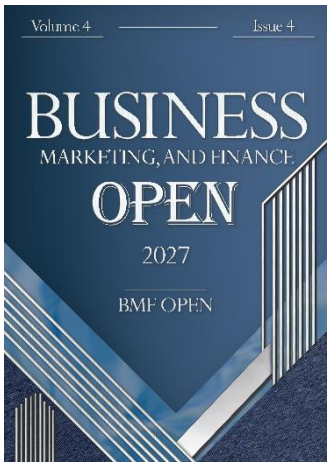
The Mediating Role of Exploration and Evaluation Cost Disclosure Quality in the Relationship Between Digital Maturity and Earnings Quality: Evidence from Mining Companies Listed on the Tehran Stock Exchange



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Citation: Delbarpoor Ahmadi, F. & Khodabakhshi Parijan, K. (2027). The Mediating Role of Exploration and Evaluation Cost Disclosure Quality in the Relationship Between Digital Maturity and Earnings Quality: Evidence from Mining Companies Listed on the Tehran Stock Exchange. *Business, Marketing, and Finance Open*, 4(4), 1-24.

Received: 02 March 2026
Revised: 14 July 2026
Accepted: 21 July 2026
Initial Publication: 21 July 2026
Final Publication: 01 July 2027

Abstract: This study aimed to examine the effect of digital maturity on earnings quality and determine whether the quality of exploration and evaluation cost disclosure mediates this relationship among mining companies listed on the Tehran Stock Exchange. This applied, quantitative, descriptive-correlational study employed an ex post facto panel-data design. The statistical population consisted of companies operating in the metallic ore, nonmetallic mineral, and coal extraction industries listed on the Tehran Stock Exchange from 2014 to 2024. Following systematic elimination based on continuity of activity, fiscal-year consistency, data availability, and absence of prolonged trading suspension, 14 companies were selected, yielding 154 firm-year observations. Earnings quality was measured as the negative absolute value of discretionary accruals estimated using the modified Jones model. Digital maturity was measured by information technology investment intensity, while disclosure quality was assessed through a ten-item checklist based on Iranian Accounting Standard No. 29. Firm size, financial leverage, and return on assets were included as control variables. Fixed-effects panel regressions with robust standard errors, the Sobel test, and bias-corrected bootstrap analysis with 5,000 resamples were conducted in Python. Digital maturity had a positive and significant effect on disclosure quality (beta = 0.150, t = 3.840, p < 0.001). Disclosure quality positively affected earnings quality (beta = 0.468, t = 2.026, p = 0.044), whereas the direct effect of digital maturity on earnings quality was nonsignificant (beta = 0.048, t = 0.596, p = 0.552). The estimated indirect effect was 0.070. Although the Sobel test was marginally significant (Z = 1.790, p = 0.073), the 95% bias-corrected and accelerated bootstrap confidence interval included zero, ranging from -0.0098 to 0.1580. Therefore, the mediating effect was not supported at the 5% significance level. Firm size and return on assets had significant negative effects on earnings quality. Digital maturity appears to improve the quality of exploration and evaluation cost disclosure, and higher disclosure quality is associated with better earnings quality; however, disclosure quality does not robustly mediate the relationship between digital maturity and earnings quality.

Keywords: Digital maturity, earnings quality, disclosure quality, exploration and evaluation costs, mining companies, panel data.

1. Introduction

Financial reporting quality is a fundamental condition for the efficient functioning of capital markets because investors, creditors, analysts, regulators, and other stakeholders rely on accounting information when evaluating corporate performance, estimating risk, and allocating economic resources. Among the various attributes of

financial reporting, earnings quality occupies a particularly important position because reported earnings are widely used as a summary measure of operating performance and as an input into valuation, contracting, lending, and stewardship decisions. High-quality earnings are generally expected to reflect underlying economic performance, exhibit an acceptable level of persistence, and contain limited discretionary manipulation. Conversely, when reported earnings are substantially influenced by managerial discretion, opportunistic accrual choices, or inadequate disclosure, their reliability and usefulness for decision-making decline [1-4]. This concern is especially pronounced in industries characterized by long investment horizons, substantial uncertainty, complex measurement procedures, and extensive managerial judgment, including the mining industry.

Mining companies operate in an information environment that differs significantly from that of many manufacturing and service enterprises. Their principal activities involve exploration, evaluation, development, extraction, environmental restoration, and the management of mineral rights and government royalties. The economic outcomes of these activities are often uncertain, project-specific, and dependent on geological, technological, regulatory, and market conditions. Expenditures incurred during the exploration and evaluation stages may be substantial, while the future benefits associated with them remain uncertain until the technical feasibility and commercial viability of mineral extraction are established. Consequently, the classification, capitalization, impairment, and disclosure of exploration and evaluation expenditures require considerable professional judgment. This accounting discretion may create opportunities for managers to influence the timing and magnitude of recognized expenses, assets, and earnings. Therefore, the quality of information disclosed about exploration and evaluation costs can play a central role in reducing information asymmetry and enabling users to assess whether reported earnings faithfully represent the economic performance of mining firms.

Earnings management is one of the major threats to the credibility of accounting information. Managers may use discretionary accruals, accounting estimates, classification choices, and disclosure strategies to achieve desired reporting outcomes. Such behavior may be motivated by compensation arrangements, debt covenant considerations, financing needs, market expectations, job security, or the desire to conceal weak performance. Evidence from Iranian organizations indicates that managerial characteristics and behavioral incentives can influence earnings-management practices. For example, Machiavellian tendencies may increase managers' willingness to manipulate accounting outcomes, whereas whistleblowing mechanisms can constrain opportunistic reporting behavior [5]. Similarly, external financing activities can intensify incentives for earnings smoothing, particularly when firms seek to present stable performance to lenders and capital providers, although effective organizational risk management may moderate this tendency [6]. These findings suggest that earnings quality is not determined solely by mechanical accounting procedures; rather, it reflects the interaction of managerial incentives, governance arrangements, organizational capabilities, and the quality of the reporting environment.

The presentation and readability of financial reports also affect how effectively users can detect earnings-management behavior. When disclosures are complicated, fragmented, or difficult to interpret, stakeholders may be less able to distinguish genuine economic performance from accounting manipulation. Organizational culture can shape the relationship between earnings management and financial-report readability by influencing managers' attitudes toward transparency, communication, and accountability [7]. This observation is particularly relevant to mining firms because their annual reports frequently contain technical descriptions of projects, reserves, development stages, impairment assessments, environmental liabilities, and capitalized expenditures. Even when mandatory information is formally disclosed, its usefulness may remain limited if it is incomplete, obscure, dispersed across several notes, or presented without sufficient quantitative and qualitative detail. Accordingly,

disclosure quality should be understood not merely as the presence of information but also as its completeness, clarity, relevance, comparability, and capacity to reduce uncertainty.

The economic consequences of earnings management further demonstrate the importance of reliable reporting. Earnings-management practices may influence firm value directly and indirectly through interactions with corporate social responsibility, intellectual capital, and organizational performance [8]. Although managers may use accounting discretion to communicate private information or smooth temporary fluctuations, excessive discretion can weaken the association between reported earnings and underlying performance. In capital-intensive industries, this problem may be amplified because asset valuation depends heavily on assumptions concerning future cash flows, reserve estimates, extraction costs, commodity prices, and project viability. For mining companies, the inappropriate capitalization of unsuccessful exploration expenditures, delayed recognition of impairment losses, incomplete disclosure of rehabilitation obligations, or insufficient explanation of project progress can materially distort reported assets and earnings. Therefore, improving the quality of disclosure relating to exploration and evaluation costs may constrain opportunistic accounting choices and strengthen the credibility of reported earnings.

Corporate disclosure is one of the principal mechanisms through which firms reduce information asymmetry and respond to the informational needs of stakeholders. However, disclosure decisions are shaped by multiple incentives, including legitimacy concerns, ownership structure, institutional pressures, managerial motivations, governance quality, and the expected costs and benefits of transparency. Voluntary disclosure theory proposes that firms with favorable information and strong reporting capabilities are more likely to disclose additional information to differentiate themselves from less transparent firms. Legitimacy theory, in contrast, emphasizes the role of disclosure in demonstrating conformity with social expectations and maintaining organizational acceptance. Evidence from Japanese companies indicates that contemporary nonfinancial reporting practices cannot be fully explained by either legitimacy theory or voluntary disclosure theory alone, because actual reporting behavior reflects a combination of strategic, institutional, and stakeholder-related forces [9]. In the mining context, companies may disclose exploration and evaluation information not only to comply with accounting standards but also to reassure investors, regulators, local communities, and other stakeholders that mineral resources and related expenditures are being managed responsibly.

Ownership and organizational characteristics may also create systematic differences in disclosure behavior. Research comparing family and non-family businesses shows that the willingness to provide voluntary nonfinancial information varies according to governance structure, control incentives, and the perceived benefits of transparency [10]. Institutional investors may likewise influence the reporting environment by demanding decision-useful information and exerting monitoring pressure. Human-capital disclosures, for example, can affect institutional ownership because sophisticated investors use such information to evaluate organizational capabilities and long-term value creation [11]. These findings imply that disclosure practices are economically consequential and are connected to external monitoring, resource acquisition, and organizational legitimacy. For listed mining firms, comprehensive disclosure of exploration methods, capitalized expenditures, impairment testing, government royalties, environmental restoration costs, mineral reserves, and physical project progress may improve investors' ability to evaluate both current earnings and future cash-flow prospects.

External transparency can also affect organizational performance and the quality of corporate disclosures. Higher levels of external transparency may strengthen accountability, enhance stakeholder confidence, and encourage companies to provide more credible information concerning their social and economic activities [12]. In

regulated industries, transparency is particularly important because firms are expected to justify not only their financial outcomes but also their use of natural resources and their environmental and social obligations. Mining companies are exposed to considerable public scrutiny due to their environmental impact, dependence on government licenses, payment of mining royalties, and responsibility for land restoration. Consequently, weak disclosure of exploration and evaluation activities may create concerns extending beyond accounting compliance. It may also signal inadequate governance, weak information systems, or limited accountability in the management of strategic natural-resource assets.

The credibility of disclosure depends not only on the volume of information reported but also on the mechanisms that verify and support it. Auditors contribute to disclosure credibility by assessing whether reported information is consistent, supportable, and free from material misstatement. Their role is particularly important where disclosures contain estimates, forward-looking assumptions, or sustainability-related claims [13]. Although exploration and evaluation cost disclosures are primarily financial and technical in nature, they often involve judgments concerning project feasibility, impairment, environmental obligations, and future development. Reliable assurance and effective internal controls can therefore increase users' confidence in these disclosures. At the same time, the existence of auditing does not eliminate managerial discretion, especially when accounting standards allow alternative treatments or when the underlying assumptions are difficult to verify. Enhanced digital systems may assist auditors and internal control functions by creating more traceable data, integrating operational and financial records, and enabling more timely examination of project-level expenditures.

Managerial disclosure choices are also influenced by incentives concerning forward-looking information. Managers may alter the amount, timing, or tone of projected information in response to performance conditions, financing requirements, market pressure, and reputational concerns. Both static and dynamic analyses of disclosure behavior indicate that managerial motivations are important in explaining changes in forward-looking reporting [14]. This issue is highly relevant to mining companies because the value of exploration projects depends substantially on expectations about future extraction, resource quantity and grade, production capacity, development schedules, and commodity-market conditions. Managers may therefore have incentives to emphasize favorable project developments, postpone the disclosure of setbacks, or provide ambiguous information about uncertain exploration outcomes. Such incentives increase the need for structured disclosure criteria and reporting systems capable of generating consistent, verifiable, and comparable project information.

Narrative disclosures may also contain signals of reporting risk. The tone, wording, complexity, and content of management reports can provide information that is not fully captured by numerical accounting measures. Management tone in management discussion and analysis disclosures has been associated with investment efficiency, indicating that qualitative reporting can affect investors' interpretation of corporate prospects and the allocation of resources [15]. Similarly, textual risk disclosures in annual reports can be used to detect accounting fraud, particularly when reporting patterns are assessed systematically against regulatory guidance [16]. These studies demonstrate that disclosure quality is not a peripheral element of financial reporting; rather, it can reveal managerial incentives, organizational risk, and the credibility of accounting numbers. In mining firms, detailed and balanced narrative explanations of exploration activities may help users determine whether recognized costs and assets are consistent with actual project progress and risk.

The increasing digitalization of organizational processes has created new possibilities for strengthening accounting information systems and corporate reporting. Digital maturity refers to the extent to which an organization has developed and integrated the technological resources, governance structures, processes,

competencies, and strategic capabilities required to use digital technologies effectively. It is more comprehensive than the mere acquisition of hardware or software because it involves the coordinated development of organizational capabilities. Research on capability maturity indicates that organizational capabilities evolve through identifiable levels, from fragmented and ad hoc practices toward standardized, measured, integrated, and continuously improved processes [17]. Therefore, a digitally mature company is expected not merely to possess technological assets but also to embed those assets in its decision-making, control, reporting, and operational systems.

Digital transformation governance is especially important in large and complex organizations because technological investments may fail to generate benefits when they are not aligned with organizational maturity. A maturity-driven approach to selecting digital-transformation governance mechanisms emphasizes that governance arrangements should correspond to an organization's existing capabilities, strategic priorities, and stage of digital development [18]. In less mature organizations, digital initiatives may remain isolated, project-based, and poorly integrated with accounting and reporting systems. In more mature organizations, data governance, process integration, accountability, and analytical capabilities are more likely to support reliable and timely information. This distinction is critical for mining companies, whose exploration and evaluation data are generated across geological, engineering, operational, environmental, financial, and legal functions. Without integrated digital governance, these data may remain dispersed among departments, reducing their consistency and limiting the quality of external disclosure.

Data governance maturity constitutes a central element of digital maturity because organizations require defined responsibilities, standardized data structures, access controls, quality assurance procedures, and monitoring mechanisms to transform raw data into reliable information. Assessments of data-governance maturity in governmental organizations with similar operational characteristics demonstrate that organizations may differ substantially in their ability to manage, integrate, and use data, even when they perform comparable functions [19]. This insight can be extended to listed mining companies. Firms operating in the same industry and under the same accounting standards may nevertheless differ in the maturity of their information systems and data-management practices. These differences may affect whether exploration expenditures are recorded at the project level, whether drilling and evaluation costs are classified consistently, whether impairment indicators are detected promptly, and whether management can produce complete disclosures at the end of each reporting period.

Although digital maturity is often conceptualized through organizational and strategic dimensions, archival financial studies frequently face limitations in measuring those dimensions over long periods. Consequently, information technology investment intensity may serve as an observable proxy for the technological foundation of digital maturity. Investments in software, databases, servers, enterprise-resource-planning systems, communication infrastructure, and specialized operational technologies can improve the integration of financial and nonfinancial data. In mining companies, these investments may facilitate the connection of geological information, project budgets, equipment data, environmental obligations, and accounting records. Improved integration can reduce manual errors, increase traceability, accelerate reporting processes, and support more precise measurement of exploration and evaluation expenditures. However, technological investment does not automatically produce higher-quality information. Its benefits depend on organizational capabilities, governance mechanisms, employee competencies, and the extent to which digital tools are incorporated into reporting practices.

The concept of maturity has been applied in diverse disciplines to describe developmental status and differences in the timing or level of progression. For example, maturity status has been used to explain variations in growth, physical activity, motor coordination, and physical fitness among adolescents participating and not participating in organized sports [20]. Although this application belongs to human biology rather than organizational studies, it illustrates the broader analytical principle that observed outcomes may depend not merely on participation in an activity but on the underlying stage of maturity. In an organizational context, this principle suggests that possessing digital technologies is not equivalent to having mature digital capabilities. Firms at different maturity levels may derive substantially different reporting benefits from similar technological investments. Therefore, the effect of digitalization on earnings quality may not be direct; instead, it may operate through intermediate organizational processes such as data governance, disclosure quality, internal control, and information integration.

The Iranian reporting environment provides an important setting in which to examine these relationships. Iranian firms operate under institutional, regulatory, technological, and market conditions that differ from those of developed capital markets. Recent efforts to develop comprehensive disclosure models in Iranian industries emphasize the importance of integrating international reporting principles with local institutional requirements and stakeholder expectations [21]. The development of a comprehensive disclosure model for Iranian commercial insurance companies, for instance, demonstrates that disclosure quality is multidimensional and depends on regulatory structures, governance, information needs, and organizational capacity. Comparable challenges are present in the mining sector, where the application of accounting requirements must be adapted to industry-specific activities, including exploration uncertainty, mineral reserves, government rights, environmental rehabilitation, and long-term project development.

Despite the growing literature on digital transformation, earnings management, and corporate disclosure, several research gaps remain. First, many studies examine digital transformation as a direct determinant of financial performance or reporting quality, without identifying the mechanisms through which digital capabilities influence accounting outcomes. Second, disclosure research has focused extensively on social responsibility, sustainability, human capital, narrative tone, and voluntary nonfinancial information, while exploration and evaluation cost disclosures have received comparatively limited attention. Third, studies of earnings quality in Iran have often emphasized managerial incentives, organizational culture, financing activities, and behavioral characteristics, but the combined role of digital maturity and industry-specific disclosure quality remains underexplored. Fourth, the mining industry presents distinctive accounting risks that cannot be fully captured by general disclosure measures. A firm may publish extensive annual reports while still providing inadequate information about exploration expenditures, reserve uncertainty, impairment tests, rehabilitation costs, and project progress.

These gaps suggest that disclosure quality may function as a mediating mechanism between digital maturity and earnings quality. Digital maturity may improve the collection, classification, integration, and traceability of exploration and evaluation data. Better data systems may then enable firms to provide more complete and reliable disclosure. Enhanced disclosure may constrain opportunistic accounting choices, strengthen external monitoring, and reduce information asymmetry, thereby improving earnings quality. At the same time, the relationship may be weak or incomplete where digital investments remain fragmented, governance structures are underdeveloped, or managers do not use technological capabilities to improve reporting transparency. Examining mediation therefore provides a more refined explanation than assuming that digital investment automatically improves the quality of reported earnings.

The examination of this mechanism has practical significance for corporate managers, investors, auditors, regulators, and standard setters. Managers may benefit from understanding that the reporting value of digital investment depends on its integration with data governance and disclosure processes. Investors and analysts may use exploration and evaluation disclosure quality as an indicator of the reliability of earnings reported by mining firms. Auditors may identify areas in which digital records can strengthen evidence concerning capitalized costs, impairment assessments, and project progress. Regulators and standard setters may also use the findings to refine disclosure requirements and encourage more comparable reporting across mining companies. More broadly, the study contributes to the literature by linking technological maturity, industry-specific transparency, and accrual-based earnings quality within an emerging capital-market setting.

Accordingly, the aim of this study was to examine the effect of digital maturity on earnings quality and to determine whether the quality of exploration and evaluation cost disclosure mediates this relationship among mining companies listed on the Tehran Stock Exchange.

2. Methodology

This applied study employed a quantitative, descriptive-correlational research design to examine the relationship between digital maturity and earnings quality and to determine whether the quality of exploration and evaluation cost disclosure mediates this relationship. Given that the study variables had already occurred and could not be manipulated by the researchers, an ex post facto approach was adopted. The empirical analysis was based on longitudinal panel data, which combined cross-sectional observations across firms with time-series observations over multiple financial years. This approach made it possible to account for both interfirm heterogeneity and changes in firm-level characteristics over time. The statistical population consisted of all companies operating in the metallic ore extraction, nonmetallic mineral extraction, and coal mining industries that were listed on the Tehran Stock Exchange during the period from 2014 to 2024. The study period was selected to provide a sufficiently long observation window for evaluating changes in digital investment, disclosure practices, and earnings quality among listed mining companies. The sample was selected through systematic elimination. To be included, a company was required to have remained continuously active throughout the study period, to have maintained a consistent fiscal year, to have had all financial statements, accompanying notes, and required market information available, and not to have experienced prolonged trading suspensions that could undermine the comparability or completeness of its data. Companies that changed their fiscal year, entered or exited the exchange during the observation period, lacked the information required to calculate one or more research variables, or experienced substantial discontinuities in trading were excluded. Following the application of these criteria, the final sample consisted of 14 mining companies observed over 11 financial years, producing a balanced panel of 154 firm-year observations. This nonprobability sampling procedure was appropriate because the study required firms to satisfy specific information-based and continuity criteria rather than to be selected randomly from the population. The unit of analysis was the firm-year, and the required data were extracted from audited annual financial statements, explanatory notes accompanying the financial statements, board of directors' reports, and information disclosed through the official reporting systems of the Tehran Stock Exchange. Because the research relied exclusively on publicly available archival data and did not involve human participants, interviews, interventions, or access to personally identifiable information, no direct participant consent procedures were required.

The data collection instrument was a researcher-developed extraction form designed to record accounting, financial, disclosure, and digital investment information consistently for each firm-year observation. The dependent variable was earnings quality, denoted by EQ, which reflects the reliability, persistence, and relative absence of managerial manipulation in reported earnings. Earnings quality was operationalized through discretionary accruals estimated using the modified Jones model developed by Dechow et al. (1995). First, total accruals were calculated for each company and scaled by lagged total assets. The parameters required to estimate nondiscretionary accruals were then obtained from the following model:

$$\frac{TACC_{it}}{A_{i,t-1}} = \alpha_1 \left(\frac{1}{A_{i,t-1}}\right) + \alpha_2 \left(\frac{\Delta REV_{it} - \Delta REC_{it}}{A_{i,t-1}}\right) + \alpha_3 \left(\frac{PPE_{it}}{A_{i,t-1}}\right) + \varepsilon_{it}$$

In this equation, $TACC_{it}$represents total accruals of firm $i$in year t, $A_{i,t-1}$denotes total assets at the end of the preceding financial year, ΔREV_{it}represents the annual change in revenue, ΔREC_{it}represents the annual change in accounts receivable, PPE_{it}denotes gross property, plant, and equipment, and $\varepsilon_{it}$is the regression residual. Total accruals were calculated as the difference between accounting earnings and operating cash flows. The estimated coefficients were subsequently used to calculate nondiscretionary accruals, and discretionary accruals, denoted by DA_{it}, were obtained as the difference between total accruals and estimated nondiscretionary accruals. Because a larger absolute value of discretionary accruals indicates greater earnings management and, consequently, lower earnings quality, the final earnings-quality measure was defined as the negative absolute value of discretionary accruals:

$$EQ_{it} = -| DA_{it} |$$

Accordingly, larger values of EQ, meaning values closer to zero, indicated higher earnings quality, whereas smaller and more negative values represented greater discretionary accruals and lower earnings quality. This reverse specification facilitated the direct interpretation of positive regression coefficients as improvements in earnings quality and was consistent with the accrual-quality literature (Francis et al., 2005).

The independent variable was digital maturity, denoted by $DigMat$. Although digital maturity is conceptually multidimensional and may encompass process automation, digital strategy, data analytics capabilities, organizational culture, technological integration, and workforce competencies, comprehensive qualitative indicators of these dimensions are not consistently disclosed by Iranian listed firms. Therefore, the study used information technology investment intensity as an archival proxy for digital maturity. The measure was calculated as the ratio of the carrying amount of software and information technology equipment to tangible fixed assets:

$$DigMat_{it} = \frac{Software_{it} + ITEquipment_{it}}{TangibleFixedAssets_{it}}$$

In this formulation, $Software_{it}$represents the reported value of acquired or internally developed software, $ITEquipment_{it}$represents the value of computers, servers, network infrastructure, communication equipment, and other identifiable information technology assets, and $TangibleFixedAssets_{it}$represents the firm's total tangible fixed assets. A higher value of this ratio indicated that a greater proportion of the company's asset base was devoted to information technology infrastructure and was therefore interpreted as a higher level of digital maturity. The use of this proxy was particularly appropriate in the context of an emerging capital market, where standardized survey-based or qualitative measures of digital transformation were unavailable for the full sample and observation

period. Nevertheless, the measure should be understood primarily as an indicator of the technological investment dimension of digital maturity rather than as a complete representation of all organizational and strategic aspects of digital transformation.

The mediating variable was the quality of exploration and evaluation cost disclosure, denoted by $DiscScore$. This variable was measured through quantitative content analysis of the notes accompanying the annual financial statements and other relevant corporate reports (Krippendorff, 2018). A researcher-developed disclosure checklist was prepared in accordance with the requirements and disclosure principles of Iranian Accounting Standard No. 29 and the informational characteristics of exploration and evaluation activities in mining companies. The checklist covered ten disclosure components: the accounting method applied to exploration expenditures; the separate presentation of exploration and evaluation expenditures; disclosure of mining assets under development or completion; disclosure of probable mineral reserves, including their quantity or grade; disclosure of impairment-testing results for exploration and evaluation assets; disclosure of environmental restoration and rehabilitation expenditures; disclosure of drilling and extraction costs; disclosure of government mining rights, royalties, or ownership charges; disclosure of changes in capitalized expenditures during the financial period; and disclosure of the physical progress of mining and development projects. Each item was coded dichotomously. A score of 1was assigned when the relevant information was disclosed clearly and separately in the annual report or accompanying notes, whereas a score of 0was assigned when the information was absent, unclear, or insufficiently distinguishable from other disclosures. The scores assigned to the ten items were summed to obtain the overall disclosure-quality score for each firm-year:

$$DiscScore_{it} = \sum_{j=1}^{10} d_{jit}$$

where d_{jit}represents the score assigned to disclosure item $j$for firm $i$in year t. The resulting score ranged from 0to 10, with higher scores indicating more comprehensive and higher-quality disclosure of exploration and evaluation costs. To enhance coding consistency, the checklist definitions and decision rules were established before the full content analysis, and disclosures were evaluated according to their explicit presence rather than inferred from general or unrelated statements.

Firm size, financial leverage, and return on assets were included as control variables because these characteristics may affect both corporate disclosure and earnings quality. Firm size, denoted by $Size$, was measured as the natural logarithm of total assets:

$$Size_{it} = \ln\left(TotalAssets_{it}\right)$$

The logarithmic transformation was applied to reduce the skewness of the asset distribution and improve comparability among companies of different scales. Larger firms generally possess more complex information systems, face greater regulatory and stakeholder scrutiny, and tend to provide more extensive disclosures than smaller firms (Leuz & Wysocki, 2016). Financial leverage, denoted by Lev, was measured as the ratio of total liabilities to total assets:

$$Lev_{it} = \frac{TotalLiabilities_{it}}{TotalAssets_{it}}$$

Highly leveraged firms may have stronger incentives to manage earnings in order to comply with debt covenants, reduce perceived default risk, or preserve access to external financing (Dechow et al., 2010). Return on assets, denoted by ROA, was calculated as net income divided by total assets:

$$ROA_{it} = \frac{NetIncome_{it}}{TotalAssets_{it}}$$

This variable controlled for the effects of profitability because profitable firms may differ from poorly performing firms in their digital investment capacity, disclosure incentives, operating accruals, and motivations for earnings management.

The data analysis was conducted using Python version 3.10 in the Google Colab cloud-based computational environment. This environment was selected because it supports transparent and reproducible execution of Jupyter Notebook code, facilitates the documentation of all data-processing and econometric procedures, and permits analytical workflows to be shared and independently verified (Google, 2023). The principal Python libraries used in the analysis were Pandas for importing, merging, restructuring, cleaning, and managing the panel dataset (McKinney, 2010); NumPy for numerical calculations and matrix operations; Statsmodels for regression estimation, diagnostic testing, robust covariance estimation, and supplementary statistical analyses (Seabold & Perktold, 2010); Linearmodels for pooled, fixed-effects, and random-effects panel estimations and panel-specific diagnostic procedures (Sheppard, 2022); Scikit-learn for resampling procedures and supplementary predictive analyses (Pedregosa et al., 2011); SciPy for the calculation of the Sobel statistic and related probability values; and Matplotlib and Seaborn for the graphical inspection of distributions, residual patterns, and correlation structures. All data preparation and model-estimation codes were developed and retained in Google Colab to ensure the reproducibility of the empirical procedures.

Before estimating the research models, the dataset was examined for completeness, coding consistency, missing observations, extreme values, and distributional irregularities. Missing data were identified at the firm-year and variable levels, and observations lacking the information required to calculate the principal variables were assessed against the sample-selection criteria. Potential outliers were initially detected using the interquartile-range method. Continuous financial variables were subsequently winsorized at the first and ninety-ninth percentiles to reduce the influence of extreme observations while retaining the corresponding firm-year records in the sample. Distributional properties were evaluated using descriptive statistics, histograms, and skewness and kurtosis coefficients. Although strict normality of the variables is not a prerequisite for consistent panel regression estimation, these procedures were used to identify severe distributional distortions and possible data-entry errors. Pearson correlation coefficients were calculated to provide an initial assessment of the direction and magnitude of the bivariate relationships among the variables. Multicollinearity was evaluated using variance inflation factors. Variance inflation factors substantially exceeding conventional thresholds were interpreted as evidence that regression coefficients might be destabilized by strong linear relationships among the explanatory variables.

Panel regression analysis was used to test the hypothesized relationships. The first model estimated the total effect of digital maturity on earnings quality while controlling for firm size, financial leverage, and return on assets:

$$EQ_{it} = \beta_0 + \beta_1 DigMat_{it} + \beta_2 Size_{it} + \beta_3 Lev_{it} + \beta_4 ROA_{it} + \varepsilon_{it}$$

In this model, $\beta_1$represented the total association between digital maturity and earnings quality before the mediating variable was introduced. A positive and statistically significant coefficient was interpreted as evidence that higher digital maturity was associated with higher earnings quality.

The second model estimated path a, namely, the relationship between digital maturity and the quality of exploration and evaluation cost disclosure:

$$DiscScore_{it} = \gamma_0 + \gamma_1 DigMat_{it} + \gamma_2 Size_{it} + \gamma_3 Lev_{it} + \gamma_4 ROA_{it} + u_{it}$$

In this equation, $\gamma_1$indicated whether firms with greater information technology investment intensity provided more comprehensive disclosures concerning exploration and evaluation activities. The third model simultaneously estimated path b, representing the association between disclosure quality and earnings quality, and path c', representing the direct effect of digital maturity on earnings quality after controlling for the mediator:

$$EQ_{it} = \theta_0 + \theta_1 DigMat_{it} + \theta_2 DiscScore_{it} + \theta_3 Size_{it} + \theta_4 Lev_{it} + \theta_5 ROA_{it} + w_{it}$$

In this model, $\theta_2$represented path b, and $\theta_1$represented the direct effect c'. The indirect effect of digital maturity on earnings quality through disclosure quality was calculated as:

$$Indirect\ Effect = a \times b = \gamma_1 \theta_2$$

The total effect was expressed as:

$$c = c' + ab$$

where $c$denotes the total effect estimated in the first model, c'denotes the direct effect after the mediator was included, and abdenotes the indirect effect transmitted through disclosure quality.

The appropriate panel estimator for each model was determined through sequential specification tests. The F-Limer test was first applied to compare pooled ordinary least squares with a model incorporating firm-specific effects. A statistically significant F-Limer statistic indicated that the pooled model was inappropriate because unobserved firm-level heterogeneity was present. When a panel-effects model was preferred, the Hausman test was used to choose between fixed-effects and random-effects estimation. A statistically significant Hausman statistic indicated that the unobserved firm effects were correlated with the explanatory variables and that the fixed-effects estimator was therefore more appropriate. A nonsignificant Hausman statistic supported the random-effects specification. The final model selection was based on these formal tests, the structure of the data, and the assumptions underlying each estimator.

Additional diagnostic tests were conducted to assess the reliability of the panel regression results. Heteroskedasticity was examined using panel-appropriate tests, including the modified Wald procedure where applicable. Serial correlation was assessed through the Wooldridge test for autocorrelation in panel data, and cross-sectional dependence was evaluated using the Pesaran cross-sectional dependence test. Because corporate financial data frequently violate the assumptions of homoskedastic and independently distributed disturbances, the reported coefficient tests were based on robust standard errors (Wooldridge, 2010; Gujarati & Porter, 2022). The form of robust covariance estimation was selected in accordance with the detected error structure. Where the diagnostics indicated within-firm heteroskedasticity or serial dependence, standard errors were clustered at the firm level. Where cross-sectional dependence was also material, a covariance estimator capable of accommodating

such dependence was considered. Statistical significance was evaluated at the conventional levels of 1%, 5%, and 10%, with the 5%level serving as the principal decision criterion.

The mediating role of exploration and evaluation cost disclosure quality was examined primarily through an indirect-effect approach. The conceptual logic of the analysis was consistent with the mediation framework proposed by Baron and Kenny (1986), but the existence of mediation was not determined solely by the sequential significance of the individual regression paths. Because the product of two regression coefficients generally has a nonnormal sampling distribution, the statistical significance of the indirect effect was evaluated using a bootstrap procedure with 5,000 resamples (Preacher & Hayes, 2008). In each resample, firm-level observations were resampled in a manner intended to preserve the dependence of repeated annual observations within companies, and the coefficients for paths $a$and $b$were re-estimated. The product $ab$was then calculated for each replication to generate an empirical sampling distribution of the indirect effect. A bias-corrected confidence interval was constructed from this distribution. Mediation was considered statistically supported when the confidence interval for the indirect effect did not include zero. This bootstrap confidence interval constituted the principal criterion for accepting or rejecting the mediation hypothesis because it does not require the indirect effect to follow a normal distribution and generally provides greater statistical power and more accurate inference than traditional stepwise procedures.

The Sobel test was additionally calculated as a supplementary assessment of the indirect effect (Sobel, 1982). The Sobel statistic was obtained from:

$$Z_{\text{Sobel}} = \frac{ab}{\sqrt{b^2 s_a^2 + a^2 s_b^2}}$$

where $a$is the estimated coefficient linking digital maturity to disclosure quality, $b$is the estimated coefficient linking disclosure quality to earnings quality while controlling for digital maturity, $s_a$is the standard error of a, and $s_b$is the standard error of b. A statistically significant absolute Z_{Sobel}value provided additional evidence of mediation. Nevertheless, because the Sobel test assumes approximate normality of the indirect-effect distribution, its results were treated as corroborative rather than decisive. The bootstrap confidence interval remained the primary inferential basis for evaluating mediation. When both the indirect effect and the remaining direct effect were statistically significant and operated in the same direction, the result was interpreted as partial complementary mediation. When the indirect effect was statistically significant but the direct effect became nonsignificant after the mediator was included, the result was interpreted as indirect-only or full mediation. When the direct and indirect effects had opposite signs, the possibility of competitive mediation or statistical suppression was considered.

As a supplementary analysis, random forest and gradient boosting algorithms were implemented to examine possible nonlinear relationships and compare the relative predictive importance of digital maturity, disclosure quality, firm size, leverage, and profitability. These machine-learning procedures were not used as substitutes for the panel regression models or as the primary basis for causal or mediational inference. Rather, they were employed as robustness-oriented exploratory tools to determine whether nonlinear patterns or interaction structures not explicitly represented in the linear panel models contributed to the prediction of earnings quality. Model performance and variable-importance results from these algorithms were analyzed separately from the principal econometric findings.

3. Findings and Results

Table 1 presents the measures of central tendency and dispersion for the study variables based on 154 firm-year observations. The mean discretionary accrual value was −0.0757, indicating that, on average, the sampled mining companies exhibited a greater tendency toward negative discretionary accruals. This pattern may reflect income-decreasing accrual choices or conservative financial reporting practices within the sample. However, the discretionary accrual values ranged from −1.0319to 1.3340, demonstrating substantial variation in accrual-based reporting behavior across firms and years.

The mean digital maturity index was 0.0427, with a median of 0.0143, indicating that information technology investments represented a relatively small proportion of the tangible fixed-asset base of most sampled companies. The considerable difference between the mean and median, together with a maximum value of 1.0862, suggests that a limited number of firm-year observations reported substantially greater investment in software and information technology equipment than the remainder of the sample.

The normalized disclosure-quality score had a mean of 0.7441and a median of 0.8000, indicating a moderate-to-high level of exploration and evaluation cost disclosure among the sampled firms. The scores ranged from 0.3000to 1.0000, showing that no firm-year observation received a disclosure score below 30% of the checklist items, whereas some companies disclosed all the items included in the disclosure checklist. Firm size had a mean of 17.4157, while the mean financial leverage ratio was 0.6737. Financial leverage displayed substantial dispersion, with a standard deviation of 2.2801and a maximum value of 19.9355, indicating considerable structural differences in the capital structures of the sampled mining companies. The mean return on assets was 0.1684, suggesting that the companies generated average net income equivalent to approximately 16.84% of their total assets.

Table 1. Descriptive Statistics of the Research Variables

Variable	Mean	Standard deviation	Minimum	First quartile	Median	Third quartile	Maximum
Discretionary accruals (***DA***)	-0.0757	0.2388	-1.0319	-0.1878	-0.0656	-0.0006	1.3340
Digital maturity (***DigMat***)	0.0427	0.1337	0.0001	0.0072	0.0143	0.0263	1.0862
Disclosure quality (***DiscScore***)	0.7441	0.1832	0.3000	0.6000	0.8000	0.9000	1.0000
Firm size (***Size***)	17.4157	2.5858	10.5687	15.7654	17.5905	19.0153	22.4549
Financial leverage (***Lev***)	0.6737	2.2801	0.0056	0.1932	0.3347	0.4381	19.9355
Return on assets (***ROA***)	0.1684	0.1738	-0.0570	0.0464	0.1387	0.2165	1.0739

The initial examination of the dataset revealed no missing values among the 154 firm-year observations retained in the final sample. Potential outliers were identified using the interquartile-range method and were adjusted through winsorization at the first and ninety-ninth percentiles. This procedure reduced the potential influence of extreme financial observations while preserving the size and panel structure of the dataset.

The distributional analysis showed that some variables, particularly financial leverage and digital maturity, exhibited positive skewness. The observed nonnormality was attributable primarily to a limited number of companies reporting unusually high leverage ratios or substantial investments in information technology assets. Nevertheless, this deviation from normality did not prevent the estimation of the panel regression models because the sample contained 154 firm-year observations and all inferential models were estimated using robust standard errors.

Table 2 presents the Pearson correlation coefficients and variance inflation factors. The strongest correlation among the explanatory variables was observed between firm size and disclosure quality, with a coefficient of 0.613. This result suggests that larger mining companies tended to disclose more comprehensive information concerning

their exploration and evaluation expenditures. However, the magnitude of the correlation remained below commonly applied critical thresholds for serious multicollinearity.

Return on assets had a positive correlation of 0.502with discretionary accruals. Because the earnings-quality measure was subsequently defined as the negative absolute value of discretionary accruals, this correlation should not be interpreted directly as the relationship between profitability and the final earnings-quality measure. Digital maturity had only weak bivariate correlations with discretionary accruals, disclosure quality, firm size, leverage, and profitability. The variance inflation factors ranged from 1.004to 1.988, and all values were substantially below the threshold of 5. Therefore, no evidence of problematic multicollinearity was identified.

Table 2. Pearson Correlation Matrix and Variance Inflation Factors

Variable	DA	$DigMat$	$DiscScore$	$Size$	Lev	ROA	VIF
DA	1.000						—
$DigMat$	0.126	1.000					1.004
$DiscScore$	0.021	0.004	1.000				1.738
$Size$	0.072	-0.005	0.613	1.000			1.988
Lev	-0.017	-0.059	-0.172	-0.304	1.000		1.050
ROA	0.502	0.033	0.073	-0.217	-0.097	1.000	1.150

The F-Limer test was used to determine whether panel estimation was preferable to pooled ordinary least squares. The test was statistically significant at the 5% level, indicating the presence of firm-specific effects and rejecting the appropriateness of the pooled regression model. The Hausman test was subsequently conducted to select between fixed-effects and random-effects estimation. The Hausman test produced a significance level of $p = .0027$, leading to the rejection of the null hypothesis that the unobserved firm-specific effects were uncorrelated with the explanatory variables. Accordingly, the fixed-effects estimator was selected as the principal estimation method.

The modified Wald test was applied to assess groupwise heteroskedasticity, while the Wooldridge test was used to examine serial autocorrelation. The results indicated that heteroskedasticity was likely to be present, whereas no statistically substantial evidence of severe serial autocorrelation was detected. Consequently, all regression models were estimated using robust standard errors to improve the reliability of the coefficient tests.

Because the sampled companies operated in related mining industries and were simultaneously exposed to common macroeconomic conditions, the Pesaran cross-sectional dependence test was also conducted. The findings indicated that the degree of cross-sectional dependence was not sufficiently strong to generate serious bias in the estimated coefficients. Nevertheless, the use of robust covariance estimation provided additional protection against possible violations of the standard error assumptions.

The fixed-effects regression results for the final earnings-quality model are presented in Table 3. In this model, earnings quality was measured as $EQ = -|\ DA\ |$; therefore, a positive coefficient represents an increase in earnings quality through a reduction in the absolute magnitude of discretionary accruals, whereas a negative coefficient represents a decrease in earnings quality.

Table 3. Fixed-Effects Regression Results for the Final Earnings-Quality Model

Variable	Coefficient ($\boldsymbol{\beta}$)	t-statistic	p-value	Result
Digital maturity ($DigMat$)	0.048	0.596	.552	Not significant
Disclosure quality ($DiscScore$)	0.468	2.026	.044	Significant
Firm size ($Size$)	-0.057	-3.204	.001	Significant
Financial leverage (Lev)	0.007	1.926	.056	Marginally significant
Return on assets (ROA)	-0.255	-2.198	.029	Significant

The direct coefficient of digital maturity in the final model was positive but statistically nonsignificant, $\beta = 0.048$, $t = 0.596$, and $p = .552$. Therefore, the hypothesis proposing a direct positive relationship between digital maturity and earnings quality was not supported. The result indicates that, after controlling for disclosure quality, firm size, leverage, and profitability, investment intensity in software and information technology equipment did not independently explain changes in the earnings quality of the sampled mining companies.

The relationship between digital maturity and exploration and evaluation cost disclosure quality was examined through path $a$in the second regression model. The coefficient was positive and statistically significant, $\beta = 0.150$, $t = 3.840$, and $p < .001$. This result supports the hypothesis that greater digital maturity is associated with higher-quality disclosure of exploration and evaluation costs. Thus, companies with greater relative investments in software and information technology equipment tended to disclose more comprehensive information about their exploration methods, capitalized expenditures, impairment assessments, environmental restoration obligations, government mining rights, and project progress.

The coefficient of disclosure quality in the final earnings-quality model was also positive and statistically significant, $\beta = 0.468$, $t = 2.026$, and $p = .044$. Consequently, the hypothesis proposing a positive relationship between disclosure quality and earnings quality was supported. Because larger values of EQindicate lower absolute discretionary accruals, the positive coefficient suggests that more comprehensive disclosure of exploration and evaluation costs was associated with reduced accrual-based earnings management and higher reliability of reported earnings.

The mediating role of exploration and evaluation cost disclosure quality in the relationship between digital maturity and earnings quality was assessed by estimating the indirect effect:

$$ab = (0.150)(0.468) = 0.070$$

Path a, representing the effect of digital maturity on disclosure quality, was positive and significant. Path b, representing the effect of disclosure quality on earnings quality after controlling for digital maturity, was also positive and significant. However, the direct effect of digital maturity on earnings quality after the inclusion of disclosure quality, denoted by c', remained nonsignificant:

$$c' = 0.048, t = 0.596, p = .552$$

The estimated indirect effect was 0.070. The Sobel test yielded $Z = 1.790$and $p = .073$, indicating that the indirect effect was statistically significant only at the 10% level. However, the bias-corrected and accelerated 95% bootstrap confidence interval based on 5,000 resamples ranged from $-0.0098$to 0.1580. Because this interval included zero, the indirect effect was not statistically significant at the conventional 5% level.

Table 4. Significance Tests for the Indirect Effect

Mediation component or test	Estimate or interval	Interpretation
Path $\boldsymbol{a}$: $\boldsymbol{DigMat \rightarrow DiscScore}$	$a = 0.150$, $t = 3.840$, $p < .001$	Digital maturity had a positive and significant effect on disclosure quality
Path $\boldsymbol{b}$: $\boldsymbol{DiscScore \rightarrow EQ}$	$b = 0.468$, $t = 2.026$, $p = .044$	Disclosure quality had a positive and significant effect on earnings quality
Direct effect $\boldsymbol{c'}$: $\boldsymbol{DigMat \rightarrow EQ}$, controlling for $\boldsymbol{DiscScore}$	$c' = 0.048$, $t = 0.596$, $p = .552$	The direct effect was not significant
Estimated indirect effect	$a \times b = 0.070$	Positive estimated mediation effect
Sobel test	$Z = 1.790$, $p = .073$	Significant at the 10% level, but not at the 5% level
Bootstrap analysis with 5,000 resamples	BCa 95% CI $[-0.0098, 0.1580]$	The confidence interval included zero; the indirect effect was not significant at the 5% level
Proportion mediated	$PM = 0.577$	Approximately 57.7% of the estimated total effect operated through disclosure quality

The Sobel test therefore provided marginal evidence of mediation at the 90% confidence level. However, the bootstrap confidence interval, which constituted the principal criterion for evaluating the indirect effect, included zero. Accordingly, the hypothesis proposing that exploration and evaluation cost disclosure quality significantly mediates the relationship between digital maturity and earnings quality was not supported at the 95% confidence level.

The proportion mediated was calculated as $PM = 0.577$, suggesting that approximately 57.7% of the estimated total relationship between digital maturity and earnings quality was transmitted through disclosure quality. Nevertheless, this proportion must be interpreted cautiously because the corresponding indirect effect was not statistically robust at the 5% level. The results thus indicate the presence of a possible mediating tendency rather than a firmly established mediation mechanism. Digital maturity appears to improve the quality of exploration and evaluation cost disclosure, and improved disclosure quality is associated with higher earnings quality; however, the combined indirect pathway was not estimated with sufficient precision to exclude a null effect at the 95% confidence level.

Firm size had a negative and statistically significant relationship with earnings quality, $\beta = -0.057$, $t = -3.204$, and $p = .001$. Given the reverse coding of the dependent variable, this finding indicates that larger companies exhibited greater absolute discretionary accruals and lower earnings quality. The result suggests that the greater operational complexity, geographical dispersion, diversity of projects, and volume of accounting estimates in larger mining companies may increase the scope for managerial discretion in determining accruals. The monitoring of exploration assets, impairment estimates, environmental obligations, and capitalized mining costs may also become more difficult as organizational scale increases.

Financial leverage had a small positive coefficient of 0.007, with $t = 1.926$and $p = .056$. This effect was not significant at the 5% level but was marginally significant at the 10% level. The positive coefficient suggests that more highly leveraged firms may have reported slightly higher earnings quality, although the evidence was insufficiently strong to support a definitive conclusion. One possible interpretation is that monitoring by creditors and debt providers restricted aggressive accrual choices in more highly indebted firms. Nevertheless, because the result was marginal and financial leverage exhibited considerable dispersion, it should be interpreted cautiously.

Return on assets had a negative and statistically significant coefficient, $\beta = -0.255$, $t = -2.198$, and $p = .029$. Because earnings quality was defined as $EQ = -|\ DA\ |$, this result means that higher profitability was associated with a larger absolute value of discretionary accruals and, consequently, lower earnings quality. Thus, more profitable mining companies appeared to engage in greater accrual-based earnings management. This pattern may indicate that managers of highly profitable companies used discretionary accruals to smooth reported earnings, sustain historical growth patterns, meet market expectations, or reduce fluctuations caused by commodity-price cycles and project-specific mining risks.

Several supplementary analyses were conducted to evaluate the stability of the main results. First, the regression models were re-estimated using a random-effects specification. The signs and statistical significance of the principal coefficients did not differ materially from those obtained using the fixed-effects estimator. In particular, the relationship between disclosure quality and earnings quality remained positive, while the direct effect of digital maturity remained statistically weak. These results indicated that the principal conclusions were not solely attributable to the use of the fixed-effects estimator.

Second, sensitivity analyses were conducted to determine whether the findings were driven by exceptional macroeconomic shocks. The models were re-estimated after separately excluding observations from 2018,

corresponding to the major foreign-exchange crisis, and 2020, corresponding to a period of intensified sanctions and substantial economic disruption. After excluding 2018, the disclosure-quality coefficient remained positive and statistically significant, $\beta = 0.451$and $p = .038$. After excluding 2020, the coefficient was $\beta = 0.472$and remained statistically significant at $p = .041$. Thus, the positive relationship between exploration and evaluation cost disclosure quality and earnings quality was not driven exclusively by observations from these exceptional years.

Third, the control variables were entered into the regression models with a one-period lag to reduce potential simultaneity bias. The lagged-variable estimations continued to indicate a positive relationship between disclosure quality and earnings quality. Although the exact magnitudes of the coefficients varied slightly, their directions and substantive interpretation remained consistent with the principal results.

Overall, the robustness analyses supported the relative stability of the main finding that higher-quality disclosure of exploration and evaluation costs is associated with higher earnings quality among mining companies listed on the Tehran Stock Exchange. However, the evidence concerning the mediating role of disclosure quality remained statistically limited. The indirect relationship was positive and marginally supported by the Sobel test, but it did not satisfy the principal 95% bootstrap confidence-interval criterion.

4. Discussion and Conclusion

The present study examined whether digital maturity affects earnings quality directly and whether the quality of exploration and evaluation cost disclosure mediates this relationship among mining companies listed on the Tehran Stock Exchange. The findings revealed four principal results. First, digital maturity had a positive and statistically significant effect on the quality of exploration and evaluation cost disclosure. Second, disclosure quality had a positive and statistically significant effect on earnings quality. Third, the direct effect of digital maturity on earnings quality was positive but statistically nonsignificant. Fourth, although the estimated indirect effect of digital maturity on earnings quality through disclosure quality was positive and the Sobel test indicated marginal significance at the 10% level, the 95% bias-corrected bootstrap confidence interval included zero. Therefore, the mediating role of disclosure quality was not supported at the conventional 5% significance level. In addition, firm size and profitability had significant negative relationships with earnings quality, while financial leverage showed only a marginally significant positive effect. The robustness analyses confirmed the relative stability of the positive relationship between disclosure quality and earnings quality, even after alternative model estimation, exclusion of economically turbulent years, and use of lagged control variables.

The first major finding was that digital maturity positively influenced the quality of exploration and evaluation cost disclosure. This result indicates that mining companies with a higher intensity of investment in software and information technology equipment tended to provide more comprehensive information about accounting policies for exploration expenditures, capitalized exploration and evaluation costs, impairment testing, probable reserves, environmental restoration expenditures, government royalties, capital expenditure movements, and the physical progress of mining projects. Digital systems can facilitate the collection, classification, reconciliation, and consolidation of data generated by geological, operational, engineering, environmental, and accounting units. Such integration is especially important in mining companies because exploration and evaluation information is frequently produced at different project sites and by technically specialized departments. When these data are captured through integrated information systems, management is more capable of preparing consistent and timely financial disclosures.

This finding is consistent with the organizational-capability maturity perspective, according to which capabilities gradually progress from fragmented and informal procedures to standardized, measured, integrated, and continuously improved processes [17]. In digitally less mature firms, project data may be dispersed across spreadsheets, local systems, paper records, and separate organizational units, making comprehensive disclosure costly and error-prone. By contrast, greater digital maturity can create standardized information flows and improve the traceability of project expenditures. The result is also aligned with the maturity-driven governance model proposed for digital transformation, which emphasizes that effective digital outcomes depend on the alignment of technological mechanisms with organizational capabilities and governance arrangements [18]. Accordingly, the observed relationship suggests that technological investment in the sampled mining companies contributed to the development of the informational infrastructure required for more complete disclosure, even though it did not independently improve earnings quality.

The positive association between digital maturity and disclosure quality can also be explained through data-governance maturity. Organizations with similar operating activities may differ considerably in their capacity to establish data ownership, quality controls, access rules, standardized definitions, and integrated reporting procedures [19]. Within mining companies, the quality of disclosures concerning exploration activities depends on whether project-level costs are coded accurately, whether data are linked to specific licenses or mining areas, and whether changes in capitalized expenditures can be reconciled across periods. The findings imply that investment in information technology may support these processes by reducing information fragmentation and facilitating stronger control over the preparation of financial statements. The result also reflects the broader meaning of maturity as a developmental condition that affects the consequences of participation or investment. Although the concept has been examined in other contexts, such as differences in physical and functional outcomes associated with maturity status [20], its underlying logic is applicable here: the possession of digital resources alone is less important than the extent to which those resources represent an advanced stage of organizational capability.

The second major finding was that the quality of exploration and evaluation cost disclosure had a positive and significant effect on earnings quality. Because earnings quality was defined as the negative absolute value of discretionary accruals, the positive coefficient indicates that more comprehensive disclosure was associated with lower absolute discretionary accruals and, consequently, less accrual-based earnings management. This finding supports the argument that transparent industry-specific disclosure constrains managerial discretion by making accounting choices more observable to investors, creditors, auditors, and regulators. When a company separately reports exploration expenditures, impairment assessments, reserve-related information, environmental obligations, royalties, and project progress, users can more effectively compare reported accounting values with the economic and operational condition of mining projects. Managers may therefore find it more difficult to capitalize inappropriate costs, delay impairment recognition, or use vague classifications to influence reported earnings.

The positive effect of disclosure quality on earnings quality is consistent with evidence that transparency strengthens corporate accountability and improves the informational environment. External transparency can enhance both organizational performance and the quality of corporate responsibility disclosures by increasing stakeholder scrutiny and reducing managerial information advantages [12]. Although that study focused on social responsibility, the same mechanism can explain the present result. In mining firms, transparent disclosure of project expenditures and obligations enables external stakeholders to assess whether accounting estimates are consistent with operational realities. The result also corresponds with research showing that voluntary disclosure behavior is

influenced by governance and ownership conditions and that organizational structures shape the extent to which companies provide decision-useful information [10]. Thus, disclosure should not be considered a merely formal reporting requirement; it functions as a governance mechanism that can restrict opportunistic financial reporting.

The finding also aligns with legitimacy and voluntary disclosure perspectives. Companies use disclosure both to reduce information asymmetry and to demonstrate conformity with stakeholder and institutional expectations [9]. Mining companies face particularly strong legitimacy pressures because their activities affect natural resources, local environments, public revenues, and community interests. Comprehensive reporting about rehabilitation costs, mineral rights, project progress, and exploration outcomes may therefore signal responsible governance and encourage managers to maintain consistency between disclosed information and accounting recognition. Similarly, institutional investors may respond to detailed corporate information because disclosure helps them evaluate organizational capabilities and long-term value creation [11]. In the context of the present study, better exploration and evaluation disclosure may strengthen external monitoring and thereby discourage aggressive accrual choices.

The result is additionally supported by studies emphasizing the credibility and analytical value of narrative disclosures. Management's tone in corporate reports can affect investment efficiency because qualitative reporting shapes how investors interpret financial conditions and future prospects [15]. Textual risk disclosures can also reveal indications of accounting fraud and reporting irregularities that may not be evident from numerical figures alone [16]. These findings reinforce the conclusion that detailed disclosure provides an additional layer of evidence through which stakeholders can evaluate the credibility of accounting numbers. Exploration and evaluation disclosures are particularly informative because they connect reported expenditures and assets to operational events, project risks, impairment indicators, and future development possibilities. Greater disclosure quality can therefore reduce managers' ability to separate accounting presentation from the underlying economic condition of mining projects.

Auditing and assurance mechanisms may further strengthen this relationship. Auditors enhance the credibility of corporate disclosures by examining whether reported information is supported by evidence, internally consistent, and free from material misstatement [13]. Comprehensive disclosures provide auditors with clearer reporting benchmarks and make it easier to identify inconsistencies between financial statements, operational reports, and management estimates. In contrast, limited or ambiguous disclosure may permit aggressive assumptions to remain concealed within aggregated accounting figures. The positive relationship found in this study may therefore reflect the combined effect of transparency and assurance: firms that disclose more detailed exploration and evaluation information create stronger conditions for auditing, monitoring, and external evaluation, which ultimately contribute to higher earnings quality.

The third finding was that digital maturity did not have a statistically significant direct effect on earnings quality. This result suggests that investment in software and information technology equipment does not automatically reduce discretionary accruals. Digital systems can improve data availability and processing speed, but their effect on financial reporting depends on how they are governed, integrated, and used by managers. Technology may support either transparency or opportunistic behavior. For example, sophisticated systems can strengthen internal controls and facilitate continuous monitoring, but they can also provide managers with more timely information for adjusting estimates or managing reported outcomes. Therefore, digital maturity should not be regarded as an inherently effective mechanism for improving earnings quality unless it is accompanied by appropriate governance, ethical culture, internal controls, and disclosure practices.

This interpretation is consistent with maturity-based digital governance research, which argues that digital-transformation mechanisms must be matched to an organization's capability level to produce effective outcomes [18]. If information technology investments remain focused on hardware acquisition or isolated software systems, their contribution to financial reporting quality may be limited. Similarly, organizational capabilities do not mature uniformly, and technological capability may advance more rapidly than governance, human expertise, or cross-functional coordination [17]. The nonsignificant direct effect may therefore indicate that the sampled companies had developed portions of their digital infrastructure without fully embedding digital capabilities in accounting controls and earnings-reporting processes.

The absence of a direct effect is also understandable in light of evidence that earnings management is influenced by behavioral and organizational factors. Machiavellian managerial tendencies and whistleblowing arrangements can affect the extent of earnings manipulation independently of technological conditions [5]. Organizational culture also influences the relationship between earnings management and the readability of financial reporting [7]. Consequently, even digitally advanced companies may continue to report low-quality earnings when managerial incentives encourage manipulation or when the organizational culture does not prioritize transparency. Likewise, external financing activities may motivate earnings smoothing, with the strength of this behavior depending on organizational risk-management arrangements [6]. These studies suggest that digital maturity is only one component of the reporting environment and may be insufficient to offset powerful financial and behavioral incentives.

The fourth result concerned the mediating role of disclosure quality. Digital maturity significantly predicted disclosure quality, and disclosure quality significantly predicted earnings quality, producing a positive estimated indirect effect of 0.070. The Sobel statistic was marginally significant at the 10% level, and approximately 57.7% of the estimated total effect was transmitted through disclosure quality. Nevertheless, the 95% bootstrap confidence interval included zero, and the mediation hypothesis was therefore rejected at the 5% significance level. This pattern indicates a plausible but statistically weak transmission mechanism. Digital maturity appears capable of improving disclosure processes, and better disclosure is associated with higher earnings quality, but the combined pathway is not yet sufficiently stable across firms and years to establish robust mediation.

One explanation is that the digital transformation of Iranian mining companies remains uneven. Some firms may have invested in technology primarily for production, engineering, or administrative purposes rather than for financial-reporting integration. Data-governance maturity studies indicate that even organizations with comparable activities may display markedly different maturity levels [19]. Therefore, the same level of information technology investment may generate different disclosure outcomes depending on data standards, management commitment, employee competencies, and integration between operational and accounting systems. The development of comprehensive disclosure models in Iranian industries likewise demonstrates that reporting quality depends on a combination of institutional requirements, governance mechanisms, stakeholder needs, and organizational capacities [21]. These conditions may explain why a positive mediation tendency emerged without achieving conventional statistical significance.

Managerial discretion over disclosure may also weaken the indirect pathway. Managers may strategically alter forward-looking information according to performance conditions, financing incentives, and reputational considerations [14]. Thus, even when digital systems produce detailed project data, management may choose not to disclose all relevant information or may present it selectively. The reporting benefits of digital maturity are therefore conditional on disclosure incentives and governance oversight. The finding that corporate social

responsibility, intellectual capital, performance, and earnings management jointly influence firm value further illustrates that financial reporting outcomes result from interacting organizational mechanisms rather than from a single technological determinant [8]. The weak mediation result is consequently reasonable because disclosure quality represents only one of several channels connecting digital capabilities to earnings quality.

The control-variable findings also provide important insights. Firm size had a negative and significant effect on earnings quality. Larger mining companies may have more complex organizational structures, multiple exploration projects, geographically dispersed operations, and greater volumes of accounting estimates. Such complexity can create additional opportunities for discretionary classification and timing of accruals. Although larger firms often possess stronger reporting systems, the present result suggests that operational complexity and managerial discretion may outweigh the monitoring benefits associated with size. The negative coefficient may also reflect greater pressure on large listed companies to meet market expectations and maintain stable performance trends.

Profitability also had a negative and significant effect on earnings quality. More profitable mining firms exhibited greater absolute discretionary accruals, suggesting that managers may use accruals to smooth earnings, preserve growth patterns, or manage expectations during periods of strong performance. This result corresponds with the broader earnings-management literature, which emphasizes that reported profitability can be strategically adjusted when managers face contracting, valuation, or reputational incentives. Studies of earnings management have shown that managerial characteristics, financing conditions, and organizational mechanisms can alter the use of discretionary reporting choices [5, 6]. Thus, strong operating performance does not necessarily imply high-quality earnings, particularly when managers have incentives to transfer profits across periods.

Financial leverage showed a marginally positive relationship with earnings quality. This finding may indicate that creditor monitoring constrains accrual-based manipulation in more highly leveraged firms. However, the effect was not significant at the 5% level and should be interpreted cautiously, especially because leverage displayed substantial dispersion. Debt can generate conflicting reporting incentives: managers may increase earnings to avoid covenant violations, but lenders may also impose stronger monitoring and reporting requirements. The marginal coefficient suggests that neither mechanism dominated consistently across the sampled companies.

Overall, the findings demonstrate that the quality of exploration and evaluation cost disclosure is more directly related to earnings quality than digital investment itself. Digital maturity appears to improve the reporting infrastructure, but its contribution to earnings quality depends on whether technological capabilities are converted into transparent, credible, and decision-useful disclosures. This conclusion extends previous research by showing that industry-specific disclosure may represent an important intermediary organizational process, even though its mediating effect was statistically fragile in the present sample. The results also reinforce the view that digital transformation should be evaluated through its organizational and governance consequences rather than merely through the amount invested in technology.

The study was subject to several limitations. The sample consisted of only 14 mining companies and 154 firm-year observations, reflecting the limited number of eligible firms listed on the Tehran Stock Exchange; therefore, the statistical power of the mediation analysis was restricted. Digital maturity was measured through information technology investment intensity, which captured the technological-asset dimension but did not directly measure digital strategy, employee capabilities, process automation, analytical capacity, cybersecurity, or digital culture. Disclosure quality was evaluated using a dichotomous checklist, and this approach measured the presence of information more effectively than its depth, accuracy, readability, or credibility. Earnings quality was operationalized solely through discretionary accruals estimated with the modified Jones model, although earnings

quality is a multidimensional construct. The findings may also have been influenced by industry-specific regulatory conditions, inflation, sanctions, commodity-price volatility, and differences in the accounting systems of the sampled companies. Finally, the observational ex post facto design did not permit definitive causal conclusions.

Future studies should examine a larger sample that includes mining firms from multiple capital markets or compare listed and unlisted companies to improve statistical power and external validity. Researchers should develop multidimensional measures of digital maturity incorporating digital governance, automation, data analytics, workforce competencies, cybersecurity, and integration between operational and accounting systems. Disclosure quality could be measured through weighted scoring, readability analysis, textual specificity, independent coding, or natural-language-processing techniques. Alternative indicators of earnings quality, including accrual persistence, earnings predictability, real earnings management, restatements, and the relationship between earnings and cash flows, should be examined. Future studies could also test additional mediators and moderators, such as internal-control quality, audit quality, board expertise, ownership concentration, organizational culture, data-governance maturity, and environmental uncertainty. Dynamic panel models, longer time periods, qualitative interviews, and mixed-method designs could provide stronger evidence about the processes through which digital transformation affects financial reporting.

Mining-company managers should integrate digital investments with financial-reporting objectives rather than treating technology acquisition as an isolated operational initiative. Project-level systems should connect geological, engineering, environmental, legal, and accounting data so that exploration expenditures, impairment indicators, royalties, rehabilitation obligations, and project progress can be traced and disclosed consistently. Boards and audit committees should monitor the completeness and reliability of industry-specific disclosures and require periodic reconciliation between operational records and financial reports. Regulators should provide more detailed disclosure guidance for exploration and evaluation activities and encourage standardized digital reporting formats across mining companies. Auditors should place greater emphasis on the consistency between project data, capitalized expenditures, impairment assumptions, and narrative disclosures. Companies should also train accounting and operational personnel in data governance and establish clear responsibilities for the accuracy, approval, and external reporting of exploration and evaluation information.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

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

Acknowledgments

Authors thank all participants who participate in this study.

Conflict of Interest

The authors report no conflict of interest.

Funding/Financial Support

According to the authors, this article has no financial support.

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