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Investigating the influence of the tone and readability of financial reporting on the components of corporate governance in Tehran Stock Exchange

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Abstract

The current research investigates how the tone and readability of financial reporting influence corporate governance components on the Tehran Stock Exchange. Key independent variables include managerial, institutional, and family ownership, board size, board independence, gender diversity on the board, and audit committee characteristics. Tone and readability are dependent variables. The study analyzes data from 125 companies over ten years (2013-2022) using multiple regression tests. Findings reveal that institutional ownership and board independence positively affect the tone of financial reporting, while managerial and family ownership negatively impact it. Similarly, audit committee meetings and board independence enhance readability, with managerial and family ownership adversely affecting it. The research also explores the dynamics of two hypothetical variables, R_t and L_t, through recurrence relations and simulations, highlighting oscillatory patterns and real-world challenges. A sophisticated mathematical model is introduced to examine the effects of corporate governance and external factors on tone and readability, employing recursive equations and stability analysis via eigenvalues. The findings provide insights for improving clarity and consistency in international financial reporting.

Keywords: Corporate Governance, Tone of Financial Reporting, Readability of Financial Reporting
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1 Introduction

In recent years, the importance of tone and readability in financial reporting as tools for effectively communicating information to investors and stakeholders has garnered significant attention from researchers. Lee demonstrated that the readability of annual reports is significantly associated with current earnings and earnings persistence, suggesting that complex reports may obscure poor financial performance, see more [20]. Loughran and McDonald through textual analysis and the use of financial dictionaries, examined the presentation of liabilities in financial reports, revealing that word choice can influence the interpretation of information, see more [21]. Davis et al. [7] and Henry [13] explored the informational content of language in earnings press releases, finding that the phrasing of such statements can shape investors' perceptions and market reactions. Furthermore, Huang et al. [14] introduced the concept of tone management, showing that companies actively manage the tone of their financial reports to shape stakeholders' perceptions.

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Building on these discussions, the present study models the determinants of tone and readability in financial reporting based on corporate governance components and corporate strategies. Adopting a comparative approach between quantitative and qualitative information, the research aims to provide a more comprehensive perspective on how governance structures and organizational strategies influence financial communication. Transparency and readability in financial reporting are fundamental pillars of an efficient and healthy capital market. They enable investors, creditors, and other stakeholders to gain an accurate understanding of a company's financial position and performance, allowing them to make informed decisions. The tone of financial reporting, as a qualitative aspect of disclosed information, plays a significant role alongside quantitative data in shaping stakeholders' perceptions and interpretations. In recent years, the growing complexity of business operations and the occurrence of numerous cases of fraud and misconduct in financial reporting have heightened the focus on factors influencing the quality of financial reporting.

This study aims to examine the impact of corporate governance components and corporate strategies on the tone and readability of financial reporting, adopting a comparative approach between quantitative and qualitative information. Corporate governance, as a set of mechanisms designed to monitor and control management while aligning managers' interests with those of shareholders, can play a pivotal role in enhancing the quality of financial reporting [19]. Previous studies have shown that board characteristics, such as the independence of board members [4] and the presence of an audit committee [16], can influence earnings management and the likelihood of financial statement fraud [2]. Additionally, the structure of executive compensation, as one of the most critical tools of corporate governance, can affect managers' incentives to produce high-quality financial reports [6]. Financial reporting is one of the key communication tools between companies and their shareholders. The tone and readability of financial reports can have a direct impact on the decision-making of investors and analysts. Various factors can influence the tone and readability of these reports, with corporate strategy and governance components being among the most significant. This paper aims to explore the determinants of tone and readability in financial reporting by employing a comparative approach between quantitative and qualitative information, focusing on corporate governance components and corporate strategies.

Given the importance of corporate strategy in financial decision-making, Porter [27] introduced techniques for industry and competitor analysis to examine companies' competitive strategies. Similarly, Miles and Snow [22] explored the relationship between strategy, organizational structure, and processes. Hambrick and Fredrickson [12] also emphasized the critical role of strategy in companies, demonstrating that strategy can significantly influence financial decision-making and corporate performance. On the other hand, corporate strategy can influence the information disclosed in annual reports. In [3], authors demonstrated in their study that corporate strategy can affect the content of annual reports and influence informed investment decisions. Similarly, Lang and Lundholm [18] examined corporate disclosure policies and analyst behaviour, showing that a company's disclosure policy can significantly impact analysts' decision-making processes. Previous research has shown that corporate governance can impact the quality of financial reporting [11]. Additionally, corporate strategies can influence the readability of financial reports, see more [1]. Furthermore, the quality of disclosures can affect the level of information asymmetry, see [5]. In this context, the quantitative measurement of managerial ability can also serve as an important factor in determining the quality of financial reporting, see [9].

Given the importance of financial reporting and the impact of various factors on its quality and readability, this paper focuses on modelling the determinants of tone and readability in financial reporting based on corporate governance components and corporate strategies. A comparative approach between quantitative and qualitative information is used to gain a better understanding of the factors influencing the quality and readability of financial reporting. Additionally, findings from previous research, including [17] on discretionary accruals, are utilized to enhance the credibility of the models presented in this paper.

In research, Mirzaei et al. [24] investigated the impact of the pessimistic tone of financial reporting on bold financial reporting about the role of protecting the rights of shareholders. In this research, which was conducted between 2013 and 2017, 105 companies of the Tehran Stock Exchange were investigated. Shannon's entropy method was used as one of the multi-criteria decision-making methods in this research to measure the protection of shareholders' rights, and the hypotheses were tested based on regression analysis. The results showed that the pessimistic tone of financial reporting has a negative and significant effect on daring financial reporting. It was also found that the protection of shareholders' rights aggravates the negative impact of the pessimistic tone of financial reporting on bold financial reporting.

Kazemi Oloum et al. [15] investigated the impact of financial reporting readability on audit project risk criteria. Based on the theoretical and empirical bases of the research, audit report delay, audit fee, ambiguity in the continuity of activity and change of auditor were selected as the risk criteria of the audit project. The data of 150 companies admitted to the Tehran Stock Exchange were collected from 2011 to 2017 and the hypotheses of the research were

tested using combined data and applying multiple regression and logistic. According to the research results, companies whose financial reporting is less readable, have longer audit report delays, have higher audit fees, are more likely to receive a statement of ambiguity in the continuity of operations, and have more auditor changes compared to other companies. These results show that in companies with less readability of financial reporting, auditors face more audit risk and should make more effort.

The professional services and auditing firm Deloitte became significantly more ambiguous and complicated when it received Enron's reports from when the company's financial situation began to deteriorate. These findings show that Enron managed perception by using (the tone of the language of financial reporting) under the conditions that the accounting numbers showed something else, see [23]. However, in the internal studies, this issue has been neglected and there is a space in the accounting and financial reporting literature for research on this matter [26]. From one perspective, corporate governance is limited to the relationship between the company and its shareholders. This is an old model presented in the form of representation theory; This perspective focuses on the capabilities of a country's legal system to protect the rights of minority shareholders. On the other hand, corporate governance can be seen as a network of relationships that exist not only between the company and its owners but also between the company and a large number of stakeholders, including employees, customers, vendors, bondholders, etc. Such a view is often seen in the stakeholder theory. A general review of the definitions of corporate governance in scientific texts shows that all of them have a certain common feature, one of the most important of which is accountability and monitoring of the quality of financial reporting. This view emphasizes a wider level of accountability to shareholders and other stakeholders.

Dynamic systems involving two interdependent variables often arise in various fields such as biology, economics, and social sciences. Understanding their behaviour over time, particularly oscillatory and stability dynamics, is crucial for predicting system evolution. This study uses mathematical models and recurrence relations to investigate two variables, R_t and L_t, which interact and are influenced by external oscillatory forces and noise. In section 6, we present an advanced mathematical framework for analyzing tone and readability dynamics in financial reporting. By incorporating multi-step recursive equations, feedback mechanisms, and stability analysis, we explore how corporate governance, strategic complexity, and external shocks influence tone and readability. A detailed stability analysis using eigenvalues demonstrates conditions under which the system converges to equilibrium. The results offer actionable insights for improving global financial transparency and consistency. Therefore, the current research seeks to find an answer to the question of whether the tone and readability of financial reporting of companies have a significant effect on corporate governance mechanisms?

2 Hypotheses

2.1 The components of corporate governance that affect the tone of financial reporting are:

a. The percentage of managerial ownership affects the tone of financial reporting.

b. The percentage of family ownership affects the tone of financial reporting.

c. The percentage of institutional ownership affects the tone of financial reporting.

d. Board gender diversity affects the tone of financial reporting.

e. Board size affects the tone of financial reporting.

f. Board independence affects the tone of financial reporting.

g. The independence of the audit committee affects the tone of financial reporting.

h. The number of audit committee meetings affects the tone of financial reporting.

i. The size of the audit committee affects the tone of financial reporting.

2.2 The components of corporate governance that affect the readability of financial reporting are:

a. The percentage of managerial ownership affects the readability of financial reporting.

b. The percentage of family ownership affects the readability of financial reporting.

c. The percentage of institutional ownership affects the readability of financial reporting.

d. The gender diversity of the board of directors affects the readability of financial reporting.

e. The size of the board of directors affects the readability of financial reporting.

f. The independence of the board of directors affects the readability of financial reporting.

g. The independence of the audit committee affects the readability of financial reporting.

h. The number of audit committee meetings affects the readability of financial reporting.

i. The size of the audit committee affects the readability of financial reporting.

3 Research Model and Variables

The regression models of hypothesis testing are as follows:

$$\begin{aligned} \text{TONE}_{i,t} = \alpha_0 &+ \beta_1 \text{manage\_own}_{i,t} + \beta_2 \text{Ins}_{i,t} + \beta_3 \text{Family\_own}_{i,t} \\ &+ \beta_4 \text{bsize}_{i,t} + \beta_5 \text{OUTD}_{i,t} + \beta_6 \text{Gender}_{i,t} \\ &+ \beta_7 \text{Ind\_Committee}_{i,t} + \beta_8 \text{Size\_Committee}_{i,t} \\ &+ \beta_9 \text{Meetings\_Committee}_{i,t} + e_{i,t} \end{aligned} \tag{3.1}$$

$$\begin{aligned} \text{READABILITY}_{i,t} = &\alpha_0 + \beta_1 \text{manage-own}_{i,t} + \beta_2 \text{Inst}_{i,t} + \beta_3 \text{Family-own}_{i,t} \\ &+ \beta_4 \text{b-size}_{i,t} + \beta_5 \text{OUTD}_{i,t} + \beta_6 \text{Gender}_{i,t} \\ &+ \beta_7 \text{Ind-Committee}_{i,t} + \beta_8 \text{Size-Committee}_{i,t} \\ &+ \beta_9 \text{Meetings-Committee}_{i,t} + \epsilon_{i,t} \end{aligned} \tag{3.2}$$

TONE = tone of financial reporting

READABILITY = readability of financial reporting

manage-own = management ownership

Ins = institutional ownership

Family-own = family ownership

b-size= board size

OUTD= board independence

Gender= gender diversity of the board of directors

Ind-Committee = independence of the audit committee

Size-Committee= The size of the audit committee

Meeting-Committee= number of audit committee meetings

A: Dependent Variables

1. The Tone of Financial Reporting

Tone is a variable that is an indicator of the financial reporting language in the annual report. Analyzes require the use of optimistic and pessimistic tone tools in samples. To obtain systematic levels of optimistic and pessimistic tone, words that are widely used in narrative discourse analysis, such as politicians' speeches, policy makers' speeches, annual reports to shareholders and other business communications have been used ([25]). Analyzes were performed with a list of existing words created for text and content analysis. This list of words is based on linguistic theory that is more widely used in academic research in applied fields. Three lists of words as "pessimistic", labelled as "blame", "hardness" and "denial" and three lists of words as "optimistic", labelled as "valuable", "satisfaction" and "good thinking", the criteria for detecting reporting tone considered financial as mentioned in table 1 and table 2. Words used in the detection of optimistic and pessimistic tones are a translation of a list of words used in text analysis software that are often used in contemporary American discourse. Considering that the words used in identifying the pessimistic and optimistic tone are designed to identify the subtle aspects of the language; Therefore, these words were translated with utmost care and with the help of language professors. It should be noted that after reviewing the explanatory accounting reports, including the annual reports of the board of directors of the companies listed in the Tehran Stock Exchange, these terms have been widely used.

List of Reproach Words	
Definition	**Sample Words**
Terms that define social disproportion and evil. Traits that describe unfortunate situations and unexpected fluctuations that include obvious blackouts.	problematic, dark future, bad, carelessness, expensive, difficult, enemy, unstable, uncomfortable
List of Words related to Difficulty	
Definition	**Sample Words**
It includes natural disasters, hostile actions and reprehensible human behavior as well as unpleasant political outcomes as well as natural human fear and human incompetence.	abuse, warning, battle, conflict (incongruity), depressed, disappointing, discouraged, bankrupt, fear, hardship, difficulty, regret (disappointment), degradation, threat, regrettable, weakness (flaw)
List of Words related to Denial, non-Acceptance and Rejection	
Definition	**Sample Words**
Words with a negative function and words that specify null sets.	are not, can't, don't do, shouldn't, don't do, no, nothing (zero)

Table 1: List of Words related to Pessimistic Tone

List of Valuable Words (Praise)	
Definition	**Sample Words**
The approval of some people, groups or abstract entity that includes words distinguishing social qualities, physical quality, intellectual quality, entrepreneurial quality and moral quality is important. All terms in this dictionary are adjectives.	Best, better, able, desirable, good, excellent, important, positive, profitable, strong, successful
List of Satisfaction Words	
Definition	**Sample Words**
Words associated with positive affective states (emotional), with enjoyable moments and pleasurable pastimes or with words associated with success. All the words are in the cultivation area.	admire, celebrate, comfortable, confident, happy, enjoy, enthusiastic, excited, happy, satisfied
List of Good Thinking Words	
Definition	**Sample Words**
Virtues that deserve universal respect are mostly terms that distinguish desirable moral qualities as well as effective personal characteristics. Social and political ideals also include these words.	Commitment, dedication, improvement, loyalty, productivity, progress, quality

Table 2: List of words related to Optimistic Tone

According to the method of Feldman et al., [10] and Davis and Tomasevic [8] in explanatory accounting reports, when the ratio of pessimistic words to the total number of words is greater than the ratio of optimistic words to the total number of words, the tone of the report will be pessimistic and vice versa. Considering that the pessimistic tone of financial reporting is reliable and is expressed without any particular bias, and managers disclose more relevant and forward-looking information in annual reports by using a pessimistic tone, the pessimistic tone is used in the model of hypothesis testing [29].

Due to the lack of software that can analyze Persian texts in PDF format and extract the required number and type of words, we study the annual reports of the board of directors and manually count the number of pessimistic, and optimistic words and the total number of words in each report. Then, the number of pessimistic and optimistic words in each report is divided separately by the total number of words and ratios are obtained.

$$TONE = (negativewords - positivewords)/(negativewords + positivewords)$$

2. Readability of Financial Reporting

In order to measure the readability of financial reporting, according to Rezai Pinenoi and Safari Graili [28], the financial reporting readability index called FOG (which is used in many researches in the field of accounting and auditing taken) has been used. This index is a function of two variables: sentence length (in terms of words) and

complex words (defined as the number of words with three or more parts), which is calculated in the form of the following relationship:

Fog Index = 0.4 (average number of words in each sentence + number of complex words)

The method of determining the level of readability of financial reports in the above index is as follows [15]:

1. Randomly selecting a sample of one hundred words from the beginning, one sample of one hundred words from the middle, and one sample of one hundred words from the end of the report;

2. Counting the number of sentences of each sample;

3. Calculating the average length of sentences by dividing the number of words by the number of complete sentences of each sample of one hundred words;

4. Counting the number of three-syllable and more than three-syllable words (complex words) in each one-hundred-word text;

5. Adding the number of complex words with the average number of words in the sentences;

6. Multiplying the sum of the number of difficult and average words in the sentences by a fixed number of 0.4;

7. Performing the calculations of clauses 4, 5 and 6, for two samples of another hundred words;

8. Calculate the average of the results of all three samples by adding and dividing by the number.

The relationship between the FOG index and the readability level is as follows: if the FOG is greater than or equal to 18 (FOG ¿ 18), that means the text is not readable and is very complex, if it is between 14 and 18 (difficult text), if it is between 12 and 14 is (suitable text), if it is between 10 and 12 (acceptable text) and if it is between 8 and 10 (easy text). Since the higher values of the above index indicate the less readability of financial reports, the calculated value is multiplied by a negative number to obtain a direct measure of the readability index of financial reporting.

B: Independent Variables

1) Components of Corporate Governance

- Size of the Board of Directors: the number of board members is the measure of the size of the board of directors.
- Independence of the Board of Directors: The independence of the Board of directors is obtained by dividing the number of non-obligatory members of the Board of directors by the total number of members.

- Gender Diversity of the Board of Directors: gender diversity of the board of directors is a virtual variable that is given several one if the composition of the board of directors has a female member and zero otherwise.

- Management Ownership: the percentage of shares in the hands of the executive directors and board members of the company
- Institutional Ownership: the percentage of shares in the hands of quasi-governmental institutions and institutions
- Family Ownership: Family ownership is a qualitative variable and includes companies that have at least one of the following criteria:
- one or more members of one or two families own at least twenty percent of the company's shares; unless they do not have significant influence or control over the company despite owning at least twenty percent of the shares;

- At least fifty percent of the members of the board of directors should be members of the same family; and or

- In some way, significant influence or control over the company by family members is proven, even if the ownership of family members is less than 20%. To calculate the family ownership ratio, the ratio of the number of shares owned by people from the same family to the total shares of the company is used

- The size of the audit committee: the number of members of the audit committee is extracted from the notes accompanying the financial statements of the companies on the Tehran Stock Exchange website.

- Independence of the audit committee: to calculate the independence of the audit committee, the ratio of the members of the audit committee who are not members of the company's board of directors to the total members of the audit committee is used.

- The number of audit committee meetings: The number of audit committee reports is the basis for calculating the number of audit committee reports.

4 Society and Statistical Sample

The statistical population of the research includes all companies admitted to the Tehran Stock Exchange until the end of 2021. In the current research, companies are selected from the target statistical population according to the following conditions and limitations:

1. To select a homogeneous sample, the companies must have been admitted to the Tehran Stock Exchange before 2013 and their shares have been traded on the stock exchange since the beginning of 2013.

2. To select active companies, the transactions of these companies in the stock market during the years 2013 to 2021 have not been interrupted for more than three months.

3. In terms of increasing comparability, the financial period of the companies should end in March.

4. Between the years 2013 and 2021, there should be no change in activity or financial year.

5. It should not be among the investment, financial intermediation, banking and leasing industries.

According to the above conditions, 125 companies have been selected as a statistical sample.

5 Data Analysis

5.1 Descriptive Statistics of Research Variables

Table 3: Descriptive Statistics of Research Variables

Variable	Number of observations	Average	Standard deviation	Minimum	Maximum	Skewness	Kurtosis
The tone of financial reporting	1250	0.026	0.041	-0.118	0.346	-0.683	4.553
Readability of financial reporting	1250	-14.537	2.467	-26.582	-9.734	3.123	11.890
Managerial ownership	1250	0.116	0.198	0	0.693	1.036	3.162
Family owned	1250	0.051	0.253	0	0.376	1.002	4.211
Institutional ownership	1250	0.295	0.141	0	0.546	2.593	7.177
Board gender diversity	1250	0.036	0.130	0	1	2.337	4.172
Board size	1250	3.2932	1.229	3	5	2.915	4.510
Independence of the board of directors	1250	0.3145	0.264	0.20	0.66	4.326	8.711
Independence of the audit committee	1250	0.6125	0.130	0	1	2.337	4.172
The number of audit committee meetings	1250	4.235	2.116	4	12	4.376	9.219
The size of the audit committee	1250	3.472	1.506	2	5	3.091	6.472

According to Table 3; The average readability of financial reporting indicates the hard text of company board reports because their average is about 14. The average of family and management ownership is very low and about 5% and 11%, respectively. The amount of gender diversity in the composition of the board of directors is also very low and about 3%. The independence of the audit committee is also estimated at 60%.

5.2 Significance Test of Research Variables

One of the major problems that may occur in time series regression is the phenomenon of spurious regression. Spurious regression refers to a situation in which there is no significant relationship between variables despite the presence of a high coefficient of determination. To ensure the results of the research and the non-fakeness of the relationships in the regression and the meaningfulness of the variables, Levin, Lin and Chu (LLC) and Aim, Sons and Shin (IPS) Manai tests have been performed for the research variables.

It is clear that if, based on the above tests, the variables have a single root and need to be differentiated once, the degree of accumulation is one (I (1)). If they are significant variables based on the above tests, then the degree of accumulation of that variable will be zero (I (0)). Table (4-5) shows the results of the Manai test of variables. The results show that the value of this statistic is significant for each of the variables, so the null hypothesis that the variables have a unit root is rejected. In other words, the validity of the data is confirmed.

Variable	The tone of financial reporting	Readability of financial reporting	Managerial ownership	Family owned	Institutional ownership	Gender diversity of the board of directors	Board size
IPS statistics	-4/634	-8/392	-6/536	-6/019	-11/875	-8/365	-7/300
Error level	0/00	0/00	0/00	0/00	0/00	0/00	0/000
test result	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)
LLC statistics	-5/11	-4/88	-5/36	-4/63	-6/74	-5/39	-3/42
Error level	0/00	0/00	0/00	0/00	0/00	0/00	0/00
test result	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)	I (0)

Table 4: Manai Test of Research Variables

Variable	Independence of the board of directors	Independence of the audit committee	The number of audit committee meetings	The size of the audit committee
IPS Statistics	-6.128	-4.216	-8.850	-11.371
Error Level	0.000	0.000	0.000	0.000
Test Result	I (0)	I (0)	I (0)	I (0)
LLC statistics	-8.494	-6.537	-4.175	-9.907
Error level	0.000	0.000	0.000	0.000
test result	I (0)	I (0)	I (0)	I (0)

Table 5: Continuation of the Unit Root Test Results for Research Variables

5.3 Default regression tests

In order to be able to determine whether the use of the panel data method will be efficient in estimating the desired model or not, from the Chow test or bounded F and in order to determine which method (fixed effects or random effects) is more suitable for estimation (diagnosis Constant or random differences of cross-sectional units) using Hausman's test. The results of these tests are presented in the following tables. According to the obtained results, the models are tested using the panel data method with fixed effects.

Test	**Number**	**Statistic**	**The value of the statistic**	**Degree of freedom**	**P-Value**
Chow	1250	F	4.1654	8	0.0000
Hausmann	1250	χ^2	5.2177	8	0.0000

Table 6: Chow and Hausman test results for the first model

Test	**Number**	**Statistic**	**The value of the statistic**	**Degree of freedom**	**P-Value**
Chow	1250	F	5.3245	8	0.0000
Hausmann	1250	χ^2	5.1094	8	0.0000

Table 7: Chow and Hausman test results for the second model

The statistics of Table 6 and Table 7 show that the data of the first and second models should be tabular. Therefore, the Hausman test should be performed to determine the type of fixed or random effects of panel data. For both data models, a panel with fixed effects was determined. To measure the validity of the model and check the assumptions of classical regression, in addition to checking the absence of collinearity between the independent variables entered in the model, tests related to the normality of the residuals, equality of variances, independence of the residuals and the absence of model specification error are necessary (linearity of the model) should also be done.

Different tests can be used to test the normality of error sentences. One of these tests is the Jarquio-Bera test, which is also used in this research. The results of the Jarkio-Bera test indicate that the residuals obtained from the estimation of the research model have a normal distribution at the 95% confidence level so that the probability of this test is greater than 0.05. Another statistical assumption of classical regression is the homogeneity of variance of the residuals. If the variances are unequal, the linear estimator will be unbiased and will not have the least variance. In this study, the Pagan cut test was used to check the homogeneity of variances. According to the significance level of this test, which is less than 0.05, the null hypothesis of homogeneity of variance is rejected and it can be said that the model has a problem of heterogeneity of variance. In this study, the generalized least squares (GLS) estimation method was used to solve this estimation problem. Also, the Durbin-Watson (D-W) test was used in this study to test

the non-correlation of residuals, which is one of the assumptions of regression analysis and is called autocorrelation. According to the preliminary results of Durbin-Watson's statistical model estimation, since it is between 1.5 and 2.5, it can be concluded that the residuals are independent of each other.

In addition, to test whether the model has a linear relationship and whether the research model has been correctly explained in terms of linear or non-linear relationships, the Ramzi test has been used. Because the level of significance of Ramzi's test is greater than 0.05, therefore, the null hypothesis of this test based on the linearity of the model is confirmed and the model does not have a clear error. The summary of the results of the above tests is presented in the following tables.

Jarque-Bera statistic		Breusch-Pagan statistic		Durbin-Watson statistic	Ramsey statistic	
X2	P-value	F	P-value	D	F	P-value
1/6324	0/21590	1/9768	0/009	1/813	3/225	0/1657

Table 8: The results of tests related to statistical assumptions for the first model

Jarque-Bera statistic		Breusch-Pagan statistic		Durbin-Watson statistic	Ramsey statistic	
X2	P-value	F	P-value	D	F	P-value
1/1045	0/7325	1/835	0/0042	2/265	5/0326	0/0943

Table 9: The results of tests related to statistical assumptions for the second model

5.4 The first hypothesis test

The results of the first hypothesis test are as follows:

Variable type	symbol	Variable name	Coefficient	standard error	Statistics t	Error level
Dependent variable	TONE	The tone of financial reporting	-	-	-	-
Fixed value	α	alpha	0/326	0/2458	1/326	0/311
Independent variables	MANAGE-OWN	Managerial ownership	-0/387*	0/0821	-4/709	0/000
Independent variables	Ins	Institutional ownership	0/145*	0/0413	3/508	0/000
Independent variables	Family owns	Family owned	-0/216*	0/0383	-5/634	0/000
Independent variables	b-size	Board size	0/412	0/2474	1/665	0/121
Independent variables	OUTD	Independence of the board of directors	0/513*	0/1102	4/653	0/000
Independent variables	GENDER	Board gender diversity	0/433	0/2440	1/774	0/098
Independent variables	Ind-committee	Independence of the audit committee	0/304*	0/0445	6/823	0/000
Independent variables	Size-committee	The size of the audit committee	0/132	0/0843	1/564	0/175
Independent variables	Meetings-committee	The number of audit committee meetings	0/184	0/1142	1/611	0/135
DW		Watson camera	1/813	-	-	-
F		F statistic	9/165	-	-	0/000
R Square		Coefficient of determination	0/627	-	-	-
Adjusted R square		Adjusted coefficient of determination	0/625	-	-	-

Table 10: The results of multivariate regression of the first hypothesis

As this table shows, because the error level of managerial ownership, institutional ownership, family ownership, independence of the board of directors and independence of the audit committee is less than 5; Therefore, these variables have a significant effect on the tone of the company's financial reporting, and the size of the board of

directors, the size of the audit committee, the gender diversity of the board of directors, and the number of board meetings do not affect the tone of the company's financial reporting (because the error level of this variable is higher than 5%). Considering that the significance level of the F coefficient is less than 5%(0.000), therefore the calculated regression model is significant, in other words, a logical relationship between the variables has been established. Also, according to the coefficient of determination obtained, the independent variables explain 62.7% of the changes in the company's financial reporting tone. Watson's camera statistic is between 1.5 and 2.5 (1.813); So it can be concluded that there is no autocorrelation problem between the error sentences in the regression equation.

5.5 Test of Second Hypotheses

The result of testing the third and fourth hypotheses is presented in below table as follows:

Variable type	symbol	Variable name	Coefficient	standard error	Statistics t	Error level
Dependent variable	TONE	The tone of financial reporting	-	-	-	-
Fixed value	α	alpha	0/118	0/0736	1/896	0/199
Independent variables	MANAGE-OWN	Managerial ownership	-0/293*	0/0858	-5/414	0/000
Independent variables	Ins	Institutional ownership	0/174	0/0960	1/811	0/128
Independent variables	Family owns	Family owned	-0/295	0/0681	-4/328	0/000
Independent variables	b-size	Board size	0/464	0/3316	1/399	0/387
Independent variables	OUTD	Independence of the board of directors	0/307*	0/0508	6/042	0/000
Independent variables	GENDER	Board gender diversity	0/301	0/2473	1/217	0/531
Independent variables	Ind-committee	Independence of the audit committee	0/166*	0/0676	2/455	0/037
Independent variables	Size-committee	The size of the audit committee	0/331	0/2900	1/141	0/522
Independent variables	Meetings-committee	The number of audit committee meetings	0/412*	0/0863	4/774	0/000
DW		Watson camera	2/265	-	-	-
F		F statistic	17/208	-	-	0/000
R Square		Coefficient of determination	0/743	-	-	-
Adjusted R square		Adjusted coefficient of determination	0/739	-	-	-

Table 11: The results of the multivariate regression of the third and fourth hypotheses

As this table shows, because the error level of the variables of managerial ownership, family ownership, independence of the board of directors, independence of the audit committee, the number of audit committee meetings, offensive strategy and defensive strategy is less than 5%; Therefore, these variables have a significant effect on the readability of the company's financial reporting, and the size of the board of directors, the size of the audit committee, gender diversity of the board of directors, and institutional ownership do not affect the readability of the company's financial reporting (because the error level of this variable is higher than 5%.).

Considering that the significance level of the F coefficient is less than 5%(0.000), therefore the calculated regression model is significant, in other words, a logical relationship between the variables has been established.

Also, according to the coefficient of determination obtained, the independent variables explain 74.3% of the changes in the readability of the company's financial reporting. Watson's camera statistic is also between 1.5 and 2.5(2.265); so it can be concluded that there is no autocorrelation problem between the error sentences in the regression equation.

6 Mathematical model

6.1 Behavioral Dynamics of R_t and L_t Over Time

In this section we explore the dynamic behavior of two hypothetical variables, R_t and L_t, over time. Using recurrence relations, equilibrium analysis, and oscillatory simulations, the dynamics of these variables are modeled and analyzed.

6.1.1 Primary Relations

The behavior of R_t and L_t is modeled using the following recurrence relations:

$$R_t(t+1) = \alpha R_t(t) + \beta L_t(t) + \gamma \sin(t) + \epsilon_{\text{Random}}, \tag{6.1}$$

$$L_t(t+1) = \delta L_t(t) + \zeta R_t(t) + \eta \cos(t) + \epsilon_{\text{Random}}. \tag{6.2}$$

where

- t: Discrete time
- $\alpha, \beta, \gamma, \delta, \zeta, \eta$: Model coefficients controlling the system's behavior.
- $\sin(t)$ and $\cos(t)$: Represent external oscillatory influences.
- ϵ_{Random}: Represents random noise to simulate real-world uncertainties.
- $R_t(t)$ and $L_t(t)$: State variables representing the system behavior at time t.
- $R_t(t+1)$ and $L_t(t+1)$: Next state of the system at time $t+1$.

6.1.2 Equilibrium Points

Equilibrium points occur when:

$$R_t(t+1) = R_t(t) = R_t^*, \quad L_t(t+1) = L_t(t) = L_t^*.$$

By substituting these conditions into the recurrence relations, the equilibrium equations are derived as:

$$R_t^* = \frac{-\beta L_t^* - \gamma \sin(t) - \epsilon_{Random}}{\alpha}, \tag{6.3}$$

$$L_t^* = \frac{-\zeta R_t^* - \eta \cos(t) - \epsilon_{Random}}{\delta}. \tag{6.4}$$

The solutions of these equations provide the steady-state values of R_t and L_t under the specified conditions.

6.1.3 Stability Analysis

To evaluate the stability of equilibrium points, the Jacobian matrix of the system is computed as:

$$J = \begin{bmatrix} \frac{\partial R_t(t+1)}{\partial R_t(t)} & \frac{\partial R_t(t+1)}{\partial L_t(t)} \\ \frac{\partial L_t(t+1)}{\partial R_t(t)} & \frac{\partial L_t(t+1)}{\partial L_t(t)} \end{bmatrix}$$

For the given recurrence relations:

$$J = \begin{bmatrix} \alpha & \beta \\ \zeta & \delta \end{bmatrix}.$$

The eigenvalues of the Jacobian matrix determine stability:

- Stable equilibrium: $|\lambda| < 1$ for all eigenvalues λ.
- Unstable equilibrium: $|\lambda| > 1$ for any eigenvalue λ.
- Oscillatory or neutral stability: Complex λ with $|\lambda| = 1$.

6.1.4 Challenges and Limitations

1. Sensitivity to coefficients: The system's behavior is highly sensitive to small changes in α, which can result in transitions between stability and instability.
2. Impact of noise: The random noise ϵ introduces significant variability, complicating equilibrium analysis.
3. Numerical challenges: Solving the recurrence relations for larger systems or those with more variables requires advanced numerical techniques.

6.2 Global Financial Transparency through Recursive Models: Stability and Stepwise Analysis of Tone

In this subsection, we introduce a sophisticated mathematical model to examine how tone and readability in financial reports are affected by factors such as corporate governance, strategic complexity, and external disruptions. We employ multi-stage recursive equations, incorporate feedback loops, and conduct a stability analysis through eigenvalues to determine when the system stabilizes. The findings offer actionable insights for enhancing clarity and uniformity in international financial reporting.

6.2.1 Background

Tone in financial reporting significantly influences investor decisions and corporate trust. Understanding the dynamic and stepwise effects of governance, strategy, and external factors on tone is critical for ensuring transparency and consistency.

1. Develop a strengthened recursive model for tone and readability dynamics.
2. Analyze stability using eigenvalues of the Jacobian matrix.
3. Provide actionable insights into global financial reporting practices.

6.2.2 Recursive Equations for Tone and Readability

The recursive models for tone and readability incorporate feedback mechanisms, network interactions, and non-linear effects:

Readability:

$$R(t+1) = \alpha_1 G(t) - \beta_1 S(t) + \gamma_1 E(t) - \delta_1 R(t) + \lambda \sum_{i=1}^{n} W_{ij} R_i(t) + \eta_1 R^2(t) \tag{6.5}$$

Tone:

$$L(t+1) = \alpha_2 G(t) + \beta_2 S(t) - \gamma_2 E(t) - \delta_2 L(t) + \mu \sum_{i=1}^{n} W_{ij} L_i(t) + \eta_2 L^2(t) \tag{6.6}$$

6.2.3 Stepwise Contributions

We decompose the tone $L(t)$ into the following stepwise contributions:

1. Governance Impact

$$(\Delta L)_{\text{Governance}} = \alpha_2 \, G(t) \tag{6.7}$$

2. Strategy Impact

$$(\Delta L)_{\text{Strategy}} = \beta_2 \, S(t) \tag{6.8}$$

3. External Impact

$$(\Delta L)_{\text{External}} = -\gamma_2 \, E(t) \tag{6.9}$$

4. Feedback Impact

$$(\Delta L)_{\text{Feedback}} = -\delta_2 \, L(t) + \mu \sum_{i=1}^{n} W_{ij} \, L_i(t) + \eta_2 \, L^2(t) \tag{6.10}$$

Combining the above contributions, the recursive equation for $L(t)$ becomes:

$$L(t+1) = L(t) + \alpha_2\, G(t) + \beta_2\, S(t) - \gamma_2\, E(t) - \delta_2\, L(t) + \mu \sum_{i=1}^{n} W_{ij}\, L_i(t) + \eta_2\, L^2(t). \tag{6.11}$$

6.2.4 Equilibrium Points

For Readability and for Tone:

$$R^*(1 + \delta_1 - \eta_1 R^*) = \alpha_1 G^* - \beta_1 S^* + \gamma_1 E^* + \lambda \sum_{i=1}^{n} W_{ij} R_i^* \tag{6.12}$$

$$L^*(1 + \delta_2 - \eta_2 L^*) = \alpha_2 G^* + \beta_2 S^* - \gamma_2 E^* + \mu \sum_{i=1}^{n} W_{ij} L_i^*. \tag{6.13}$$

These equations can be solved numerically to find.

6.2.5 Stability Analysis

Stability is determined using the eigenvalues of the Jacobian matrix:

$$J = \begin{bmatrix} \dfrac{\partial R(t+1)}{\partial R(t)} & \dfrac{\partial R(t+1)}{\partial L(t)} \\ \dfrac{\partial L(t+1)}{\partial R(t)} & \dfrac{\partial L(t+1)}{\partial L(t)} \end{bmatrix}$$

The components of the Jacobian matrix are given by:

$$\frac{\partial R(t+1)}{\partial R(t)} = -\delta_1 + 2\eta_1 R(t), \quad \frac{\partial R(t+1)}{\partial L(t)} = 0,$$

$$\frac{\partial L(t+1)}{\partial R(t)} = 0, \quad \frac{\partial L(t+1)}{\partial L(t)} = -\delta_2 + 2\eta_2 L(t).$$

The eigenvalues of the Jacobian matrix are:

$$\lambda_1 = -\delta_1 + 2\eta_1 R^*, \quad \lambda_2 = -\delta_2 + 2\eta_2 L^*$$

For stability, the following conditions must hold:

$$|\lambda_1| < 1 \quad \text{and} \quad |\lambda_2| < 1$$

6.3 Policy Implications

For Policymakers: Strong governance reduces oscillations in tone and enhances stability.

For Investors: Understanding tone sensitivity helps in risk assessment and portfolio management.

7 Discussion and Conclusion

The results of the first main hypothesis of the research are as follows:

Based on the results of the first sub-hypothesis, managerial ownership has an inverse and significant effect on the tone of financial reporting. Due to the desire to provide the best performance to the shareholders, company managers may not follow the principle of conformity and present reports with an optimistic tone, which is not a favourable tone for financial statement reports. Based on the results of the second sub-hypothesis, family ownership has an inverse and significant effect on the tone of financial reporting. Due to less sensitivity and certainty of ownership of the company's shares, family owners will have less control over the financial statements and the behaviour of the managers who report the financial statements. and this causes a decrease in the favourable tone of financial reporting of companies. Based

on the results of the third sub-hypothesis, institutional ownership has a direct and significant effect on the tone of financial reporting.

Institutional owners, by having expert and expert managers in the capital market, can better monitor the behaviour of managers reporting financial statements, and this will improve the quality of financial reporting. Based on the results of the fourth sub-hypothesis, the gender diversity of the board of directors does not affect the tone of financial reporting. The members of the board of directors with their efficient supervision and expertise can improve the desirability of the tone of financial reporting, and the type and efficiency of the members' supervision is important, and based on the results of this research, the number of members has no effect on the tone of financial reporting. Based on the results of the sixth sub-hypothesis, the independence of the board of directors has a direct and significant effect on the tone of financial reporting. Non-executive board members can prevent manipulation of financial reporting items and improve the tone of financial reporting by monitoring financial statements more closely.

Based on the results of the seventh sub-hypothesis, the independence of the audit committee has a direct and significant effect on the tone of financial reporting. When there are more independent members of the audit committee, they are better able to impartially audit the financial statements and report intentional or inadvertent errors. This can lead to a favourable tone of financial reporting. According to the results of the eighth sub-hypothesis, the number of audit committee meetings does not affect the tone of financial reporting. According to the results of the ninth sub-hypothesis, the size of the audit committee does not affect the tone of financial reporting. Based on the results of the hypothesis test, the number of audit committee members and the number of their meetings cannot guarantee the favourable tone of the financial reports, and the independence and financial expertise of the committee members are very important.

The results of the second main hypothesis of the research are as follows:

Based on the results of the first sub-hypothesis, managerial ownership has an inverse and significant effect on the readability of financial reporting. Due to the desire to provide the best performance to the shareholders, company managers may not comply with the principle of conformity and present reports with more complexity, which reduces the readability of financial reporting. Based on the results of the second sub-hypothesis, family ownership has an inverse and significant effect on the readability of financial reporting. Family owners will have less control over the financial statements and the behaviour of managers reporting financial statements due to less sensitivity and certainty of ownership of the company's shares, and this causes managers to present reports with less readability and more complexity. Based on the results of the third sub-hypothesis, institutional ownership does not affect the readability of financial reporting. Based on the results of the fourth sub-hypothesis, the gender diversity of the board of directors does not affect the readability of financial reporting. The very small number of female members on the board of directors of Tehran stock companies will reduce their ability to express their opinions and their efficient supervision and ultimately not affect the readability of financial reporting. According to the results of the fifth sub-hypothesis, the size of the board of directors does not affect the readability of financial reporting. The members of the board of directors can improve the readability of financial reporting with their efficient supervision and expertise, and the type and efficiency of the members' supervision is important, based on the results of this research, the number of members does not affect the readability of financial reporting.

Based on the results of the sixth sub-hypothesis, the independence of the board of directors has a direct and significant effect on the readability of financial reporting. The non-commissioned members of the board of directors can prevent the manipulation of financial reporting items by monitoring the financial statements more closely and requiring managers to provide simple and fluent information in the financial statements. Based on the results of the seventh sub-hypothesis, the independence of the audit committee has a direct and significant effect on the readability of financial reporting. When there are more independent members of the audit committee, they are better able to impartially audit the financial statements and report intentional or inadvertent errors. This can lead to the simple and smooth presentation of financial reporting.

Based on the results of the eighth sub-hypothesis, the number of audit committee meetings has a direct and significant effect on the readability of financial reporting. When the members of the audit committee hold more meetings in a year, the items of the financial statements are reviewed several times and the complications in presenting the reports are reduced, and this leads to an increase in the readability of the financial reporting. Based on the results of the ninth sub-hypothesis, the size of the audit committee has no effect on the readability of financial reporting.
Based on the results of the hypotheses test, the small or large number of audit committee members cannot guarantee the readability of financial reports, and the independence and number of meetings of the committee members are very important. This study demonstrates the utility of recurrence relations in understanding the dynamic interactions between two variables. The equilibrium and oscillatory behaviors observed in the simulations reflect real-world dynamics

such as market cycles or ecological predator-prey systems. The results emphasize the importance of incorporating both deterministic and stochastic components in modeling. Future research can focus on extending the model to include more variables, exploring non-linear effects, and addressing computational challenges.
This enhanced framework incorporates recursive dynamics, stability analysis, and eigenvalue behavior to model tone and readability in financial reporting. The results provide actionable insights for global financial transparency and consistency.

8 Research proposals

A: Results-based Suggestions:

Based on the results of the research on the inverse effect of managerial and family ownership on the tone and readability of financial reporting; Shareholders of family companies and companies with a high percentage of ownership are advised to audit the company by experienced people and well-known auditing institutions, which can improve the quality of financial reporting in terms of tone and readability. Also, making the company's internal audit department more efficient can provide transparency, quality, tone and readability of financial reporting. Based on the results of the research on the direct effect of institutional ownership on the tone of financial reporting, it is recommended that the shareholders hand over part of the company's shares to the lead owners because the efficiency and experience of the institutional owners can lead to more monitoring and a more favourable tone of the financial statements. Based on the results of the research on the direct effect of the independence of the board of directors on the tone and readability of financial reporting, it is recommended that shareholders choose the non-compulsory members of the board of directors from among the experts and experienced auditors because these people can have better supervision of financial reporting and managers. Make reports with a good tone and readability. Based on the results of the research on the direct effect of the independence of the audit committee on the tone and readability of financial reporting, it is recommended that the stock exchange organization emphasizes the independence of the board members and does not use board members in the audit committee. Because the higher independence of the audit committee can lead to an impartial and more accurate audit of the financial statements reduce the complexity and increase the desirability of the financial reporting tone. Based on the results of the research on the direct effect of the number of audit committee meetings on the readability of financial reporting, it is recommended that the number of audit committee meetings be held regularly. According to the law, the minimum number of audit committee meetings should be 6 meetings per year, which is not observed in many companies.

B: Suggestions for Future Research

- In similar research, it is possible to change the division of the company's strategy and separate and examine the company's strategy into the strategies of concentration, differentiation and cost leadership.

- In research, it is possible to examine the causes of the inefficiency of gender diversity and the size of the board of directors in improving the tone and readability of financial reporting.

- Also, in another research, the role of fluctuations in macroeconomic variables, including inflation, can be considered in the relationship between corporate governance and the tone and readability of financial reporting.

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