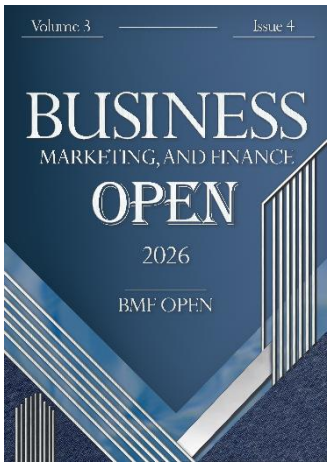
Examining the Effect of the Developed Investment Efficiency Model on Disclosure Tone and Financial Reporting Readability: A Study of Companies Listed on the Tehran Stock Exchange



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Abstract: In addition to focusing on financial figures and ratios, users of information attach considerable attention to the narrative disclosures contained in financial reports, as these disclosures facilitate the interpretation of numerical information presented in the financial statements. In this context, the tone and readability of financial reporting emerge as important features, and a firm's investment efficiency can influence both its disclosure tone and the readability of its financial reporting. The present study investigates the effect of the developed investment efficiency model on disclosure tone and financial reporting readability among companies listed on the Tehran Stock Exchange. This study is applied in nature and uses panel data. Applying a systematic elimination method, observations from 120 firms were collected for the period from 2016 to 2023, and the research hypotheses were tested using multiple regression analysis. The temporal dimension of the study is retrospective, and a deductive approach was used to interpret the findings. The results indicate that investment efficiency has a positive and significant effect on the readability of corporate financial reporting. Moreover, the findings show that investment efficiency has a negative and significant effect on firms' disclosure tone. Therefore, based on the results of the study, improving investment efficiency can be expected to enhance the qualitative characteristics of financial reporting. Accordingly, efforts to optimize resource utilization through precise evaluation of investment efficiency can create a win–win outcome for both the firm and the users of financial reports.

Keywords: Investment efficiency, disclosure tone, financial reporting readability

1. Introduction

Investment efficiency has emerged as a central construct in contemporary corporate finance and financial reporting research because it captures how effectively firms transform financial resources into value-creating investment projects rather than engaging in underinvestment or overinvestment [1]. Classical theories of investment behavior emphasize the role of information asymmetry, agency conflicts, and financing frictions in producing deviations from optimal investment, but more recent work shows that the quality of financial reporting, the architecture of corporate governance, and the textual characteristics of disclosures all shape the information environment in which

investment decisions are made [1, 2]. As a result, investment efficiency is no longer analyzed solely in terms of quantitative cash flow and valuation models; it is increasingly situated within a broader disclosure ecosystem in which the tone, readability, and credibility of financial reports influence how managers, investors, and other stakeholders perceive and evaluate corporate investment strategies [3, 4].

A substantial stream of research has sought to measure corporate investment efficiency and identify its determinants across different institutional settings. Early work developed benchmark models of expected investment based on growth opportunities and financial constraints, with deviations from benchmark levels interpreted as under- or overinvestment [1, 2]. Subsequent studies in Iran and other emerging markets refined these models to better reflect local capital market conditions and reporting regimes, proposing measurement frameworks tailored to the structure of the Tehran Stock Exchange [2, 5, 6]. More recently, model-based measurement of investment efficiency has been extended by incorporating additional performance metrics, risk indicators, and behavioral variables, highlighting that both firm-specific fundamentals and managerial characteristics play a role in driving investment inefficiencies [7-9].

International evidence shows that investment efficiency is linked to the life cycle of the firm, with younger and rapidly growing firms often displaying different investment patterns than mature firms as they move through stages of growth, maturity, and decline [10]. Firm-level financing choices such as the structure of external funding, reliance on internal cash flows, and management of liquid assets further condition the extent to which managers invest optimally relative to the firm's opportunity set [10, 11]. For example, cash holdings can either mitigate underinvestment by relaxing financing constraints or exacerbate overinvestment when weaker governance allows managers to allocate excess liquidity to low-return projects [11]. In distressed firms, the interaction between cash policy and governance mechanisms is particularly critical, as monitoring by boards and shareholders can moderate the relationship between liquidity and inefficient investment [11]. In emerging markets, stock liquidity and market depth also shape the feedback channel between investors and managers, influencing the valuation consequences of investment decisions and the incentives to align investments with shareholder interests [12].

The quality of financial reporting has been identified as a key channel through which information frictions are reduced and investment efficiency is improved [1, 13]. High-quality earnings and transparent disclosure reduce uncertainty about future cash flows, enabling more precise capital budgeting and more disciplined monitoring of managerial investment choices [13, 14]. Studies on earnings quality and institutional features show that the effectiveness of accounting information in supporting efficient investment depends not only on firm-level reporting practices but also on the broader legal, enforcement, and governance environment [13, 14]. In European and emerging markets alike, firms with better earnings quality and more robust institutional settings tend to allocate capital more efficiently, as evidenced by smaller deviations from benchmark investment models [14, 15].

Corporate governance and stakeholder relationships add another layer to the investment efficiency landscape. Governance structures affect managerial incentives to undertake value-creating versus empire-building investments, shaping both the quantity and quality of capital expenditures [16, 17]. Mechanisms such as compensation contracts, clawback provisions, and board oversight influence managers' risk-taking and their choice between short-term earnings management and long-term investment strategies [17]. In the Iranian context, recent research has emphasized the importance of managerial conservatism, board monitoring, and stakeholder connectivity in channeling resources toward projects with higher net present value and improving capital allocation efficiency [16, 18, 19]. The mosaic homogeneity theory suggests that when information flows are more coherent and stakeholder relationships are stronger, firms are better able to coordinate expectations and reduce investment

distortions [18]. Social capital and relational networks also support more efficient investment by enhancing trust, reducing agency conflicts, and facilitating access to complementary knowledge and financing channels [19].

A growing body of literature has explored how environmental, social, and governance (ESG) performance and corporate environmental governance schemes intersect with investment decisions. Evidence from emerging markets indicates that firms with higher ESG performance and more developed environmental governance frameworks are more likely to invest in long-term sustainable projects and less likely to misallocate capital to opportunistic or short-sighted initiatives [15, 20]. The COVID-19 period highlighted that governance arrangements, including environmental oversight, can maintain or even enhance investment efficiency under heightened uncertainty [20]. Similarly, media coverage and external scrutiny influence managers' incentives to pursue efficient investment, as increased visibility raises reputational costs for inefficient behavior and earnings manipulation [21, 22]. The interaction between CEO characteristics, media attention, and macro shocks such as the pandemic shapes earnings management and, indirectly, the quality of investment decisions [22, 23].

In parallel with this governance-oriented literature, researchers have increasingly turned their attention to the qualitative and textual properties of financial reporting—particularly the readability and tone of narrative disclosures—and their implications for both earnings quality and investment behavior [3, 4]. Advances in textual and sentiment analysis allow scholars to quantify features such as linguistic complexity, sentiment polarity, and rhetorical emphasis in sections like the management discussion and analysis (MD&A), chairman's statements, and board reports [4, 24]. By converting unstructured text into structured indicators, these methods provide new proxies for the transparency, bias, and information content of corporate communication [3, 24]. For example, studies have shown that textual risk disclosures and sentiment-laden narratives predict future risk, returns, and firm value, suggesting that tone is informative rather than purely cosmetic in many contexts [3, 24].

The tone of narrative disclosures has been linked to earnings management, earnings persistence, and broader disclosure strategies. Evidence from the United Kingdom and other markets indicates that more optimistic or overly positive tone can be associated with aggressive earnings management and attempts to obscure underlying performance, whereas balanced or cautious tone tends to correlate with more sustainable earnings patterns [25, 26]. Cross-listing and regulatory reporting requirements, such as Form 20-F, provide a setting in which the tone of language and the structure of financial disclosure are explicitly regulated, enabling the study of how linguistic cues relate to real economic outcomes and managerial reporting choices [27]. Research in China and other emerging markets further shows that managerial tone in MD&A sections is systematically related to future investment efficiency, suggesting that narrative sentiment reflects underlying governance and information quality rather than being mere rhetorical noise [24, 28].

Readability, distinct from tone, captures the cognitive effort required for users to process financial narratives. High readability reduces processing costs and contributes to a more accessible information environment for investors, analysts, and other stakeholders [29, 30]. Evidence from South Africa and other markets demonstrates that complex, jargon-laden texts in sections such as the chairman's statement can limit the usefulness of disclosures and potentially mask risk or poor performance [30]. In the Iranian context, studies using the Fog index and similar metrics show that more readable financial reporting is associated with lower agency costs and more efficient monitoring of managers, particularly when managerial ability and other moderating factors are taken into account [29]. This line of research supports the broader view that both the quantity and the linguistic quality of disclosure—encompassing readability and tone—are integral components of the firm's information environment.

Several recent contributions have explicitly integrated investment efficiency with textual and narrative dimensions of disclosure. Studies examining management's tone in MD&A reports document that more conservative or neutral tone is associated with better alignment between investment and firm fundamentals, whereas excessively optimistic tone can signal or even facilitate overinvestment [28, 31]. Other research finds that narrative tone correlates with earnings persistence and future performance, reinforcing the idea that textual features capture meaningful information about managerial expectations and strategic choices [24, 26]. At the same time, corporate investment efficiency has been linked to investor sentiment and ownership structure, with evidence showing that sentiment-driven markets and concentrated ownership can amplify the impact of disclosure characteristics on capital allocation decisions [31, 32]. Directors' and officers' liability insurance, for instance, has been shown to influence investment efficiency through changes in risk-sharing and governance incentives, pointing to a complex interplay between contractual arrangements, disclosure policies, and investment outcomes [32].

In Iran, a rapidly growing research stream has examined the determinants and consequences of investment efficiency in the context of the Tehran Stock Exchange. Studies have proposed models that incorporate behavioral biases, financing patterns, and macro-institutional factors into the measurement of investment efficiency, emphasizing that local capital market characteristics and regulatory structures must be reflected in empirical models [5, 7, 9]. Recent work has analyzed the role of political connections, cost of capital, and CEO narcissism in shaping the efficiency of investment decisions, highlighting that managerial traits and political ties may either support or undermine efficient capital allocation depending on the surrounding governance environment [33, 34]. Other studies have used artificial intelligence and advanced analytics to refine performance metrics and improve the explanatory power of investment efficiency models, demonstrating the potential of data-driven methods to capture nonlinear relationships and complex interactions among determinants [8]. There is also growing interest in how financial reporting readability and disclosure quality influence investment decisions, with evidence suggesting that clearer, more accessible reporting supports more disciplined corporate investment behavior in Iranian firms [29, 35].

Despite these advances, there remains a relative paucity of research that simultaneously considers a developed, context-specific model of investment efficiency and its association with both the tone and readability of financial reporting in an emerging market setting such as Iran. Prior studies have examined each dimension—investment efficiency measurement, governance mechanisms, ESG factors, and textual features of disclosure—largely in isolation [4, 6, 15, 21]. However, the interaction between a refined investment efficiency construct and the qualitative characteristics of narrative disclosure has not been comprehensively explored using a unified empirical framework for firms listed on the Tehran Stock Exchange. Given that investment efficiency affects and is affected by information asymmetry, monitoring intensity, and stakeholder perceptions, it is reasonable to expect systematic relationships between a firm's efficiency in allocating capital and the linguistic qualities of its financial reporting [14, 19, 28]. Addressing this gap is essential for regulators, standard-setters, and practitioners who seek to enhance both the efficiency of capital markets and the decision-usefulness of financial reports in emerging economies.

Accordingly, building on the developed investment efficiency model tailored to the Iranian market and the growing literature on textual analysis of financial reporting, the aim of this study is to investigate the effect of a developed investment efficiency model on disclosure tone and financial reporting readability in companies listed on the Tehran Stock Exchange.

2. Methodology

This study has several dimensions. The first dimension concerns the research approach, which is micro-analytic. The second dimension relates to the research objective, which is applied. The third dimension concerns the nature of the study, which is review-based. The fourth dimension pertains to the nature of the data, which is quantitative. The fifth dimension concerns the descriptive research method, in which the description of conditions or phenomena is employed, and most accounting research can be categorized as descriptive. The sixth dimension pertains to the type of reasoning, which is field-based. The seventh dimension indicates that the research is retrospective. The eighth dimension concerns the time span, which is a combined method (year–firm). The ninth dimension concerns data collection methods, which include archival, observation, library, and document analysis.

In this research, similar to many studies conducted domestically and due to limitations in access to information, the statistical population includes all companies listed on the Tehran Stock Exchange. Using a systematic sampling method and after meeting the following criteria, the final research sample was determined.

The company must have been continuously active on the Tehran Stock Exchange from the beginning of 2016 to the end of 2023 and must not have changed its fiscal year during this period.

The company must not belong to the financial intermediaries, banks, leasing companies, insurance companies, or investment companies sector.

The company's fiscal year-end must coincide with the end of March.

The information required must have been fully disclosed by the company.

Ultimately, 120 firms were included in the final sample.

Measurement of Variables and Research Models

Investment Efficiency (Inv.Effe)

In this study, following the research of Lafta et al. (2025), the developed model of Biddle et al. (2009), which has been adapted for the Iranian context and has demonstrated higher predictive power, was used to measure investment efficiency.

The model is estimated according to Equation (1).

$$\text{newInv.Effe}_{i,t} = \beta_0 + \beta_1 \text{Growth}_{i,t-1} + \beta_2 \text{MS}_{i,t} + \beta_2 \text{PF}_{i,t} + \beta_2 \text{SRD}_{i,t} + \beta_2 + \beta_2 \text{CS}_{i,t} + \beta_2 \text{CG}_{i,t} + \beta_2 \text{AQ}_{i,t} + \beta_2 \text{FC}_{i,t} + \beta_2 \text{ACC}_{i,t} + \beta_2 \text{CEOC}_{i,t} + \beta_2 C_{i,t} + \beta_2 \text{TA}_{i,t} + \beta_2 \text{OS}_{i,t} + \varepsilon_{i,t}$$

Equation (1)

Since large absolute residual values represent investment inefficiency, and for ease of interpretation, the absolute values of the residuals obtained from Equation (1) were multiplied by negative one according to Equation (2). Thus, higher values of this index indicate greater investment efficiency.

$$\text{Inv.Effe}_{i't} = \mid \varepsilon_{i't} \mid$$

Equation (2)

Two additional variables—financial reporting readability and disclosure tone—were used as indicators of disclosure practices and served as dependent variables. The operational measurement procedures for these two variables are explained below.

Disclosure Tone (Tone)

Tone is a variable used as an index of the language of financial reporting in the annual report. Analyses require tools to identify optimistic and pessimistic tone in textual samples. To obtain systematic levels of optimistic and pessimistic tone, words widely used in narrative discourse analysis—such as political speeches, policymakers' statements, annual shareholder reports, and other business communications—are applied. The analyses are conducted using lists of words constructed for textual and content analysis. These word lists are based on linguistic theory widely used in academic research in applied fields (Davis & Brennan, 2012).

Three lists of words categorized as "pessimistic"—labeled "blame," "hardship," and "denial"—and three lists of words categorized as "optimistic"—labeled "valuable," "satisfaction," and "good thinking"—are considered the criteria for identifying the tone of financial reporting and are shown in Figures 1 and 2. The words used to identify optimistic and pessimistic tone are translations of word lists used in textual analysis software derived from the Harvard dictionary, which is commonly applied in contemporary American discourse (Davis et al., 2012). Given that the words used for identifying optimistic and pessimistic tone were designed to capture subtle linguistic features, the translation was performed with utmost care and with the assistance of language experts. It is noteworthy that after examining explanatory accounting reports—including annual board reports of companies listed on the Tehran Stock Exchange—it was observed that these words are widely used.

In this regard, the present study examined annual board reports and notes to the financial statements. The number of pessimistic, optimistic, and total words in each report was counted. Then, the number of pessimistic and optimistic words in each report was divided separately by the total number of words to obtain ratios. According to the method of Feldman et al. (2020) and Davis & Tama-Sweet (2012), in explanatory accounting reports, if the ratio of pessimistic words to total words exceeds the ratio of optimistic words to total words, the report's tone is considered pessimistic, and vice versa. Given that pessimistic financial reporting tone is reliable, unbiased, and that managers use pessimistic tone to disclose more relevant and forward-looking information in annual reports, pessimistic tone was used in the hypothesis-testing model.

Table 1. Full List of Words Used for Tone Measurement

Tone Category	Sub-Category	Sample Words
Pessimistic Tone	Blame Words	faulty, dark future, bad, negligence, expensive, difficult/complex, enemy/adversary, unstable, distressing
Pessimistic Tone	Hardship Words	abuse, warning, battle, conflict/inconsistency, depressed, discouraging, disheartened, bankruptcy, fear, hardship, difficulty, regret/despair, deterioration, threat, unfortunately, weakness/defect
Pessimistic Tone	Denial / Rejection Words	are not, cannot, did not, should not, not doing, no, none/zero
Optimistic Tone	Valuable (Praise) Words	best, better, capable, desirable, good, excellent, important, positive, profitable, strong, successful
Optimistic Tone	Satisfaction Words	admire, celebrate, comfortable, confidence, happy, enjoy, enthusiasm, excited, cheerful, satisfied
Optimistic Tone	Good Thinking Words	commitment, dedication, improvement, loyalty, productivity, progress, quality

In the present study, to measure the readability of financial reporting in accordance with Hassan (2017) and Norouzi et al. (2020), the Fog Index—known to better align with Persian linguistic structures—is used. In Iran, some researchers such as Fazlollahi and Maleki Tavana (2010) have confirmed the validity and reliability of this index for assessing the readability of Persian texts. The first measure of financial reporting readability is the Fog Index, which is a function of two variables: sentence length (measured as the number of words) and complex words (defined as words with three or more syllables). It is calculated as follows:

Fog Index = 0.4 × (average number of words per sentence + percentage of complex words)

The procedure for determining the readability level of financial reporting using this index is as follows:

1. Selecting a 100-word sample from the beginning, a 100-word sample from the middle, and a 100-word sample from the end of the report randomly;
2. Counting the number of sentences in each sample;
3. Determining the average sentence length by dividing the total number of words by the number of complete sentences in each 100-word sample;
4. Counting the number of words with three or more syllables (complex words) in each 100-word sample;
5. Adding the number of complex words to the average number of words per sentence;
6. Multiplying the sum of the number of complex words and the average number of words per sentence by the constant 0.4;
7. Performing steps 4, 5, and 6 for the other two 100-word samples;
8. Computing the mean of the results from all three samples by summing them and dividing by three.

• To measure the two variables of tone and readability of financial reporting, the board of directors' reports submitted to the annual general meetings of companies were downloaded from the CODAL website for the study period. Since these reports were provided in PDF format, they were converted to Word format using Wondershare PDFelement. In some cases where the software lacked necessary support, Ashampoo software was used, and in a few instances, the words were typed manually. Subsequently, artificial intelligence tools were employed to identify and code the words in the reports. The targeted words were those specified in the operational definitions of the variables.

Based on prior research, the effects of the following variables on the dependent variables were controlled. Previous studies have identified these variables as determinants of disclosure practices.

Firm Size (SIZE): measured through the natural logarithm of total assets.

Financial Leverage (LEV): measured as the ratio of total debt to total assets (Bayardo et al., 2022).

Cash Holdings (CH): calculated by dividing cash by total assets.

Firm Age (Age): measured as the natural logarithm of the time elapsed from the company's establishment to the period under study.

Dividend Ratio (DIV): equal to earnings per share divided by share price.

Auditor Size (Au.Size): assigned a value of 1 if the Audit Organization or Grade A audit firms audited the company's statutory books during the period under study, and 0 otherwise.

Research Model

Based on the research objectives and hypotheses, the following multiple linear regression models will be used to test the hypotheses.

Hypothesis 1: Investment efficiency has a positive and significant effect on firm financial reporting readability.

$$Readability_{it} = \alpha + \beta_1 Inv.Effe_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 CH_{it} + \beta_5 BM_{it} + \beta_6 DIV_{it} + \beta_7 ROA_{it} + \beta_8 Au.Size_{it} + \varepsilon$$

Hypothesis 2: Investment efficiency has a negative and significant effect on firm disclosure tone.

$$Reporting\ Tone_{it} = \alpha + \beta_1 Inv.Effe_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 CH_{it} + \beta_5 BM_{it} + \beta_6 DIV_{it} + \beta_7 ROA_{it} + \beta_8 Au.Size_{it} + \varepsilon$$

To interpret the research hypotheses, the estimated coefficient of investment efficiency indicates the direction of the independent variable's effect on the dependent variable. Additionally, if the significance level of the

independent variable after model estimation is less than 0.05, the hypothesis is confirmed at the 95 percent confidence level.

3. Findings and Results

In this section, descriptive statistics of the research variables are first presented, followed by the testing of the research hypotheses.

Table 2. Descriptive Status of Variables After Normalization and Data Refinement

Variable	Count	Mean	Std. Dev.	Minimum	25%	50%	75%	Maximum
Inv.Effe	960	0.66	0.11	0.48	0.57	0.67	0.76	0.85
newInv.Effe	960	0.60	0.18	0.18	0.46	0.59	0.75	0.96
GROWTH	960	0.51	0.14	0.12	0.43	0.52	0.61	0.78
FIREPORT	960	0.21	0.13	0	0.11	0.21	0.32	0.44
REPORTREADABILITY	960	0.36	0.12	0.12	0.28	0.35	0.43	0.74
SIZE	960	0.48	0.16	-0.09	0.37	0.48	0.59	1
LEV	960	0.55	0.09	0.23	0.49	0.55	0.62	0.87
CH	960	0.56	0.18	0.25	0.41	0.57	0.71	0.87
Age	960	0.62	0.11	0.38	0.53	0.61	0.68	0.87
DIV	960	0.48	0.15	0	0.38	0.48	0.59	0.98
Au.Size	960	0.68	0.47	0	0	1	1	1
MS	960	0.39	0.09	0.16	0.33	0.39	0.45	0.61
PF	960	0.39	0.09	0.19	0.32	0.39	0.45	0.60
SRD	960	0.24	0	0.24	0.24	0.24	0.25	0.25
CS	960	0.26	0	0.25	0.25	0.26	0.26	0.26
CG	960	0.24	0.01	0.23	0.23	0.24	0.24	0.25
AQ	960	0.24	0.01	0.23	0.24	0.24	0.24	0.25
FC	960	0.23	0.01	0.22	0.23	0.23	0.24	0.25
ACC	960	0.26	0	0.25	0.25	0.26	0.26	0.27
CEOC	960	0.23	0.01	0.21	0.22	0.23	0.24	0.25
C	960	0.24	0.01	0.23	0.23	0.24	0.24	0.25
TA	960	0.25	0	0.25	0.25	0.25	0.26	0.26
OS	960	0.25	0	0.24	0.25	0.25	0.25	0.25

The results indicate that each variable contains 960 observations, derived from 120 companies over the 2016–2023 period, equivalent to an eight-year model. The mean value of investment efficiency based on the developed model is 0.60, which is lower than the investment efficiency measured using the Biddle et al. (2009) model. The minimum value of this variable is 0.18, and the maximum is 0.96.

Hypothesis 1: Investment efficiency has a positive and significant effect on firm financial reporting readability.

In this section, panel data for the variables under study were used to examine this hypothesis. Investment efficiency was examined according to the first model with mediator variables. The results are presented below. First, the Hausman test was used to determine whether the fixed effects or random effects model is appropriate for panel regression. The Hausman test results show that the test statistic is 156.828 with 8 degrees of freedom and a significance value of 0.0. Since the significance value is less than 0.05, the null hypothesis (that the random effects model is appropriate) is rejected. This indicates the presence of correlation between individual effects (firm-specific characteristics) and the independent variables; therefore, the fixed effects model is more suitable for analyzing the relationship between the dependent variable (financial reporting readability) and the independent variables while

controlling for the control variables. Using the fixed effects model helps to control firm-specific heterogeneity and produces more reliable results.

Table 3. Fixed-Effects Panel Regression Between Investment Efficiency and Financial Reporting Readability

Component	Coefficient	Sig. Level	Lower CI	Upper CI	Std. Error	Test Statistic
Fixed Effect	0.022942	0.498248	-0.0435	0.0894	0.0339	0.6775
Investment Efficiency	0.290237	0.000	0.2457	0.3348	0.0227	12.789
SIZE	-0.01627	0.722649	-0.1062	0.0737	0.0458	-0.355
LEV	0.246884	0.000007	0.1396	0.3542	0.0547	4.515
CH	-0.03663	0.024176	-0.0685	-0.0048	0.0162	-2.2584
Age	0.040193	0.200754	-0.0214	0.1018	0.0314	1.2804
DIV	0.086425	0.082542	-0.0112	0.184	0.0497	1.7382
Au.Size	-0.01511	0.02227	-0.0281	-0.0022	0.0066	-2.29

F-statistic: 82.999; Significance level: 0.0000; R-squared: 0.4109

The results of the fixed-effects panel regression model show the relationship between investment efficiency and financial reporting readability. The investment efficiency variable has a coefficient of 0.2902, indicating a positive effect on financial reporting readability. This means that for every one-unit increase in investment efficiency, financial reporting readability increases by 0.2902 units. This effect is statistically significant, as the significance level equals 0.

Firm size, with a coefficient of –0.0163, shows a weak negative effect on readability; however, this effect is not statistically significant because the significance level equals 0.7226. Debt ratio, with a coefficient of 0.2469, indicates that an increase in leverage results in higher financial reporting readability, and this effect is statistically significant because the significance level is 0.000007. Cash holdings, with a coefficient of –0.0366, have a negative and statistically significant effect on readability since the significance level equals 0.0242, which is below 5 percent.

Firm age, with a coefficient of 0.0402, has a positive effect on readability, but this effect is not statistically significant because the significance level equals 0.2008. The dividend variable, with a coefficient of 0.0864, has a relatively positive effect on readability, but the significance level of 0.0825 shows that this effect is not statistically significant at the 5 percent level. Auditor size, with a coefficient of –0.0151, has a negative and statistically significant effect on readability, as the significance level equals 0.0223.

Overall, the model, with an F-statistic of 82.999, indicates overall significance, and the significance level equals 0.0000, meaning that at least one independent variable has an effect on financial reporting readability. The R-squared value of 0.4109 indicates that the model explains about 41 percent of the variance in the data. Overall, the analysis shows that investment efficiency, leverage, and cash holdings have significant effects on financial reporting readability, whereas other variables such as firm size and firm age do not have statistically significant effects.

Hypothesis 2: Investment efficiency has a negative and significant effect on the firm's disclosure tone.

In this section, panel data of the variables under investigation were used to examine this hypothesis. Investment efficiency was examined according to the second model while considering the mediator variables. The results of this analysis are presented below. First, to determine whether a fixed-effects or random-effects panel regression method is appropriate, the Hausman test was used. The results of the Hausman test show that the test statistic is 3.2149 with 8 degrees of freedom and a significance value of 0.9202. Since the significance value is far greater than 0.05, the null hypothesis (that the random-effects model is appropriate) is not rejected. This result indicates that the individual effects (specific to each company) are not significantly correlated with the independent variables;

therefore, the random-effects model is more suitable for analyzing the relationship between the dependent variable (disclosure tone) and the independent variable (investment efficiency), while considering the control variables SIZE, LEV, CH, Age, DIV, and Au.Size. The use of the random-effects model helps in analyzing variations across firms and over time and provides more reliable results in this context.

Table 4. Random-Effects Panel Regression Between Investment Efficiency and the Firm's Disclosure Tone

Component	Coef.	Std. Err.	Test Statistic	Sig. Level	Lower CI	Upper CI
Constant Effect	0.3356	0.0467	7.1793	1.41E-12	0.2438	0.4273
Investment Efficiency	–0.0887	0.0315	–2.8194	0.004912	–0.1504	–0.027
SIZE	0.0498	0.0602	0.8262	0.40888	–0.0684	0.168
LEV	–0.0171	0.0743	–0.2308	0.817535	–0.1629	0.1286
CH	–0.0208	0.0226	–0.9201	0.357761	–0.0651	0.0236
Age	–0.0655	0.0412	–1.5895	0.112271	–0.1465	0.0154
DIV	–0.0703	0.0672	–1.047	0.295366	–0.2022	0.0615
Au.Size	0.006	0.0087	0.6909	0.489781	–0.011	0.023

R-squared: 0.0299; F-statistic: 4.1903; Significance level: 0.0001

The results of the random-effects panel regression model show the relationship between investment efficiency (measured by the investment efficiency variable) and the firm's disclosure tone (the dependent variable). In this analysis, eight independent variables were examined, including firm size, leverage, cash holdings, firm age, dividend ratio, and auditor size. The coefficient of the investment efficiency variable is –0.0887, indicating that an increase in investment efficiency leads to a decrease in the firm's disclosure tone. This negative effect is statistically significant because the significance level is 0.004912, which is less than 0.05. The 95% confidence interval for this coefficient ranges between –0.1504 and –0.027, confirming that this negative effect is statistically significant.

The coefficient for firm size is 0.0498, indicating a positive but insignificant effect on disclosure tone. The significance level for this variable is 0.40888, which is greater than 0.05, indicating that firm size does not have a meaningful effect on disclosure tone. In other words, increasing firm size does not significantly influence disclosure tone.

The coefficient for LEV is –0.0171, indicating a negative and insignificant effect of leverage on disclosure tone. The significance level of 0.817535 is greater than 0.05; therefore, this negative effect cannot be confirmed.

The coefficient for CH is –0.0208, showing a negative effect of cash holdings on disclosure tone. However, the significance level of 0.357761—greater than 0.05—indicates that the effect is not statistically significant.

The coefficient for Age is –0.0655, indicating a negative effect of firm age on disclosure tone. The significance level of 0.112271 indicates that this effect is not statistically significant.

The coefficient for DIV is –0.0703, showing a negative effect of the dividend ratio on disclosure tone. The significance level of 0.295366—greater than 0.05—indicates that this effect is not statistically significant.

The coefficient for Au.Size is 0.006, indicating a positive and insignificant effect of auditor size on disclosure tone. The significance level of 0.489781 indicates that auditor size does not have a statistically meaningful effect on disclosure tone.

The overall results of the model show that the model is statistically significant, with an F-statistic of 4.1903 and a significance level of 0.0001, indicating that the overall model adequately explains the relationship between the independent and dependent variables. However, the R-squared value of 0.0299 indicates that only about 3% of the variance in disclosure tone is explained by this model. This low value suggests that the model does not explain a

substantial portion of the variation in disclosure tone and that other factors not included in this model may also influence disclosure tone.

4. Discussion and Conclusion

The findings of this study offer new empirical evidence on the relationship between investment efficiency, disclosure tone, and financial reporting readability among listed firms in the Tehran Stock Exchange, contributing to a growing interdisciplinary literature that integrates corporate investment behavior with the linguistic and qualitative characteristics of financial reports. The results indicate that investment efficiency has a positive and statistically significant effect on financial reporting readability, suggesting that firms with more efficient capital allocation tend to produce clearer, more comprehensible narrative disclosures. This finding aligns with the theoretical perspective that efficient investment behavior reduces information asymmetry, enhances managerial credibility, and strengthens the incentives of firms to communicate transparently with stakeholders [1]. In contexts where reporting incentives are shaped by agency conflicts and monitoring constraints, higher investment efficiency can reflect stronger governance structures, which in turn support the preparation of more readable disclosures [14, 16]. This positive association resonates with the broader view that information environments characterized by stronger performance discipline and better oversight foster clearer communication in narrative sections of annual reports [29].

The positive influence of investment efficiency on readability can also be interpreted through the monitoring role of stakeholders and capital market participants. When firms allocate resources more optimally and avoid excessive risk-taking or wasteful spending, managerial incentives to obscure information decline, and reporting practices tend to emphasize clarity rather than obfuscation. Prior research in both emerging and developed markets supports this interpretation, documenting that firms with higher-quality investment choices also exhibit higher-quality reporting, including greater readability and lower textual complexity [27, 35]. The findings of this study confirm this pattern in the Iranian setting, where high-quality investment behavior appears to complement the production of more comprehensible financial reports, consistent with previous models that integrate reporting quality and investment outcomes [13].

The results concerning the negative relationship between investment efficiency and disclosure tone further extend insights from narrative disclosure research. This study finds that firms with higher investment efficiency tend to use more pessimistic or cautious tone in their narrative disclosures. While a negative tone is traditionally associated with risk communication or performance decline, emerging evidence indicates that cautious tone can also reflect managerial conservatism, commitment to transparency, and avoidance of optimism bias in reporting [25, 26]. The use of more balanced or cautious tone is considered a signal of responsible communication, particularly in environments where overly optimistic tone has been linked to earnings manipulation, low-quality reporting, and inefficient investment decisions [24, 28]. In this study, the negative relationship between efficiency and tone may indicate that firms investing more optimally are also more conservative and realistic in discussing risks and future expectations, thereby enhancing credibility.

This interpretation is consistent with research showing that conservative managerial behavior is associated with higher investment efficiency and more responsible communication patterns [16, 17]. Conservative tone has also been found to help mitigate the divergence between managerial and shareholder interests by reducing inflated expectations and limiting room for opportunistic reporting [36]. In this regard, the findings support the argument that tone is not merely a stylistic feature but instead reflects broader governance dynamics and the underlying

health of capital allocation processes. In particular, firms that invest efficiently may prefer pessimistic or neutral tone to prevent overvaluation or excessive investor optimism, thereby protecting long-term financial stability [32].

Furthermore, the significant effects of leverage, cash holdings, and auditor size on readability highlight the importance of contextual and firm-level characteristics in shaping the production of narrative disclosures. The positive association between leverage and readability aligns with studies suggesting that higher external financing imposes greater monitoring by creditors, incentivizing firms to produce clearer and more understandable disclosures to reduce information risk [14]. Meanwhile, the negative effect of cash holdings on readability is consistent with evidence that firms with high liquidity may face fewer monitoring pressures and thus have weaker incentives to provide readable and transparent disclosures [11]. Additionally, the negative association between auditor size and readability may reflect stricter reporting controls and adherence to standardized disclosure templates imposed by top-tier auditors, which can sometimes increase textual complexity but improve reporting precision [21].

In terms of disclosure tone, the statistical insignificance of most control variables—such as firm size, leverage, age, and auditor size—suggests that tone is less sensitive to structural firm attributes and more directly related to managerial reporting behavior and underlying investment performance. This finding corroborates research demonstrating that tone is primarily influenced by managerial incentives, behavioral biases, and strategic communication choices, rather than routine operational or structural characteristics [9, 33]. Given that tone has been shown to influence market perceptions, risk premiums, and investor decision-making, understanding the strategic determinants of tone remains crucial for interpreting financial narratives [26, 28].

Taken together, the findings of this study contribute to a nuanced understanding of the ways in which investment efficiency intersects with textual attributes of financial reporting. The simultaneous analysis of tone and readability reveals that investment efficiency operates through different information channels: improving clarity while encouraging managerial conservatism. This dual influence is consistent with integrative conceptual models that view investment efficiency as part of a broader ecosystem of reporting quality, governance strength, and stakeholder communication [18, 19]. By contextualizing investment behavior within narrative disclosure dynamics, this study advances interdisciplinary perspectives in accounting and finance and highlights the importance of integrating textual analysis into corporate investment research.

The findings also have broader implications for emerging markets such as Iran, where institutional frameworks, enforcement mechanisms, and disclosure regulations are evolving [6]. In such settings, the clarity and tone of financial reporting may play an even more important role in reducing information asymmetry and supporting optimal investment decisions. Moreover, the increasing integration of textual analysis tools into financial research—including sentiment analysis, readability indices, and artificial intelligence models—provides promising avenues for capturing the nuanced communication strategies employed by firms [3, 4]. The present results confirm that linguistic features are not superficial aspects of reporting but meaningful indicators of investment practices and managerial behavior.

In summary, this study reinforces the notion that investment efficiency is closely linked to the quality and credibility of narrative disclosures, both in tone and readability. Efficient firms communicate more clearly and more conservatively, reflecting both performance discipline and strategic transparency. These findings align with evidence from global markets while offering context-specific insights for Iranian firms, thereby contributing to the broader discourse on financial communication, governance, and investment behavior.

This study is limited by the use of secondary financial data extracted from annual reports, which may not fully capture managerial intentions or unobservable factors influencing disclosure choices. The reliance on textual analysis tools, while methodologically robust, is constrained by language-specific limitations and the structure of Persian financial reporting. Additionally, the study focuses solely on listed firms in the Tehran Stock Exchange, limiting the generalizability of the findings to private companies or other emerging markets with different regulatory and institutional environments.

Future research could examine the relationship between investment efficiency and disclosure characteristics using more advanced natural language processing techniques, including machine learning models capable of detecting nuanced linguistic patterns. Comparative studies across different industries or across multiple emerging markets would offer further insights into institutional influences. Longitudinal designs could also explore whether changes in disclosure readability and tone precede or follow improvements in investment efficiency.

Practitioners, including financial managers and auditors, should consider the strategic importance of both readability and tone in corporate disclosures as these features influence investor confidence and market perceptions. Boards of directors may also utilize the findings to strengthen oversight mechanisms aimed at enhancing both reporting quality and investment decision-making. Finally, regulators may use insights from this study to refine disclosure guidelines in ways that promote transparency and support efficient capital allocation.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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