-agent frameworks are appropriate for AT in financial markets because of their robust performance. Scholtus et al. (2014) found that news-based trading strategies become significantly less profitable if there is a delay of 300 MS or more in news delivery. The reduction in volatility is more pronounced on days with efficacious news and high levels of volatility. They also examine AT's impact on market quality around the release of macroeconomic news. It was stated in their report that automated activity increases trading volume and depth within one minute of the arrival of macroeconomic news. A real-world setting where prices are interrelated is considered by Iqbal et al. (2019). In this scenario, each price is determined by the price that precedes it. They also derive a lower bound on non-preemptive randomized algorithms. Based on the erroneous and fixed price bounds, they developed an updated model that enhances the bounds. Based on the updated model, they proposed a non-preemptive reservation price algorithm RP^* and analyzed it using a comparative analysis framework. A quantitative analysis of time series data was used to propose trading strategies by Salkar et al. (2021) to achieve high profits on intraday trades, and these strategies were developed. Findings indicate that the strategy combining RSI and MACD provides the highest returns of up to 12%. Chang et al. (2017) assessed the performance of every stock listed on the Taiwan Stock Exchange (TWSE) using variable-length moving averages (VMAs). They calculated the excess returns of technical trading in comparison with BH trading. In addition, the study results indicate that VMAs perform better than BH strategies. Furthermore, the profitability of VMAs is positively correlated with the size and volume of trades. Pradhan et al. (2021) developed the strategy of SMA(30,100) based on the predicted price by LSTM.

Garcia and Schweitzer (2015) analyzed economic and social signals about Bitcoin prices. These signals included exchange volume, technology adoption, Analysis of Bit coin-related tweets for information, word-of-mouth volume, emotional valence, and opinion polarization. The study's findings inform profitable AT strategies for Bitcoin, which leverage the sentiments expressed in social media to generate positive investment returns. Vo and Yost-Bremm's (2020) Applied Design Science Study to develop a high-frequency trading strategy for Bitcoin based on six exchanges as their Information Technology artefact. Their strategy incorporates indicators related to the financial market and algorithms based on ML. Chaboud et al. (2014) examined AT and its effects on the FOREX utilizing extensive high-frequency data. They observe that AT improves price efficiency by reducing triangular arbitrage opportunities and decreasing autocorrelation of high-frequency returns. Hendershott et al. (2011) studied the effect of AT on liquidity by employing the NY Stock Exchange (NYSE) automatic quote dissemination system in 2003 as an external control. AT decreases spreads, minimizes adverse choices, and diminishes trade-related pricing, especially in large firms. The results of this study indicate that AT contributes to improved liquidity and informativeness of quotes. Weller (2018) has challenged the idea that AT can enhance price efficiency. Based on an analysis of stock-quarter data provided by the Securities and Exchange Commission (SEC), researchers found that the amount of information in prices diminished between 9% and 13% per standard deviation of AT activities one month before the planned disclosure. Another innovative tool available to investors, investment funds, and other institutions is the ability to predict market fluctuations with high accuracy through advanced methods and techniques. ML, artificial neural networks, DL, etc., are among the methods and techniques that are involved in these

processes.

2.3 Robust portfolio optimization

A robust portfolio optimization process considers the worst-case scenario and performs optimization based on that scenario. Robust optimization for the first time was presented by Soyster (1973) in the form of a linear optimization model that provides the best-justified solution regardless of the duration of the input data. This approach produces conservative results in practice. To ensure robustness, we move away from the optimality of the nominal problem. This field has been the subject of numerous research studies. Bertsimas and Sim (2004) presented a model that can be adjusted to resolve high conservatism. This can only be done by setting one parameter to this model's linearity and ability to solve integer models quickly. Following, we will briefly review some examples of robust portfolio optimization models. In this section, we will review a few examples. Goldfarb and Iyengar (2003) Formulated and solved a robust portfolio selection problem (allocation). This study analyses an optimal portfolio to determine its sensitivity to errors and optimize the relevant market parameters. According to the study's findings, uncertainty structures are related to statistical confidence regions used to evaluate parameters. Eskorouchi et al. (2024) conducted a bibliometric analysis to investigate recent progress in the robustness of portfolio optimization in light of the current global economic instability impacting financial markets. Kim et al. (2018) described recent developments in the classification of robust optimization models, the allocation of assets according to asset classes, and the selection of portfolios based on private assets. Additionally, robust portfolio selection methods suitable for each asset category were separated. A hierarchical model for robust investment between two risky assets has been proposed by Lin et al. (2022). The model consists of two steps. First, it chooses a relatively safe asset, and then it decides how much to invest in the relatively risky asset to avoid uncertainty in the relatively safe asset. A robust portfolio optimization model based on evidence theory was presented by Eskorouchi et al. (2022); using the Dempster-Shaffer model, they determined each share's range. Following this, the Bertsimas model was applied to calculate stock portfolio returns at different levels of uncertainty. The literature review indicates that there are two gaps in algorithm trading studies. First is the lack of integration between AT studies and robust portfolio optimization models. Secondly, a study that combined the VLMA, FLMA, EMA, and SMA algorithms with the predicted price using LSTM in a short-term period was not observed.

Therefore, to cover the gaps mentioned in this paper, we developed a robust portfolio optimization model based on LSTM prediction using the AT algorithm for the first time. First, we predicted daily price fluctuations using the LSTM model. In the next step, we developed a robust portfolio optimization model for each VLMA, FLMA, EMA, and SMA algorithm based on the predicted price. This study was conducted between January 2018 and July 2023 on ten assets, including five shares of the American stock market and five cryptocurrencies.

3. Research methodology

3.1 Model

In this section, we present the methodology employed in our study, which consists of three key subsections: portfolio optimization model, LSTM prediction model, and algorithmic trading strategies. Each subsection focuses on a specific aspect of our research and contributes to our robust

portfolio optimization framework using LSTM-based stock and cryptocurrency price prediction.

3.1.1 Mean-variance portfolio optimization model (MV)

Mean-variance Portfolio optimization was introduced by (Markowitz, 1952). The objective of this model is to balance profit and risk. The first objective function in Eq (1) focuses on minimizing portfolio risk, whereas Eq (2) is geared towards maximizing returns. Eq (3) is a budget constraint, indicating that the sum of all stock weights must equal 1. It is also possible to define restrictions based on different conditions. Markowitz's model takes the general form shown below:

$$\min \sum_{i,j=1}^n x_i \times x_j \times cov_{i,j} \quad (1)$$

$$\max \sum_{i,j=1}^n r_i \times x_j \quad (2)$$

$$S.T. \sum_{i=1}^n x_i = 1 \quad (3)$$

$$x_i \geq 0, \quad \forall i \in (1, \dots, n) \quad (4)$$

The variable x denotes the allocated budget for each stock, while n represents the total number of stocks in the portfolio and r is the stock's historical return. Eq (4) explicitly dictates the prohibition of short selling.

3.1.2 MVF model.

To develop the Markowitz Mean-Variance model (MV), Yu et al. (2020) developed a model called MVF. Unlike MV which relies on historical data, the MVF model uses the predicted rate of return for its calculations (Ma et al., 2021). In addition to minimizing risk and maximizing return, it provides a novel objective function for reducing prediction error Eq (7).

$$\min \sum_{i,j=1}^n x_i \times x_j \times cov_{i,j} \quad (5)$$

$$\max \sum_{i=1}^n x_i \times \hat{r}_i \quad (6)$$

$$\max \sum_{i=1}^n x_i \times \varepsilon_i \quad (7)$$

$$S.T. \sum_{i=1}^n x_i = 1 \quad (8)$$

$$x_i \geq 0, \quad \forall i \in (1, \dots, n) \quad (9)$$

The above model uses $\hat{r}_i$ instead r_i that is predicted return, and also $\varepsilon_i = r_i - \hat{r}_i$ calculates prediction errors.

3.1.3 case study: robust MVF model

This analysis, similar to the MVF, computes the rate of return using forecast data. However, it employs an uncertainty interval return based on algorithmic trading strategies. Therefore, this paper assumes that the return is an interval uncertainty parameter and utilizes Bertsimas' robust optimization to address these uncertainties. *eq* (10) Shows a uniform interval of changes of predicted return ($\tilde{r}$).

$$\tilde{r} \sim (\tilde{r} - \hat{\alpha}_i, \tilde{r} + \hat{\alpha}_i) \quad (10)$$

In this study, to maintain the linearity of the model, we focus on the first part of the objective function of the model and run the robust model. It specifies the level of conservatism and determines how many parameters can have their maximum value. *eq* (15) specifies that the maximum weight assigned to each AT strategy in the portfolio should be 40% of the total budget and improves portfolio diversification

$$\text{Max } U \quad (11)$$

Subjected to:

$$U - \sum_{i=1}^n \hat{r}_{i,k} \times x_{i,k} + z_j \Gamma_j + \sum_i p_{ij} \leq 0 \quad \forall j \quad (12)$$

$$z_j + p_{ij} \geq a_{ij} y_i, \quad \forall i, j \in j_j \quad (13)$$

$$-y_i \leq x_{i,k} \leq y_i \quad \forall i, k \quad (14)$$

$$x_{i,k} \leq 0.4 \quad \forall i, k \quad (15)$$

$$x_{i,k} \geq 0 \quad \forall i, k$$

$$p_{ij} \geq 0, \quad \forall i, j \in j_j \quad (16)$$

$$y_i \geq 0, \quad \forall i \quad (17)$$

$$z_j \geq 0, \quad \forall j \quad (18)$$

In this study, i denotes the index associated with each asset. Furthermore, k is the implemented AT strategies index on each asset, including FLMA (15), SMA, FLMA (30), EMA, and VLMA. $\hat{r}_{i,k}$ is the uncertainty parameter of the model, it shows the expected return for implementing each AT strategy on each asset. $x_{i,k}$ shows the dedicated weight when applying each AT strategy on each asset. Γ specifies the uncertainty level, and $\hat{\alpha}_{i,k}$ shows the maximum possible variance from $\hat{r}_{i,k}$.

3.2. LSTM prediction model

As the name suggests, LSTM stands for Long-Short-Term-Memory. It is a type of RNN network. However, it has long-term memory, while RNN does not have this possibility. There are generally three layers in an LSTM neural network: the input layer, the hidden layer, and the output layer.

3.3. Algorithm trading strategies

Buy and hold strategy

Buy and hold is the oldest and simplest trading strategy. Likewise, many researchers have used this article as a benchmark strategy, including [Mohr et al. \(2014\)](#) and [Chang et al. \(2017\)](#). This strategy generates the buy signal on the first day of the study period and the sell signal on the last day.

Simple Moving Average (SMA)

MA is considered one of the oldest and most popular technical analysis tools and has different types. According to Table 1, as the name suggests, the Simple Moving Average (SMA) is the simplest type of the MA family. If $MA_{short} > MA_{long}$, a buy signal is issued. And when $MA_{short} < MA_{long}$ a sell signal is issued. Algorithm 1 presents a formal description of the algorithm.

Table 1. Structure of SMA

Algorithm 1: SMA Algorithm

REQUIRE: MA_{long} , MA_{short}

1. if $MA_{short} > MA_{long}$
2. A buy signal should be generated
3. end if
4. if $MA_{short} < MA_{long}$
5. A sell should be generated
6. end if
7. Issue a sell signal on the last trading day, regardless of the open position

Exponential moving average (EMA)

An exponential EMA is based on generating buy and sell signals like a simple SMA in Algorithm 1. But in the roll's calculations $eq(19)$, act differently. In this technique, more weight is given to the value of the recent day.

$$EMA_{t1} = price_{t1} * \left(\frac{smoothing}{1 + days} \right) + EMA_{t0} * \left(1 - \left(\frac{smoothing}{1 + days} \right) \right) \quad (19)$$

Variable and fixed length MA: (VLMA) & (FLMA)

To prevent multiple signals from being generated in SMA, (Brock et al., 1992) introduced a new model that was used by Ahmad et al. (2021), Zhu et al. (2015) and Ming-Ming and Siok-Hwa (2006). this algorithm generates a buy signal when $MA_{short} > (1 + \beta) * MA_{long}$ and the sell signal when if $MA_{short} < (1 - \beta) * MA_{long}$. The FLMA model can also be operated similarly, except that in this case, we also have a maintenance period. In other words, once a signal has been generated, the position must be held for a fixed period. For example, if the holding time is 30 days, the current open position will be maintained for those 30 days, regardless of the type of new signal issued (Table 2).

Table 2. Structure of (VLMA) & (FLMA)

Algorithm 2: Variable Moving Average Algorithm (VLMA) & Fixed Moving Average Algorithm (FLMA)

REQUIRE: $Band(\beta)$ MA_{long} , MA_{short}

1. if $MA_{short} > (1 + \beta) * MA_{long}$
2. A buy signal should be generated
3. end if
4. if $MA_{short} < (1 - \beta) * MA_{long}$
5. A sell should be generated
6. end if
7. Issue a sell signal on the last trading day, regardless of the open position

4. Experimental results

$$MSE = \frac{1}{n} \sum_{i=1}^n \left(\frac{\hat{r}_i - r_i}{r_i} \right)^2 \quad (20)$$

$$MAE = \frac{1}{n} \sum_{i=1}^n |\hat{r}_i - r_i| \quad (21)$$

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n \left(\frac{\hat{r}_i - r_i}{r_i} \right)^2} \quad (22)$$

First, we extracted daily price data for the five largest shares of the American stock market, including APLE, TSLA, AMD, GOOG, SONY, and five cryptocurrencies from the crypto market, BITCOIN, Dodge, ADA, BNB and ETH, from the finance.yahoo.com, From January 2018 to June 2023. The data from 2018 to November 2022 are considered training data, and then using the LSTM neural network model ([kaggle.com](https://www.kaggle.com)), we predicted each asset's six months of December 2022 to June 2023. Table 3 displays the mean squared error (MS), the root mean squared error (RMSE), and mean absolute error (MAE) metrics for LSTM based on the change in return percentage over the past 45 trading days.

(20), (21), and (22) equations are MSE, RMSE, and MAE metrics calculations.

The effectiveness of the LSTM model in ranking is demonstrated using the Rank Graduation Accuracy (RGA) measure, as shown in Equation (23), and Spearman's Rank Correlation Coefficient (ρ) in Equation (24), with the results presented in Table 3. In these equations, $Y_{\hat{r}}(Y)$ denotes the actual price reordered by the predicted ranks, Y represents the actual price of assets, and $F(Y)$ is the cumulative distribution function based on the actual price, (Raffinetti, 2023). Additionally, d_i represents the squared difference between the predicted and actual ranks, and q is for days in the test period, (Spearman, 1961). According to the results in Table 3, the MSE and RMSE criteria indicate that Apple and Sony have the lowest prediction errors. Additionally, Apple shows the smallest variance from the actual value based on the MAE criterion, with an error of 1.19E-02. The LSTM model demonstrates high predictive accuracy, with errors below 4% across all three criteria and for all assets studied.

$$RGA = \frac{cov(Y_{\hat{r}}(Y), F(Y)) + cov(Y, F(Y))}{cov(Y, F(Y)) * 2} \quad (23) \quad \rho = \frac{6 * \sum_{i=1}^n d_i^2}{q(q^2 - 1)} \quad (24)$$

The RGA criterion, which evaluates the model's effectiveness in predicting the relative ranking of assets, achieves the highest accuracy for ADA, with a value of 0.95. In contrast, the model's accuracy in ranking assets such as SONY (0.57) and APLE (70.61%) is comparatively lower. Additionally, the LSTM model exhibits a strong positive rank correlation (ρ) between actual and predicted values across most assets.

Table 3. Comparing prediction accuracy with various measurements

Metrics	Stock					Cryptocurrency				
	tesla	aple	sony	amd	goog	btc	ada	bnb	eth	doge
MSE	8.270	2.300	3.530	1.460	3.210	1.090	8.390	8.450	6.130	8.890
RMSE	2.880	1.520	1.880	3.830	1.790	3.300	2.900	2.910	2.480	2.980
MAE	2.170	1.190	1.420	2.880	1.390	2.420	3.470	2.080	1.920	2.090
RGA	86.96%	70.61%	57.69%	91.03%	81.92%	80.08%	95.03%	71.28%	78.53%	79.01%
ρ	95.66%	88.73%	95.02%	96.29%	94.80%	97.61%	97.45%	93.21%	96.50%	95.23%

BTC shows a particularly high correlation of 97.61%, while ETH achieves a correlation of 96.50%, indicating a strong alignment with actual values. The RGA and ρ criteria results indicate that the LSTM model demonstrates a strong ability to detect the general direction of asset movements. This capability can aid in identifying suitable strategies for algorithmic trading and enhance the model's robustness against future market fluctuations. Then, we implemented short-

term trading strategies derived from FLMA (15) FLMA (30), VLMA, EMA, and SMA algorithms on predicted prices. Table 4 shows the results of each strategy.

4.1 Which strategy is most profitable?

In this study, as well as in (Schmidt et al., 2010), returns have been calculated utilizing the geometric average trading period return (GPR) in equation (25).

$$GPR = \left(\prod_{i=1}^n r_i \right)^{1/n} \quad (25)$$

Table 4. AT Strategies geometric rate of return

<i>sstrategy</i>	<i>Hold time</i>	<i>stock portfolio</i>	<i>crypto portfolio</i>	<i>(stock + crypto)</i>
<i>FLMA (5,15,0.01)</i>		1.086	1.081	1.083
<i>FLMA (6,18,0.01)</i>		1.061	1.094	1.078
<i>FLMA (10,30,0.01)</i>		1.024	1.078	1.051
<i>FLMA (15,45,0.01)</i>		0.995	0.988	0.991
<i>FLMA (5,15,0.02)</i>	15	1.057	1.103	1.080
<i>FLMA (6,18,0.02)</i>		1.030	1.085	1.057
<i>FLMA (10,30,0.02)</i>	days	1.042	1.033	1.038
<i>FLMA (15,45,0.02)</i>		0.961	1.026	0.993
<i>VLMA (5,15,0.01)</i>		1.085	1.0439	1.064
<i>VLMA (6,18,0.01)</i>		1.063	1.0408	1.052
<i>VLMA (10,30,0.01)</i>		1.031	1.0549	1.043
<i>VLMA (15,45,0.01)</i>	0	0.987	0.9881	0.988
<i>VLMA (5,15,0.02)</i>		1.059	1.0472	1.053
<i>VLMA (6,18,0.02)</i>		1.039	1.0316	1.035
<i>VLMA (10,30,0.02)</i>	day	1.042	1.0335	1.038
<i>VLMA (15,45,0.02)</i>		0.961	1.0254	0.993
<i>FLMA (5,15,0.01)</i>		1.117	1.124	1.120
<i>FLMA (6,18,0.01)</i>		1.098	1.126	1.112
<i>FLMA (10,30,0.01)</i>		1.054	1.062	1.058
<i>FLMA (15,45,0.01)</i>	30	0.991	0.980	0.986
<i>FLMA (5,15,0.02)</i>		1.100	1.110	1.105
<i>FLMA (6,18,0.02)</i>		1.079	1.090	1.085
<i>FLMA (10,30,0.02)</i>	days	1.046	1.020	1.033
<i>FLMA (15,45,0.02)</i>		0.967	1.019	0.993
<i>SMA (5,15)</i>		1.119	1.036	1.077
<i>SMA (6,18)</i>		1.094	1.047	1.071
<i>SMA (10,30)</i>	**	1.014	1.042	1.028
<i>SMA (15,45)</i>		1.003	1.017	1.010
<i>EMA (5,15)</i>		1.085	1.045	1.065
<i>EMA (6,18)</i>	**	1.066	1.043	1.054
<i>EMA (10,30)</i>		1.058	1.071	1.065
<i>EMA (15,45)</i>		0.945	1.100	1.039
<i>B&H (5)</i>		1.007	1.001	1.004
<i>B&H (15)</i>		1.017	1.010	1.014
<i>B&H (30)</i>	**	1.033	1.032	1.033
<i>B&H (45)</i>		1.030	1.038	1.034
<i>GPR</i>		1.039	1.045	1.044

Results indicate that the crypto portfolio with GPR 1.045 will profit more than the stock portfolio with GPR 1.039.

In the *first portfolio (stocks)*, *SMA (5,15)* with 1.119 and *FLMA(5,15,0.01)* with 1.117 will have the highest *GPR*. As compared to the FLMA algorithm with a holding period of 15 days,

FLMA (5,15,0.01) has the highest return of 1.086. Also, for the *VLMA* algorithm, *VLMA* (5,15,0.01) has the highest return. Additionally, *FLMA* (5,15,0.01) is the best strategy for the *FLMA* algorithm with a 30-day holding period and *GPR* 1.117. According to the *SMA* algorithm, *SMA* (5,15) is the most profitable, while *EMA*(5,15) will be the best strategy with *GPR* 1.085.

For the *second portfolio (cryptocurrencies)*, *FLMA*(6,18,0.01) in 30 days is the best strategy with a *GPR* of 1.126. Based on the *FLMA* algorithm with a 15-day holding time, *FLMA* (6,18,0.02) exhibits the highest performance. Among the *VLMA* algorithms, *VLMA*(10,30,0.01) will have the highest *GPR* at 1.054. Also, *SMA*(6,18) strategy with *GPR* 1.047 for the *SMA* algorithm and *EMA*(15,45) will have the greatest performance in the *EMA* algorithm for the second portfolio with a *GPR* value of 1.1.

4.2 Develop a robust portfolio optimization model

Considering that the *GPR* calculated in Table 4 is based on the predicted price, and the prediction will always include some errors, it is impossible to formulate definitive conclusions about the market. Therefore, we developed a robust portfolio optimization model for each portfolio to manage these uncertainties. Figure 1 presents the performance of the different algorithms for Uncertainty levels in the robust portfolio. Based on the results shown in this figure, when we are in stable conditions, the *FLMA* algorithm with a 30-day holding time will be the most suitable algorithm for investment in a stock portfolio. Also, by increasing variance from the central limit (a highly volatile situation) for the first portfolio, the *EMA* algorithm will perform better than all the other algorithms. In addition, the crypto portfolio *EMA* algorithm performs better than the others for certain uncertainty conditions.

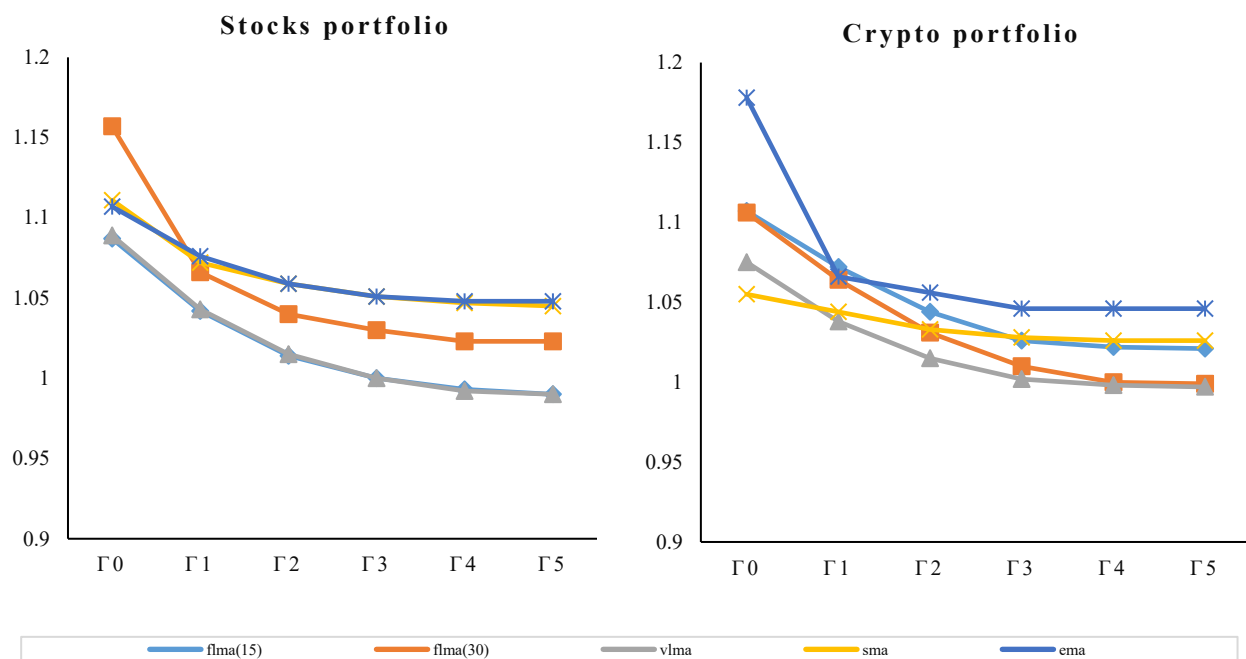


Figure 1. Analyzing the performance of algorithms in stock and cryptocurrency portfolios

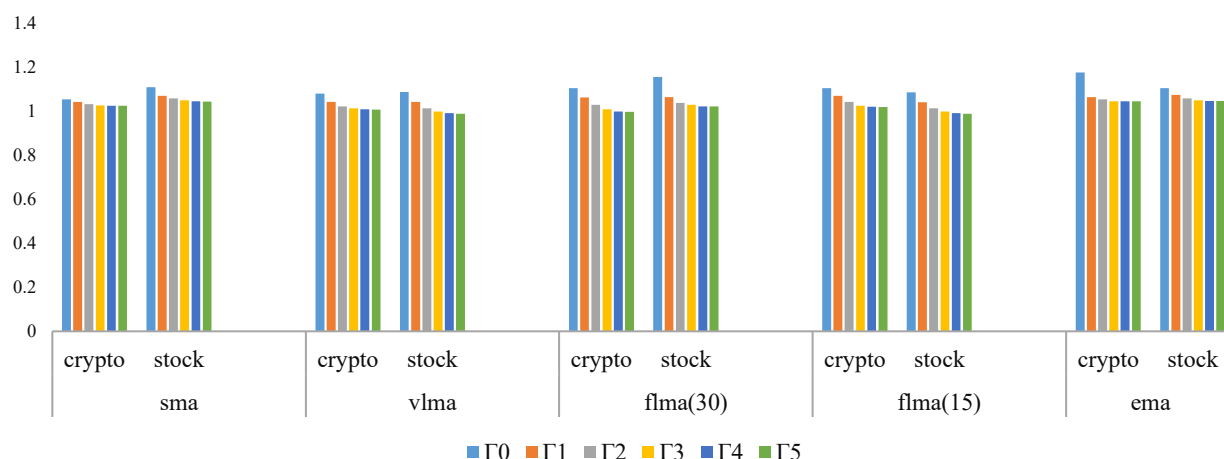


Figure 2. Comparing the profitability of stock and crypto portfolios using different algorithms.

Furthermore, Figure 2 illustrates the portfolio most suitable for each investment algorithm. According to the SAMA algorithm, the first portfolio (stocks) is expected to have a higher profit. Also, the FLMA algorithm with a 15-day holding period for the crypto portfolio and the FLMA algorithm with a 30-day holding period for the stock portfolio would be better investment options. In stable market conditions, VLMA performs better on the stock portfolio. However, this algorithm will be more beneficial to the crypto portfolio when market uncertainty increases. Although the crypto portfolio is more advantageous in a deterministic state, the algorithm produces the same results on both portfolios when uncertainty is high.

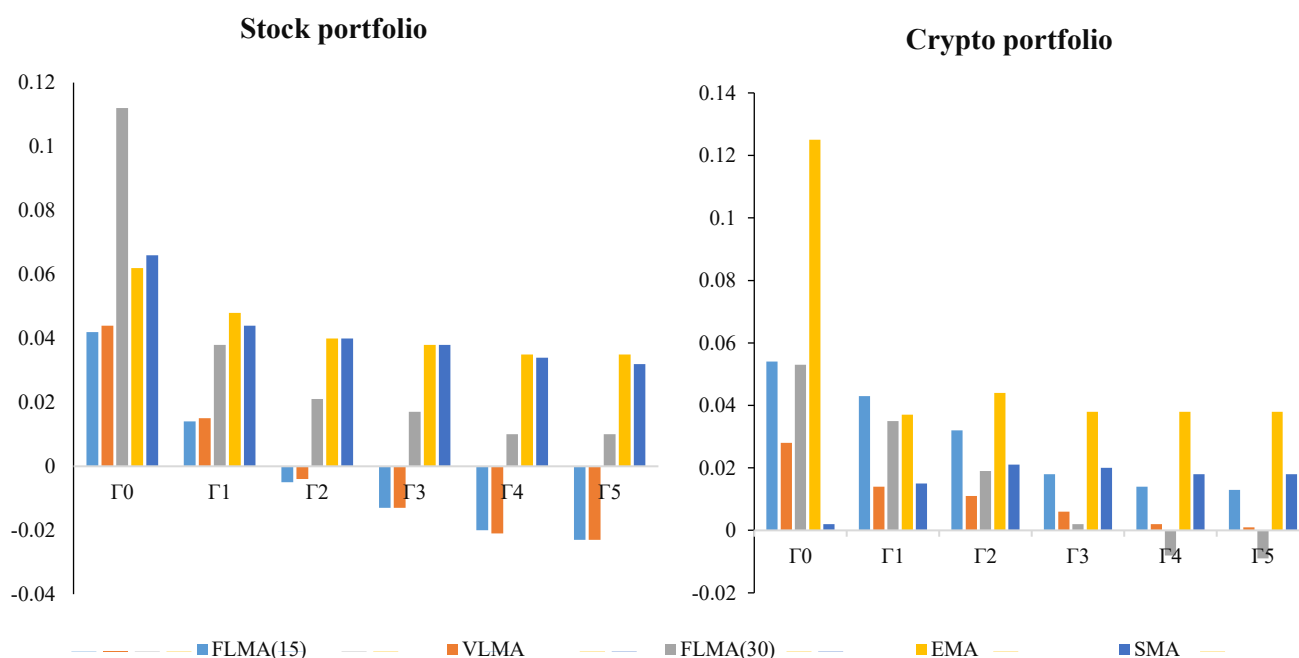


Figure 3. Excess return of each algorithm

According to Figure 3, which shows the excess return of each algorithm over the benchmark

algorithm (B&H) for both portfolios, results show that, for the first portfolio, all the MA algorithms outperform the benchmark algorithm when the model is certain. However, in situations of increased uncertainty (most variance from certain conditions), the VLMA and FLMA (15-day holding) algorithms will not be suitable for a stock portfolio.

4.3 Development of a diversified portfolio

Both portfolios studied have similar assets but are low in diversity, so we combined them for this purpose. The excess return of the newly created portfolio is shown in Figure 4.

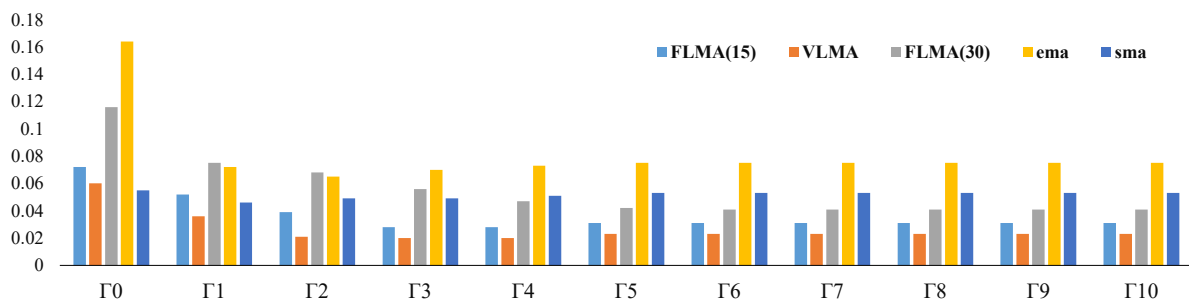


Figure 4. The excess return of the diversified portfolio for each algorithm

The results indicate that the diversified portfolio is a very suitable option for all MA algorithms, regardless of the degree of uncertainty associated with the model parameters.

5. Discussion and managerial insights

This study presents a novel approach to algorithmic trading by integrating LSTM-based price predictions with robust portfolio optimization strategies that leverage various MA, including SMA, EMA, VLMA, and FLMA. The findings reveal that these strategies consistently outperform the traditional buy-and-hold (B&H) method in both stable and uncertain market conditions. Notably, the SMA (5,15) strategy for stocks and the FLMA (6,18,0.01) strategy for cryptocurrencies emerged as top performers, delivering the highest returns over short holding periods. These results highlight the effectiveness of short-term MA in capturing market trends and optimizing portfolio performance. The research further underscores the critical role of diversification in portfolio management. By combining stock and cryptocurrency assets within a robust optimization framework, the study demonstrates that diversified portfolios can maintain strong performance across various market scenarios, including periods of heightened uncertainty. The robust portfolio models, especially those based on SMA and EMA, exhibit remarkable resilience, making them invaluable for investors seeking to balance risk and reward in volatile markets. This approach ensures that the portfolio remains reliable and profitable, even when model parameters are uncertain. Additionally, this study significantly contributes to algorithmic trading by offering practical insights into the real-world application of LSTM-based predictions. The seamless integration of advanced predictive models with robust portfolio optimization provides a powerful strategy for navigating the complexities of contemporary financial markets. Future research could expand on these findings by exploring a broader range of assets, investigating longer-term investment strategies, and incorporating real-time data to further enhance the model's robustness and versatility. Ultimately, this study presents a compelling argument for adopting diversified,

algorithmically optimized portfolios in today's rapidly evolving financial landscape.

5.1. Limitations and future works

This study presents certain limitations that open up avenues for future research. Firstly, while economic forces such as macroeconomic trends and geopolitical events can significantly impact data generation and influence financial markets, the current research focused exclusively on algorithmic trading strategies driven by price predictions. Additionally, due to their simplicity, flexibility, and compatibility with other tools, this study exclusively evaluated the performance of MA-based techniques on an LSTM model, excluding other notable algorithmic trading strategies like MACD, statistical arbitrage, etc. These alternative strategies could provide valuable insights and potentially enhance performance under varied market conditions. Future research could further integrate economic forces to improve prediction accuracy and portfolio resilience. Moreover, incorporating alternative strategies and economic indicators such as arbitrage trading, mean reversion, weighted average price, and statistical arbitrage strategies into the proposed framework could lead to a more comprehensive and robust portfolio optimization approach.

6. Conclusion

This study presents a new approach to algorithmic trading. Initially, we examined the short-term performance of trading algorithms based on MA, including EMA, SMA, VLMA, FLMA (15), and FLMA (30) on predicted prices using LSM. Then, we formed a robust portfolio optimization model for each algorithm. As a result, when we invest in stocks, the *SMA*(5,15) strategy will have a better return of 1.119, and when we invest in crypto, *FLMA*(6,18,0.01) will have the highest return over a 30-day holding period. When evaluating the performance of strategies for all assets, the *FLMA* (5,15,0.01) strategy with 30 holding times will have the highest GPR with a value of 1.12.

We developed a robust portfolio optimization model for each algorithm to manage uncertainties. The results indicate that robust portfolio models based on SMA and EMA perform better than other algorithms in both determined and uncertain scenarios. A portfolio optimization model utilizing VLMA and FLMA algorithms will outperform benchmark strategy (B&H) under certain conditions and low uncertainty. Also, the FLMA (15-day holding), the VLM for stocks, and the FLMA (30-day holding) for crypto portfolios will not be suitable investment options when uncertain. In our investigation, we have integrated the two portfolios to comply with the key principle of diversity. The results indicate that the proposed portfolio suits all MA algorithms, even when the model parameters are highly uncertain. Therefore, to have a profitable and low-risk investment, using the new diversified-robust portfolio is very suitable.

Despite the promising results, this study faces limitations, notably the reliance on short-term MA strategies, which may restrict the applicability to longer-term investment approaches. Additionally, while the robust portfolio optimization model performs well under certain conditions, its effectiveness in highly volatile or unprecedented market scenarios remains untested.

Future research should explore alternative predictive models, such as reinforcement learning or hybrid approaches that integrate LSTM with other techniques, to improve accuracy and robustness. Expanding the analysis to include a broader range of assets and incorporating real-time data sources like sentiment analysis could enhance the model's adaptability and practical utility in algorithmic trading.

Declaration of generative AI in scientific writing

The authors used the AI system [Chat Gpt] in the writing process to improve the readability and

language of the manuscript. After, the authors reviewed and edited the content as needed and took full responsibility for the content of the published article.

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Ferdowsi University of Mashhad

RESEARCH ARTICLE

Management Commentary and the Value Relevance of Earnings: The Accreditation Role of Independent Auditors

Azam Valizadeh Larijani*

Department of Accounting, Faculty of Social Sciences and Economics, Alzahra University, Tehran, Iran

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Abstract

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Keywords:

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A management commentary is a descriptive report on the various aspects of a company's operations that can provide useful information to investors. According to the regulations of the Securities and Exchange Organization of Iran, the companies' board of directors has been mandated since 2017 to prepare and submit management commentary. This report has been designed as an essential element in offering information to the capital market and improving the usefulness of the information companies provide. The present study, therefore, aims to investigate the effects of issuing regulations for management commentary on the value relevance of earnings. Considering that these reports must be audited and disclosed at specific intervals, the present study also examines the interactive effect of audit quality and the issuance of regulations for management commentary reporting on the value relevance of earnings. The statistical population of this study includes companies listed on the Tehran Stock Exchange (TSE) and Iran Fara Bourse (IFB) from 2012 to 2023. A linear regression model was used to test the study hypotheses. The results show that issuing regulations to present management commentary has increased the value relevance of companies' earnings. In other words, after these regulations were issued, the quality of companies' earnings increased. Based on the results obtained, audit quality also enhances the effect of issuing rules for management commentary reporting on the value relevance of earnings; that is, when the audit quality is higher, issuing regulations for management commentary reporting has a more significant potential to improve the earnings quality.

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*Corresponding Author: Azam Valizadeh Larijani

Email: a.valizadeh@alzahra.ac.ir

Tel: 09124724563

ORCID: 0000-0002-8874-990X

1. Introduction

Following the financial scandals of past years, investors' confidence in financial statements and reports has dwindled, and the quality of financial reporting has emerged as a key factor in determining the credibility of the figures reported in financial statements. In recent decades, significant fluctuations due to financial crises at the global level have underscored the importance of high-quality and reliable financial reporting, further emphasizing the importance of improved quality of earnings and financial statements. Improving the quality of earnings is critical to accountants for sound financial and economic decision-making and gaining greater confidence at the global level. Financial reporting quality is also important to users of financial statements, market participants, regulators, and accounting researchers. High-quality accounting information is also imperative for companies to facilitate access to debt markets. According to [Schipper and Vincent \(2003\)](#), the importance of financial reporting quality can be explained by two approaches, including contractual and investment strategies ([Schipper and Vincent, 2003](#)). Based on the contractual approach, low-quality financial reports can lead to unintended wealth transfers. For instance, companies that base their managers' bonuses on earnings will, in practice, receive disproportionately high bonuses if the earnings are overstated. Based on the investment approach, low-quality financial reports are problematic because they can mislead investors when allocating resources ([Myers et al., 2003](#); [Schipper and Vincent, 2003](#)). High-quality financial reporting enhances the attractiveness of stocks for investors, strengthens market liquidity ([Young and Guenther, 2003](#)), reduces capital costs ([Khalifa et al., 2018](#); [Leuz and Verrecchia, 2000](#); [Salvato and Moores, 2010](#)), improves the evaluation of past and current company performances, forecasts future positions ([Ismail et al., 2021](#)), and enhances capital allocation in the market ([Ha and Feng, 2018](#); [Biddle et al., 2009](#); [Bushman et al., 2011](#)).

Various indicators have been proposed in research to measure earnings quality. Kernel and Landsman divided the measurement indicators of earnings quality into three categories: Value relevance indicators, information content indicators, and predictive indicators. [Francis et al. \(2004\)](#) divided the measurement indicators of earnings quality into two categories: Market-related and accounting-related indicators. They introduced the value relevance of earnings as one of the most significant market-based indicators. They argued that the value relevance of earnings is a criterion that indicates the qualitative attributes of relevance and reliability ([Francis et al., 2004](#)). The value relevance of earnings has been defined as the ability of earnings to explain the behavior of stock returns. More precisely, when earnings can better explain the stock returns, they have a higher value relevance. Thus, based on the abovementioned research, the present study has used the value relevance of earnings as an indicator to measure financial reporting quality.

In recent years, capital market regulators, including the US Securities and Exchange Commission (SEC), have become concerned about the quality of financial reporting by companies. These professional regulatory bodies have compiled various financial disclosure and reporting laws to address these concerns. One of the most important regulations is the Sarbanes-Oxley Act, ratified by the US Senate in 2002. This act aimed to reduce future misdemeanors and regain investors' confidence in companies' financial reports and statements. It introduced significant changes in issues related to the reliability of company information disclosure and corporate governance quality. The changes include the development of mechanisms to regulate the accounting profession and revising the regulations regarding auditor independence, corporate governance standards, and banking investment regulations. Also, additional criminal penalties for violating stock exchange rules were introduced by this act.

In Iran, the Securities and Exchange Organization (SEO) is the regulatory body for the capital market. One of the main strategies of SEO is to promote public trust and the transparency and flow

of sound information in the capital market. According to the Securities Market Act of the Islamic Republic of Iran (ratified on 22 Nov. 2005 by the Islamic Consultative Assembly), companies must prepare and issue their financial statements according to the accounting standards, guidelines, and regulations of the SEO. The executive regulations for the disclosure of information by companies registered with the organization, approved by the Board of Directors on 25 July 2007 (last amended on 5 Aug. 2019), outline the policies and procedures of the SEO on the disclosure of information by companies, including the type of information to be issued, the disclosure timeline, and the consequences of non-compliance with the guidelines. It must be noted that the executive regulations for disclosing information have been revised several times by the said organization since their ratification. One of these revisions occurred through memo 122/29386 on 20 Dec. 2017. An important change of guidelines in this memo was the exemption of listed issuers from disclosing their earnings per share (EPS) predictions while obliging them to publish management commentary. More precisely, according to Clause 5 of the said memo, "Given the absence of issuing EPS prediction following the provisions of the executive regulations for the disclosure of information by companies registered with the organization, listed issuers of TSE and IFB are required to prepare and disclose their management commentary along with interim financial statements for 3, 6, and 9-month periods and their annual financial statements. The companies must also present their auditor's opinion on the management commentary and their 6-month interim and annual financial statements ...". In addition, based on Clauses 1, 3, 4, and 5 of the said guidelines, listed issuers of TSE and IFB are required to present an audited annual management commentary, interim management commentary, audited 6-month interim management commentary, and an unaudited annual management commentary. Subsequently, on 25 Dec. 2017, The SEO Board of Directors approved the regulations for preparing management commentary as a mandatory framework for listed issuers of TSE and IFB. According to these regulations, the management commentary, the responsibility for the preparation and presentation of which lies with companies' boards of directors, is a descriptive report that provides a basis for interpreting the financial position, financial performance, and cash flows of the business unit. This report also allows managers to set their objectives and strategies for achieving them. The report is considered a significant item in informing capital markets and a supplementary and complementary of the financial statements. The report aims to enhance the usefulness of the information provided by business units that are presented along with the financial statements and, therefore, help users make better decisions about resource allocation to the business unit. The management commentary consists of information on the nature of the business, management objectives and strategies to achieve these objectives, key resources, risks and relationships, operational outcomes and prospects, and the key performance indicators and criteria that the management uses to evaluate the performance of the business unit against the stated objectives ([Securities and Exchange Organization, 2017](#)). Since the regulatory body claims that management commentary enhances the usefulness of information and facilitates investors' decision-making, it seems that the publication of this report can improve the quality of financial reporting and consequently enhance the value relevance of information. Nevertheless, the potential of management commentary in enhancing the quality of information and financial reporting of companies has not been extensively studied in research in this field. The present study, therefore, aims to investigate whether the quality of financial reporting has improved with the ratification and communication of regulations for presenting management commentary by listed issuers. As mentioned previously, the value relevance of earnings is used in this study to measure the quality of financial reporting. Therefore, the study first investigates the effects of issuing regulations to present management commentary on the value relevance of earnings. Then, the findings of this study can be used by the SEO of Iran to assess and improve management

commentary.

The quality of audit services is one of the main factors affecting the quality of financial reporting. Auditors can help increase the accuracy and integrity of financial reports by reducing information asymmetry. They can thus provide stakeholders with more reliable information by reducing information asymmetry and managers' ethical risks (Ismail, 2020). Audit quality has different definitions. From the perspective of financial reporting quality, audit quality means the accuracy of the information provided by auditors to investors to enable them to make exact assessments of the company's value (Titman and Truman, 1986). In the accounting research literature, various studies have focused on the consequences and impact of audit quality on earnings management, financial reporting quality, value relevance, cost of capital, and investment decision-making (Ismail, 2020; Lee and Lee, 2013). The quality of financial reporting is a critical consequence of audit quality. Many studies have also investigated the effects of audit quality on the value relevance of earnings and shown that the value relevance of earnings, an indicator used for measuring earnings quality, increases significantly as audit quality increases (Heydari, 2015; Zakaria and Daud, 2013). Furthermore, Alkali et al. (2018) showed that audit quality statistically affects the earnings response coefficient (ERC) (Mirtaheri and Darabi, 2018; Alkali et al., 2018). Considering the abovementioned, audit quality can improve the value relevance of earnings. Also, the disclosure of management commentary can enhance the value relevance of earnings by improving the usefulness of the information; the present research investigates the interactive effects of audit quality and the issuance of regulations for presenting management commentary on the value relevance of earnings. This study examines whether or not a higher audit quality for management commentary can improve the value relevance of these reports.

The present research can strengthen the existing literature on financial reporting quality from two different aspects. First, in this research, the value added of the management commentary on the company's financial reporting chain has been investigated by examining the effect of the management commentary on the quality of financial reporting (the value relevance of earnings). In this regard, it should be mentioned that Taherinia and Darbandi Farahani (2022) showed in the result of their research that the simultaneous disclosure of management commentary and earnings forecasts by managers reduces information asymmetry and increases the quality of investment (Taherinia and Darbandi Farahani, 2022). In other words, in their research, the value added of the management commentary on the predicted earnings has been investigated. At the same time, this study has examined this issue from the perspective of actual (historical) earnings. Also, that research measured the reduction of information asymmetry through the bid-ask spread. In contrast, the criterion for determining the quality of financial reporting in this research is the value relevance of earnings. Finally, the period investigated in this research is 2012 to 2023, while that research period is from 2017 to 2019.

Second, according to the accreditation requirement of the management commentary by independent auditors at 6-month and yearly intervals, this research examines whether a higher quality audit can improve the value mentioned earlier. Previous research has yet to be found in this field.

2. Literature review

2.1 Financial reporting guidelines and the value relevance of earnings

Companies utilize different methods to disclose their information and reports. The literature on disclosure has shown that annual financial reports are one of the most important mechanisms companies use to provide information on their position. Research has also shown that investors and other users have higher confidence in companies' financial statements compared to other

information sources. Additionally, the volume and content of information and reports disclosed by companies vary in different countries, depending on the level of economic development, the reporting rules and regulations, the accounting standards, and the degree of financial market development of each country. Company disclosures may be based on enforceable laws and standards or be optional over the requirements. Rules and regulations indicate the minimum required disclosures, and companies may issue helpful complementary information to facilitate investor decision-making (Haddad et al., 2017). Thus, the requirements, standards, and rules of reporting following the economic, financial, cultural, and business context of companies and business units can affect the quality of the final product of financial reporting, i.e., their financial statements, and lead to improved financial reporting quality.

Cohen et al. (2008) investigated the effects of the Sarbanes-Oxley Act on accruals management and earnings management in companies, showing a rising trend for accruals management from 1987 until the law was enacted in 2002. At that time, a decreasing trend started, while earnings management had a decreasing trend due to manipulating actual activities before the enactment of this law. After that time, a rising trend started. In other words, based on the findings of this study, the Sarbanes-Oxley Act has shifted companies from accrual-based management to real earnings management (Cohen et al., 2008). Alfraih and Alanezi (2015) also investigated the relationship between the degree of improvement in financial disclosures and the value relevance of their accounting information in the Kuwait stock exchange (Boursa Kuwait), showing a positive relationship between improved financial disclosures, the value relevance of net income, and the book value of companies. They used Ohlson's model (1995) to measure value relevance (Alfraih and Alanezi, 2015). Haddad et al. (2017) investigated the effect of changes in corporate governance and accounting regulations on the disclosure quality of companies in Jordan from 1986 to 2014, reporting a significant relationship between the changes and the quality of company disclosures. They also stated that certain features, such as the company's size and audit quality, can significantly affect this relationship (Haddad et al., 2017). Santos and Coelho (2018) examined the value relevance of risk-related disclosures and company risk management in the reporting of discussions and management analyses, revealing that the disclosures significantly affect company stock returns, therefore boasting a significant value relevance (Santos and Coelho, 2018).

Mustapha et al. (2021) investigated the effect of changes in corporate governance regulations in Nigeria in 2011 on the quality of financial reporting by companies. These changes pertained mainly to increased responsibility for board members and the increased number of audit committee members in companies. They reported that the increased responsibility for the board members does not significantly affect the quality of financial reporting, but increasing the number of audit committee members improves the quality of financial reporting (Mustapha et al., 2021). Espahbodi et al. (2022) investigated the effect of enacting the Sarbanes-Oxley Act on accruals management and real earnings management of companies in both the short-term and long-term, reporting that the enactment of this law successfully reduced accruals and real earnings management in the short term. In the long term, however, the accruals management returned to the same levels as before the enactment of the law (Espahbodi et al., 2022).

Binz and Graham (2022) investigated the effect of the 1934 US Securities Act on the information content of earnings disclosures. In this research, a short window around the earnings announcement has been employed to measure the information content of earnings. This research showed that the above law has increased the information content of earnings, which is more prominent in companies governed by more substantial requirements (Binz and Graham, 2022). Benkraiem et al. (2022) investigated the effect of adopting IFRS on information asymmetry. As a result, the earnings quality of companies listed on the French Stock Exchange showed that after applying these standards,

information asymmetry and earnings quality increased significantly (Benkraiem et al., 2022). Botica Redmayne et al. (2023) examined the perspectives of shareholders, users, compilers, and independent auditors on management commentary in financial reports in New Zealand, showing that independent auditors believe management commentary reports are less beneficial and require further confidence and trust-building. The responses also revealed that the most critical objectives of management commentary in financial reports include enabling management assessment, evaluating the company's prospects, and evaluating future cash flows. The results also showed that the key principle in preparing these reports is presenting the most important and relevant information (Botica Redmayne et al., 2023). Amin and Cumming (2023) investigated the effect of corporate governance reforms in 2012 in Singapore and Vietnam (mainly related to independent non-executive directors) on earnings management. The result showed that new changes in corporate governance regulations have effectively limited earnings management. Also, based on the result of his research, higher education and longer tenure of these managers will lead to a more reduction in earnings management (Amin and Cumming, 2023). Radwan and Xiongyuan (2024) investigated the value relevance of integrated reporting quality by companies in some Asian countries from 2015 to 2022, demonstrating that investors react to the quality of integrated reporting (Radwan and Xiongyuan, 2024). Xia et al. (2024) following the Sarbanes-Oxley Act and the requirement for companies to use financial experts on their audit committees, the effect of compliance with the new law on various earnings management tactics of American companies from 2003 to 2016 was examined. The result showed that this regulation has significantly reduced various earnings management tactics, including accrual and real earnings management (Xia et al., 2024). Duan et al. (2024) investigated the proceedings of the Shanghai Stock Exchange to implement mandatory disclosure requirements (taken from the US capital market). In this regard, the companies' stock prices reaction to the comment letters published by the Shanghai Stock Exchange in connection with the mandatory disclosure requirements from 2013 to 2018 was analyzed. The results showed that the stock prices had a significant adverse reaction to the said letters (Duan et al., 2024).

Behbahaninia et al. (2021) investigated the effects of the SEO's overseeing independent auditors in listed companies on the audit quality and financial reporting quality of companies (the degree of relevance of the accounting information) from 2001 to 2018, reporting that audit quality and financial reporting quality grew significantly from 2007 onwards, following the start of SEO's supervision of auditors compared to the years before (Behbahaninia et al., 2021). Babaei and Etemadi (2016) investigated the factors affecting the value relevance of companies' earnings, claiming that timely accounting information, quality accruals, sustainability, conservatism in earnings, high predictability of earnings, and low volatility of earnings have significant positive effects on the value relevance of earnings (Babaei and Etemadi, 2016). Setayesh et al. (2015) investigated the concurrent impact of company size and the information environment on the value relevance of earnings and operating cash flow of TSE-listed companies from 2007 to 2012, demonstrating that these variables have a significant effect on the value relevance of earnings both separately and simultaneously, with a higher impact on earnings value relevance compared to operating cash flow (Setayesh et al., 2015).

As mentioned previously, the value relevance of earnings is an indicator used for measuring financial reporting quality. The literature on value relevance investigates the effect of financial variables on users' decision-making and, consequently, company value (Osazevbaru, 2020). Amir et al. (1993) interpreted value relevance as the extent to which accounting data reflect the information used by the investors (Amir et al., 1993). Holthausen and Watts (2001) argued that a financial variable has value relevance when it has a predictive relationship with the market value (Holthausen and Watts, 2001). Brimble (2003) argued that the goal of accounting data value

relevance is enabling access to information that reflects the company's performance, thereby also reflecting itself in the company's stock prices as an indicator of investors' return (Brimble, 2003). The value relevance of accounting information depends on its effects on performance analysis and company value, thereby affecting the forecasting of future financial performances (Menike and Prabath, 2014).

2.2 The interactive effects of financial reporting regulations and audit quality on the value relevance of earnings

As discussed previously, the primary objective of financial reporting is to provide financial statements and helpful information for users to make decisions. Financial information provides a transparent and fair view of the financial position and performance of companies, their changes in ownership, and cash flows. Providing incorrect information to users by companies can result in asymmetrical information among intra- and extra-organizational persons. Reducing information asymmetry is only possible with the help of third-party services, such as independent auditors, who can create confidence and trust in the rigor and accuracy of the information. The task of an independent auditor is to provide an independent, professional, and objective opinion on the reported information regarding the financial position and financial performance of the company as an audit statement, which is central to decision-making by investors and leads to added value. Major financial scandals over the past years and significant errors in financial statements have further underscored the critical importance of independent auditors in guaranteeing the quality of financial statements and information. Auditors issue independent, professional, and targeted reports that emphasize the accuracy and rigor of the financial statements and take correct and reliable positions on essential aspects of the financial statements in line with the accounting standards and thus significantly affect investors' perspectives on the company's share (Abdollahi et al., 2020). Investors face various risks in the capital market, including conflicts of interest with managers due to information asymmetry. Auditing is a tool to reduce information asymmetry between the users and the compilers of financial reports. In other words, the independent auditor's statement supports the decisions made by actual and potential investors of the company (Arens et al., 2017).

Furthermore, the value relevance of accounting information is also a significant subject for investors and other stakeholders when making correct investment decisions about investment items. It has remained an important topic of discussion for accounting researchers in the past years. As mentioned previously, the value relevance of accounting information refers to the relationship between accounting information and the company's value. A range of factors, such as audit quality, affect the degree of value relevance of accounting information, including earnings (Tshipa et al., 2018). Independent auditors provide valuable services in eliminating or decreasing asymmetrical information and reducing agency costs; however, this issue depends significantly on the ability of the auditors to limit the managers' opportunistic behaviors for manipulating earnings. A higher audit quality is more likely to reveal incorrect accounting procedures (Becker et al., 1998; Reynolds and Francis, 2000). Lee and Lee (2013) investigated the relationship between audit quality, earnings' value relevance, and the companies' net book value in Taiwan's capital market. In their research, companies that had used big audit firms for their audit services were selected as companies with a high audit quality. They reported that when high-quality audit services are used, earnings' value relevance and assets' net book value are higher (Lee and Lee, 2013). Solikha and Mardijuwono (2020) investigated the relationship between audit quality, the value relevance of earnings, and the book value of equity in companies listed on the Indonesian stock exchange. The measurement criterion for audit quality in the cited study was also the size of the audit firm. The study results showed that audit quality significantly positively affects the mentioned value relevance (Solikha

and Mardijuwono, 2020). Dang et al. (2011) reported that companies with failed audits experience lower earnings value relevance (Dang et al., 2011). Jerry and Saidu (2018) investigated the effect of the size of the audit firm on the quality of financial reporting in insurance companies listed on the Nigerian stock exchange. They claimed that the size of the audit firm significantly increases the quality of financial reporting (Jerry and Saidu, 2018). Wahyuni and Herawaty (2018) studied companies listed on the Indonesian stock exchange and reported that audit quality increases the ERC (Wahyuni and Herawaty, 2018). Ismail (2020) surveyed companies listed on the Egyptian stock exchange. He reported that audit quality (i.e., the audit firm's size) significantly affects earnings quality (Ismail, 2020). Verma et al. (2024) investigated the effect of audit quality on the earnings quality of companies listed on the Indian stock exchange in the 20 years from 2001 to 2020. They showed that characteristics such as the auditor's size, audit fee, and auditor tenure have a significant negative relationship. Auditor turnover significantly correlates with earnings quality (Verma et al., 2024).

Mirtaheri and Darabi (2019) investigated the relationship between the emotional biases of investors and the ERC of companies listed on the TSE, as well as the effect of audit quality on this relationship in the timespan from 2013 to 2017, reporting a significant relationship between the emotional biases of the investors and ERC. They also noted that audit quality affects the relationship (Mirtaheri and Darabi, 2019). The significance of the independent auditor's statements on financial information from the perspective of the regulatory body overseeing the Iranian capital market has also been addressed. For instance, Article 7 of the executive regulations for the disclosure of information by listed companies on the SEO requires that listed issuers provide audited 6-month interim and annual financial statements, auditors' statements on the board report, and audited 6-month interim and annual financial statements of subsidiary companies within specific time intervals. Issuers are also required to disclose their 6-month interim and annual management commentary after approval by the independent auditor, which is the topic of the present study.

2.3 Hypothesis development

According to the research literature, changes in accounting requirements, regulations, and disclosure of financial information can affect and improve the quality of financial reporting (which can be measured by various indicators, including the value relevance of earnings). In this regard, due to the change in the disclosure regulations of the SEO as of Dec. 2017, underscoring the necessity to provide management commentary instead of issuing EPS predictions (detailed in the introduction), the initial objective of this research is to investigate the effect of the issuance of new financial reporting regulations by the Securities and Stock Exchange Organization (i.e., the issuing of rules for management commentary) on the earnings quality. Thus, the initial hypothesis of this study is as follows:

H1: Issuing regulations for management commentary has a significant positive effect on the value relevance of earnings.

In addition, according to previous research, independent auditing is considered an important pillar in crediting the company's information and financial statements from the investors' perspective, and investors have always paid attention to the audit quality of companies. So, it seems that auditors' statements on management commentary, which is the main subject of this research, can further reduce information asymmetry between the providers and users of information, significantly affecting investors' responses to accounting information. Hence, the second objective of this study is to investigate the interactive effects of issuing and communicating regulations for financial reporting and audit quality on the value relevance of earnings, and the second hypothesis

of the study is therefore as follows:

H2: Audit quality enhances the effects of the issued regulations for presenting management commentary on the value relevance of earnings.

3. Research methodology

This is applied research because its main objective is to find solutions for existing problems under the current circumstances. Usually, secondary data is used for this type of research. In this study, the researcher explains the subject being studied, which is descriptive research. It can also be considered correlational research as it investigates the relationship between variables. Overall, two types of information, i.e., bibliographic and empirical information, are required to conduct every study. This research collected bibliographic and empirical data from specialized Persian and English journals and papers, financial statements, explanatory notes, and existing databases such as “Rahavard Novin” and “Codal. ir”. Finally, all the models in this study were tested in Excel and EViews 10.

3.1 Statistical population and sample

The statistical population consists of all the companies listed on the TSE and IFB from 2012 to 2023. The inclusion criteria for selecting the samples were: Company being listed during the study period, inactive in financial intermediation, banking, insurance, and leasing sector, not having adjusted their fiscal year during the study period, and not having loss.

Based on the above criteria, 182 companies were investigated in this research.

3.2 Research models and variables

To test the first hypothesis of this research, Model 1 (Espahbodi et al., 2022) was used as follows:

Model 1:

$$Pit = \beta_0 + \beta_1 EPS_{it} + \beta_2 MC_{it} + \beta_3 EPS_{it} * MC_{it} + \beta_4 Lev_{it} + \beta_5 Size_{it} + \beta_6 MBit + \epsilon_{it}$$

To test the second hypothesis and investigate the effect of audit quality on the relationship between management commentary and the value relevance of earnings, Model 2 (Ismail, 2020) was used as follows:

Model 2:

$$Pit = \beta_0 + \beta_1 EPS_{it} + \beta_2 MC_{it} + \beta_3 AUDQ_{it} + \beta_4 EPS_{it} * MC_{it} + \beta_5 EPS_{it} * MC_{it} * AUDQ_{it} + \beta_6 Lev_{it} + \beta_7 Size_{it} + \beta_8 MBit + \epsilon_{it}$$

In which:

Pit (dependent variable): The natural logarithm of company stock prices at the end of the fiscal year.

EPS_{it} (independent variable): This is the natural logarithm of the company's EPS.

MC_{it} (moderator variable in Models 1 and 2): Represents the periods in which management commentary became mandatory by the SEO regulations. Thus, a value of 1 is assigned to this variable from the year 2017 onwards, and 0 is assigned for previous years (note that to test the first hypothesis, this moderator variable is used to examine and compare the relationship between the value relevance of earnings before and after the issuance of regulations for management commentary).

AUDQ_{it} (moderator variable in Model 2): Represents the company's independent audit quality.

The audit quality is measured using the audit firm class index provided by SEO. When the class index of the reporting audit firm is 1 or 2 according to SEO's classification, a value of 1 is assigned to this variable; otherwise, 0 is assigned to it.

Control variables:

Levit: The financial leverage of the company, calculated as the liabilities to assets (L/A) ratio (Espahbodi et al., 2022).

Sizeit: The size of the company, calculated as the natural logarithm of the sum of the company's assets (Espahbodi et al., 2022).

MBit: The market-to-book (P/B) ratio, calculated by dividing the equity market value by its book value (Espahbodi et al., 2022).

4. Research findings

4.1 Results of descriptive statistics

Table 1 presents the descriptive statistics of the variables. A total of 2002 company-years were investigated in this study.

Table 1. Descriptive statistics of the variables

Variables	Mean	Median	Maximum	Minimum	SD
P	3.895	3.848	5.648	2.755	0.488
EPS	2.782	2.847	4.860	-0.134	0.664
Lev	0.499	0.501	1.365	0.013	0.202
Size	14.908	14.662	21.328	10.492	1.684
MB	4.440	2.742	54.686	-49.704	5.978
MC	0.545	1.000	1.000	0.000	0.498
AUDQ	0.620	1.000	1.000	0.000	0.486

As can be seen among the companies investigated in this study, the mean logarithm for EPS is 2.782 (for IRR 1,529), with the maximum being 4.860 (for IRR 72,415) and minimum -0.134 (for IRR 1). The mean financial leverage is 0.499, with a maximum of 1.365 and a minimum of 0.013. in about 62% of observations, independent auditors are positioned in the first or second classes according to the SEO rankings.

4.2 Results of hypothesis 1 testing

Table 2 presents the results of testing hypothesis 1 using the panel regression method with time and a cross-sectional fixed effects model. A probability of $F = 0.000$ indicates the model's significance. The adjusted R-squared of the model shows that the independent and control variables can explain the changes in the dependent variable by 66.5%. Additionally, a Durbin-Watson statistic of 1.792 indicates independence among the residuals of the model fitting.

Table 2. Results of hypothesis 1 testing

Variables	Coefficients	Standard error	t-statistic	Significance level
C	4.422	0.253	17.469	0.000
EPS	0.220	0.011	20.772	0.000
MC	1.743	0.154	11.287	0.000
EPS*MC	0.374	0.021	17.880	0.000
Lev	-0.043	0.092	-0.466	0.641
Size	0.162	0.015	10.470	0.000
MB	0.047	0.002	22.236	0.000
R-squared			0.678	
Adjusted R-squared			0.665	
Durbin-Watson statistic			1.792	
F-statistic			63.171	
Significance level			0.000	

In the above table, the coefficients of EPS, t-statistics, and its significance level show the value relevance of earnings at a 5% significance level. To investigate the effect of issuing regulations for presenting management commentary on the value relevance of earnings, the coefficient of the EPS*MC variable (i.e., earnings per share*management commentary) was investigated. As shown in the above table, the coefficient of the EPS*MC variable, the t-statistic value, and its significance level suggest a significant positive relationship between this variable and stock prices at a 5% significance level. Thus, the study's first hypothesis is confirmed, indicating that the issuance of regulations for presenting management commentary enhances the value relevance of earnings. Also, investigating the control variables demonstrated a significant negative relationship between financial leverage and stock prices. Additionally, company size and the market-to-book equity ratio significantly and positively correlated with stock prices.

4.3 Results of hypothesis 2 testing

Table 3 presents the results of testing hypothesis 2 using the panel regression method with time and a cross-sectional fixed effects model. A probability of $F = 0.000$ indicates the model's significance. The adjusted R-squared of the model shows that the independent and control variables can explain the changes in the model's dependent variable by 68.5%. Additionally, the Durbin-Watson statistic of 2.005 indicates the independence of the residuals from the model fitting.

Table 3. Results of hypothesis 2 testing

Variables	Coefficients	Standard error	t-statistics	Significance level
C	6.696	0.252	26.588	0.000
EPS	0.0242	0.019	12.981	0.000
MC	1.030	0.112	10.170	0.001
AUDQ	1.590	0.207	7.698	0.000
EPS*MC	0.288	0.025	16.680	0.003
EPS*MC* AUDQ	0.291	0.026	11.040	0.000
Lev	-0.447	0.115	-3.899	0.001
Size	0.045	0.014	3.140	0.002
MB	0.057	0.003	21.769	0.000
R-squared			0.692	
Adjusted R-squared			0.685	
Durbin-Watson statistic			2.005	
F-statistic			11.088	
Significance level			0.000	

In the above table, to investigate the interactive effects of audit quality and issuing regulations for management commentary on the value relevance of earnings, the coefficient of the EPS*MC*AUDQ variable (earnings per share*management commentary*audit quality) was examined. As shown in the above table, the coefficient of the EPS*MC*AUDQ variable, t-statistic value, and its significance level show a significant positive relationship between this variable and the stock prices at a 5% significance level. Therefore, the study's second hypothesis is confirmed, indicating that audit quality enhances the effect of issuing regulations for presenting management commentary on the value relevance of earnings in companies.

5. Conclusion

Based on the results of hypothesis 1 of the study, issuing regulations for presenting management commentary has improved the value relevance of earnings. Based on this finding and the study's theoretical basis, issuing disclosure regulations or changing rules to encourage greater information transparency can enhance the quality of earnings in companies. Thus, the obligation to present a

management commentary, which is a comprehensive descriptive report for interpreting a company's financial position, financial performance, and cash flows, aimed at enhancing the usefulness of the information provided to the users, can affect the value relevance of earnings as a measure of earnings quality. Providing descriptive reports on various aspects of a company's activities has provided more useful information to investors and improved their responses to share prices. These results are consistent with the findings of Espahbodi et al. (2022).

According to the results of hypothesis 2 of the study, higher audit quality can enhance the effect of issuing regulations for presenting management commentary on the value relevance of earnings. According to the rules of the SEO, companies must provide their independent auditor's statement on their management commentary on a 6-month interim and annual basis. Considering that audit quality varies among audit firms, the study's results suggest that when audit quality is higher, the effect of issuing regulations for presenting management commentary on the value relevance of earnings also grows higher. In other words, the present study confirms the interactive effects of audit quality and issuing regulations for presenting management commentary, consistent with the findings reported by Solikha and Mardijuwono (2020) and Wahyuni and Herawaty (2018).

Based on the outcome of testing the hypotheses of this study, regulatory bodies, such as the SEO, are recommended to focus on the quality of the information provided in management commentary because, according to the results of this study, the disclosure of this information affects investors' response to accounting information and the financial reporting quality of companies. Given the importance of this information from an investor perspective, it is also recommended that company managers be more rigorous in preparing and presenting management commentary to improve the value relevance of the company's stocks under their management. The present findings also demonstrate that improving audit quality enhances the effect of management commentary on the value relevance of earnings; therefore, shareholders are recommended to pay more attention to quality when selecting an independent audit firm for their company at ordinary general assembly meetings of shareholders and to utilize higher-quality auditors for their independent auditing.

Future researchers are recommended to investigate the effects of issuing and communicating other disclosure regulations by regulatory bodies such as the SEO on the quality of earnings and thus provide appropriate feedback to the relevant authorities. Reviewing this study using other indicators to measure the quality of earnings and audit quality is also recommended.

It should be noted that in this research, to measure the audit quality variable, the data related to the classification of SEO was employed, and due to the lack of access to the details of how to classify, there is a possibility of measurement error in this regard, which is one of the limitations of this research. Also, considering the value relevance of earnings in this research, controlling factors such as institutional shareholders ownership or the percentage of free-floating shares could lead to more accurate results. Finally, in this research, it is not possible to investigate the different reactions of different types of shareholders (institutional, individuals, etc.) to the earnings and analyze the effect of the management commentary on this reaction due to the lack of access to data related to share prices in transactions related to each category of these shareholders.

Resources

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