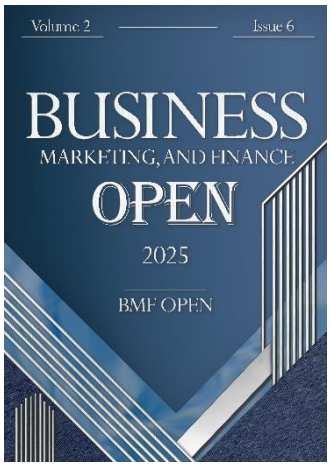
Determinants of a Financial and Operational Supervision Model in Iran's State-Controlled Banks: The Mediating Role of Electronic Banking in Reducing Corruption

Mahdi Sohbati [1], Mohammad Ali Aghaei [2,*] and Gholam Reza Kordestani [3]



[1] Department of Accounting, Qa.C., Islamic Azad University, Qazvin, Iran;
[2] Associate Professor, Department of Accounting, Tarbiat Modares University, Tehran, Iran;
[3] Professor, Department of Accounting, Faculty of Social Science, Imam Khomeini International University, Qazvin, Iran;

* Correspondence: aghaeim@modares.ac.ir

Citation: Sohbati, M., Aghaei, M. A., & Kordestani, G. R. (2027). Determinants of a Financial and Operational Supervision Model in Iran's State-Controlled Banks: The Mediating Role of Electronic Banking in Reducing Corruption . *Business, Marketing, and Finance Open*, 4(6), 1-17.

Received: 02 May 2026
Revised: 27 August 2026
Accepted: 06 September 2026
Initial Publication: 09 September 2026
Final Publication: 01 November 2027

Abstract: Administrative corruption is a major issue affecting government organizations in many countries. Meanwhile, the development and implementation of information technology solutions are a turning point for improved transparency and mitigated financial corruption. The present study aims to determine the variables of a financial and operational supervision model in Iran's banking sector (i.e. a case study of state-controlled banks). The present study is applied in terms of aim, descriptive survey in terms of design, and correlational in terms of type. 63079 employees of the Central Bank of Iran comprise the present study's statistical population. A total of 382 individuals were sampled using Cochran's formula and stratified random sampling method. Data collection and evaluation were carried out using Pintrich and Drabdali's Standard Decentralization Questionnaire (2013), Financial Supervision Model in Iran's Banking Industry Questionnaire, and Sharifi and Zhang's Standard Operational Supervision in Iran's Banking Industry Questionnaire with the reliability coefficient of 0.85, 0.81, and 0.9, respectively. It is noteworthy that experts in the field had approved the content validity of the questionnaires. The findings of the present study point out that implementing electronic banking services would contribute to the decentralization of the Central Bank of Iran and mitigate corruption within state-controlled banks. The results point out the significant codependency between financial and operational supervision, and mitigated corruption and implementation of electronic banking services. Relevant propositions were presented at the end of the article.

Keywords: Electronic Banking, Financial Supervision, Operational Supervision

1. Introduction

Banks occupy a distinctive position in modern economies because they do not merely intermediate between savers and borrowers; they also create, allocate, monitor, and redistribute financial resources across economic sectors. The quality with which banks perform these functions directly affects credit allocation, investment, liquidity, financial stability, and ultimately economic development. At the same time, the special characteristics of banking—including high leverage, information asymmetry, maturity transformation, interconnectedness, and the potential transmission of individual institutional problems to the broader financial system—make banking fundamentally different from most other industries. These characteristics explain why banking institutions are subject to extensive regulation, supervision, and monitoring. Effective bank supervision is

consequently not limited to verifying formal compliance with laws; rather, it encompasses continuous assessment of financial soundness, operational conduct, risk exposure, governance arrangements, internal controls, and the extent to which banking activities remain consistent with regulatory and public-policy objectives. International evidence has shown that the design and quality of bank regulation, supervision, and monitoring can materially influence both bank efficiency and the stability of the financial system, although excessively rigid or poorly designed interventions may themselves generate inefficiencies [1, 2].

The global financial crisis of 2007–2009 substantially transformed thinking about banking supervision. One of the principal lessons of that crisis was that formal compliance with prudential requirements cannot, by itself, guarantee financial stability when supervisors fail to identify emerging vulnerabilities, interconnected risks, excessive leverage, deteriorating asset quality, or weaknesses in bank governance. Post-crisis reforms therefore increasingly emphasized forward-looking, risk-sensitive, and institution-specific supervision rather than predominantly rule-based inspection. Experiences such as the restructuring of Iceland's financial regulatory environment illustrated how restoring confidence after a systemic banking crisis requires both stronger regulation and credible supervisory institutions capable of enforcing prudential standards [3]. A decade after the global financial crisis, international assessments similarly demonstrated that supervisory architecture, institutional independence, supervisory powers, capital regulation, disclosure requirements, and market discipline remained essential components of resilient banking systems [2]. More recently, the banking turmoil of 2023 has renewed concern about the capacity of supervisory systems to identify vulnerabilities associated with rapid deposit withdrawals, interest-rate risk, liquidity pressures, technological interconnectedness, and accelerated information transmission, indicating that supervisory frameworks must evolve as rapidly as the risks confronting banks [4].

The effectiveness of banking supervision depends not only on the existence of regulatory rules but also on the manner in which supervision is operationalized. Financial supervision generally concerns the monitoring of capital adequacy, liquidity, asset quality, credit exposures, profitability, financial reporting, solvency, and compliance with prudential standards. Operational supervision, by comparison, extends to organizational processes, internal control systems, implementation of banking procedures, governance mechanisms, operational risks, information flows, execution of lending policies, and conformity between managerial practices and regulatory requirements. These two dimensions are closely interconnected because financial deterioration often originates in operational weaknesses, while operational deficiencies may remain concealed until they appear in financial indicators. Research on the relationship between regulation, supervision, and liquidity creation suggests that supervisory policies can shape banks' ability and incentives to create liquidity, underscoring the need to evaluate supervision not merely by the volume of regulatory intervention but by its consequences for banking behavior and risk [5]. Likewise, evidence concerning the interaction between banking supervision, monetary policy, and risk-taking indicates that supervisory actions can influence banks' lending and risk decisions and that the effects of supervision must be understood in conjunction with broader monetary and financial conditions [6].

These concerns are particularly important in the Iranian banking system, where banking institutions perform a dominant role in financing economic activity and where weaknesses in credit allocation, governance, regulatory compliance, financial transparency, and supervisory implementation may have implications extending far beyond individual banks. Legal analyses of the supervisory authority of the Central Bank of Iran have emphasized that the effectiveness of banking oversight depends on a coherent legal framework, clearly defined supervisory authority, enforceable regulations, and mechanisms enabling the central bank to intervene when regulated institutions violate prudential or operational requirements [7]. Iranian research has also highlighted the importance of effective

corporate governance as a mechanism for improving supervision within bank credit units, particularly because credit decisions represent one of the areas in which weak controls, conflicts of interest, inadequate accountability, and informational deficiencies can generate substantial financial and operational risks [8]. In parallel, analyses of operational supervision in banking facilities have demonstrated that the institutional arrangement through which monitoring functions are performed—including possible outsourcing of supervisory activities—can affect the effectiveness, efficiency, and reliability of oversight [9].

A fundamental challenge in banking supervision is therefore to move from fragmented, reactive, and primarily compliance-oriented control toward an integrated model in which supervisory resources are allocated according to the magnitude and probability of risk. Risk-based supervision has increasingly become a central paradigm because banks differ substantially in their business models, balance-sheet structures, governance quality, operational complexity, and vulnerability to financial shocks. A uniform supervisory approach may devote excessive resources to low-risk activities while failing to identify institutions or processes that present systemic or institution-specific threats. Iranian studies have accordingly sought to develop risk-based supervisory models for banks and credit institutions by identifying causal conditions, structural components, strategies, contextual factors, and supervisory outcomes relevant to the domestic banking environment [10]. Related research has further refined the conceptualization of risk-based bank supervision within Iran and has emphasized the need to integrate identifiable supervisory dimensions within coherent models capable of guiding regulatory action [10]. More recent quantitative modeling has provided additional support for the development of structured risk-based supervision frameworks for banks and credit institutions, demonstrating the continuing relevance of empirically validated supervisory models to the modernization of the Iranian banking sector [11].

The importance of effective supervision becomes even more apparent when banking corruption is considered. Banking activities involve substantial financial resources, discretionary decisions, privileged information, complex contractual relations, and repeated interactions among managers, employees, borrowers, regulators, and other stakeholders. Under conditions of weak monitoring, insufficient transparency, ineffective internal control, regulatory fragmentation, or conflicts of interest, these features may create opportunities for administrative and financial misconduct. Corruption within banking can manifest in preferential lending, manipulation of credit evaluations, concealment of non-performing exposures, collusive transactions, misuse of privileged information, circumvention of regulatory requirements, or improper influence over supervisory processes. Because such practices can distort credit allocation and weaken confidence in financial institutions, the prevention of corruption should be regarded as an integral component of sound supervision rather than an issue separate from financial stability. The manuscript underlying the present study similarly identifies corruption control as closely related to financial and operational supervision and positions electronic banking as an important mediating mechanism in this relationship.

Within Iran, weaknesses in banking supervision may be particularly consequential where rapid credit expansion becomes disconnected from the productive capacity of the economy. The Basel credit-gap approach provides one means of identifying excessive deviations of credit from longer-term trends and thereby generating early warning signals for financial vulnerabilities. Research applying this approach to Iran has indicated the relevance of credit-gap measurement to banking supervision and crisis prediction, supporting a more anticipatory rather than exclusively retrospective supervisory orientation [12]. Such evidence reinforces the argument that effective financial supervision requires timely information, robust analytical instruments, and mechanisms capable of detecting abnormal patterns before they develop into more serious institutional or systemic problems. In this

respect, supervision becomes an information-intensive process whose quality depends increasingly on supervisors' capacity to collect, integrate, process, and interpret large volumes of financial and operational data.

The digital transformation of banking has fundamentally altered this informational environment. Banking services that were previously conducted through physical branches, paper documentation, and relatively slow administrative processes are increasingly performed through electronic platforms, digital channels, automated systems, and interconnected databases. This transformation creates new supervisory opportunities because electronic transactions leave digital records that can potentially improve traceability, standardization, timeliness, and transparency. At the same time, digitalization generates new categories of operational, cyber, technological, and model risk. Consequently, digital transformation cannot be treated merely as a modernization of customer services; it also requires a corresponding transformation of supervisory capability. The European supervisory perspective has increasingly stressed that supervisors must understand how digitalization changes banks' business models, internal processes, operational resilience, technology dependencies, and risk profiles [13]. Similarly, research on digital technologies in financial-market monitoring has shown that regulatory authorities can employ advanced technological infrastructures to improve the speed, scope, and precision of supervisory activities [14].

Big data and machine learning further extend the potential of technology-enabled bank supervision. Traditional supervision frequently relies on periodic reports, sampling, on-site inspections, and backward-looking financial indicators. In contrast, large-scale digital data can enable supervisors to identify unusual patterns, monitor transactions more continuously, develop predictive indicators, and prioritize institutions or activities requiring closer examination. The application of big data and machine-learning techniques to bank supervision has therefore been discussed as an important development in supervisory technology, particularly for identifying emerging risks and extracting relevant information from increasingly complex datasets [15]. Artificial intelligence likewise has potential applications in auditing, anomaly detection, regulatory monitoring, risk classification, fraud detection, and automated compliance assessment. However, its adoption also raises legal questions concerning accountability, explainability, privacy, data governance, responsibility for automated decisions, and procedural fairness [16]. Regulatory compliance in an AI-driven financial environment consequently requires a balance between technological efficiency and legal safeguards, particularly when automated systems influence consequential supervisory judgments [17].

A related development is the transition from conventional periodic supervision toward forms of embedded or continuous supervision. The concept of embedded supervision suggests that regulatory requirements can, under certain technological architectures, be incorporated directly into financial infrastructures so that relevant compliance information becomes available automatically or close to real time. Distributed-ledger and blockchain-based financial systems have been discussed as environments in which supervisors may obtain verified information directly from technological processes rather than relying exclusively on delayed institutional reporting [18]. Although electronic banking in conventional state-controlled banks differs significantly from decentralized blockchain finance, the underlying principle is highly relevant: greater digital integration can reduce informational delays between regulated institutions and supervisors, improve audit trails, and make selected banking operations more readily observable. These capacities are particularly important where supervisory objectives include reducing opportunities for concealment, manipulation, or discretionary intervention.

Digitalization alone, however, does not ensure better supervision or lower corruption. Technology may reproduce existing institutional weaknesses when systems are fragmented, access rights are poorly governed, databases are incomplete, regulatory responsibilities overlap, or decision-making remains highly centralized. The

institutional design within which technology operates is therefore crucial. One relevant dimension is decentralization, understood not as the absence of central regulatory authority but as an appropriate distribution of operational responsibility, information access, monitoring capacity, and decision-making authority across organizational levels. In the context of financial supervision, excessive centralization can create bottlenecks, delay responses, overburden supervisory authorities, and limit the ability of lower organizational units to respond to operational risks. Conversely, poorly governed decentralization can generate inconsistent implementation and weakened accountability. The challenge is thus to create a supervisory architecture in which authority is distributed sufficiently to enable timely action while standards, data systems, and accountability remain integrated.

The relationship among governance structure, technological infrastructure, and supervisory effectiveness is also relevant to Islamic banking systems. Islamic banking introduces additional requirements relating to Sharia compliance, contractual structures, and institutional arrangements for ensuring that banking products and operations conform to Islamic principles. Iranian scholarship has long emphasized the need for an appropriate Sharia supervisory model at the national banking-system level, indicating that supervisory architecture should reflect the substantive characteristics of the financial system it governs [19]. More recent socio-legal analysis of Islamic banking supervision in Indonesia has similarly emphasized the importance of integrated supervision and the interaction between formal regulatory institutions and Islamic governance requirements [20]. These perspectives suggest that effective supervision cannot simply be imported from another jurisdiction; it must be institutionally compatible with the legal, organizational, financial, and normative characteristics of the national banking system.

Supervisory effectiveness is also closely connected with financial stability. The European experience, particularly under centralized banking supervision, has generated substantial interest in whether stronger supranational supervision can contribute to more stable financial institutions through harmonized standards, improved monitoring, and reduced supervisory fragmentation [21]. This experience has broader relevance because it illustrates the importance of institutional coordination and supervisory consistency in financial systems characterized by interconnected banking organizations. At the same time, periods of extraordinary disruption demonstrate that supervisory frameworks must retain sufficient flexibility to respond to systemic shocks. During the COVID-19 pandemic, regulators and bank supervisors had to reconcile prudential objectives with the need to sustain lending, provide regulatory relief, and maintain financial-system functioning under exceptional economic conditions [22]. Such episodes reveal that supervision is inherently dynamic: its effectiveness depends on the ability to preserve prudential discipline while adapting rules and monitoring priorities to rapidly changing conditions.

These developments collectively suggest that contemporary banking supervision should be understood as a multidimensional system integrating financial control, operational monitoring, risk-based prioritization, governance, technological capacity, regulatory enforcement, and institutional coordination. For state-controlled banks, the issue may be particularly significant because ownership structure can add layers of public accountability and administrative complexity to conventional prudential concerns. When managerial discretion, public resources, regulatory obligations, and political or administrative relationships intersect, supervisory mechanisms must be capable of ensuring both financial soundness and operational integrity. The efficiency effects of regulation and supervision further indicate that more regulation is not necessarily equivalent to better regulation; instead, supervisory quality depends on appropriate institutional design, reliable information, and effective monitoring mechanisms [1]. Likewise, the interaction between supervisory policies and banks' risk-taking demonstrates the

need to consider behavioral responses to regulatory actions rather than treating supervision as a purely mechanical process [6].

Against this background, electronic banking can be conceptualized as more than a service-delivery mechanism. When effectively integrated into supervisory structures, it can provide standardized transaction records, facilitate data accessibility, accelerate reporting, strengthen auditability, limit unnecessary face-to-face discretion, and improve the capacity of supervisors to identify inconsistencies between authorized procedures and actual banking activities. These attributes create a plausible mechanism through which electronic banking can strengthen the relationship between financial and operational supervision and corruption reduction. The conceptual model presented in the underlying manuscript similarly treats electronic banking as a mediating component connecting supervisory and organizational arrangements with the reduction of banking corruption. This interpretation is consistent with wider developments in technology-enabled financial supervision, including digital monitoring [14], big-data-based supervisory analysis [15], AI-supported compliance and auditing [16, 17], and embedded supervision [18].

Nevertheless, technological modernization must be accompanied by appropriate governance, internal controls, regulatory clarity, and supervisory competence. Recent banking crises demonstrate that sophisticated financial systems remain vulnerable when rapidly changing risk profiles are not adequately captured by supervisory practices [4]. Similarly, the evolution of bank regulation after the global financial crisis indicates that effective supervision requires continuous reassessment rather than reliance on static regulatory arrangements [2]. In the Iranian context, this need is reinforced by calls for stronger legal foundations for central-bank supervision [7], better governance and credit-unit oversight [8], more effective arrangements for operational supervision [9], and risk-based supervisory models tailored to banks and credit institutions [10, 11]. The capacity to detect excessive credit developments also remains an important part of preventive supervision and crisis anticipation [12].

Accordingly, a significant research need exists for an integrated explanation of how financial and operational supervision can be structured in Iran's state-controlled banking sector and how electronic banking may translate supervisory arrangements into stronger corruption-control outcomes. Existing scholarship has examined regulation and supervisory efficiency [1], liquidity creation [5], risk-taking [6], financial stability [21], crisis-related supervisory challenges [4, 22], digital transformation [13], and technology-based monitoring [14, 15, 18]. Other studies have contributed important insights into Islamic and national supervisory architecture [19, 20] and Iran-specific legal, governance, credit-risk, and risk-based supervisory requirements [7, 8, 11, 12]. Yet these strands need to be connected within a framework that simultaneously addresses financial supervision, operational supervision, electronic banking, organizational decentralization, and corruption reduction in state-controlled banks.

Therefore, the aim of the present study was to determine the factors constituting a financial and operational supervision model for Iran's state-controlled banks and to examine the mediating role of electronic banking in the relationship between supervisory arrangements and the reduction of banking corruption.

2. Methods and Materials

This study is applied in terms of its objectives and is descriptive (survey-based) regarding the nature and method of data collection. Additionally, it is classified as correlational research in terms of the relationships between variables. The research's geographical scope encompasses all employees of the Central Bank and state-owned banks. The statistical population of this study includes all employees of the Central Bank and state banks, totaling 63,079 individuals. Using Cochran's formula and stratified random sampling method, a sample of 382 individuals

was selected as the statistical sample members. For data collection and assessment in this research, the standard questionnaire for financial and operational supervision by Pintarich and Iravani (2013) was utilized, with a reliability coefficient of 0.80, and the standard questionnaire for the implementation of electronic banking by Rezai Kia (2013), with a reliability coefficient of 0.85. To measure the validity of the items, the content validity ratios and the construct validity were assessed, with the operational and financial supervision scale by Sharifi and Zhang (2009) having a validity coefficient of 0.90.

3. Findings and Results

According to the results regarding the frequency of gender, 18% (or 313 individuals) of the respondents were women, with the lowest number of respondents being 69 women, constituting 1.81%. Based on the age frequency results, most participants in the study were men (99%) aged between 35 and 46 years, totaling 36 individuals (or 43%). The least represented group was individuals aged 55 and above, with 167 individuals (or 58%). In terms of educational qualifications, the majority of participants held a bachelor's degree, totaling 224 individuals (or 62%), while the least number had doctoral degrees, totaling 10 individuals (or 12%). Regarding marital status, 87% of the participants were married, comprising 334 individuals (or 84%), while the smallest group consisted of 48 single individuals (or 6%).

In factor analysis, it is first necessary to ensure whether the existing data can be used for analysis or not. This purpose is served by the KMO index and Bartlett's test.

Table 1: Sample Adequacy

Index	KMO	Bartlett's Test Chi-Square	Degrees of Freedom	Significance Level
Questionnaire	0.852	336.297	36	0.000

Since the KMO index value is 0.793 (an adequate value is more than 0.6), the sample size for factor analysis is sufficient. Furthermore, the significance level of Bartlett's test is less than 0.05, which indicates that factor analysis is suitable for identifying the structure and an appropriate factor model.

To indicate whether the distribution of variables is normal or non-normal, the Kolmogorov-Smirnov (K-S) test was used. If the significance level is greater than 0.05, the distribution is normal; otherwise, it is not.

Table 2: Kolmogorov-Smirnov Test Results for Normality of Data Distribution

Dimension	Sample Size	Kolmogorov-Smirnov	Significance Level
Operational Supervision	382	1.021	0.134
Electronic Banking	382	1.022	0.130
Financial Supervision	382	1.012	0.198

According to Table 2, the test results show that all variables examined have a normal distribution.

Before conducting the structural model test, a correlation matrix of the research variables was presented to examine the relationships between them, as shown in the following table.

Table 3: Correlation Matrix of Research Variables

Research Variable	Government Decentralization	Establishment of E-Government	Reduction of Administrative Corruption
Operational Supervision	1	0.823	0.709
Electronic Banking	...	1	0.831
Financial Supervision	...	...	1

According to Table 3, all the variables in the study have significant correlations with each other. The software output, based on standardized coefficients, is presented as follows.

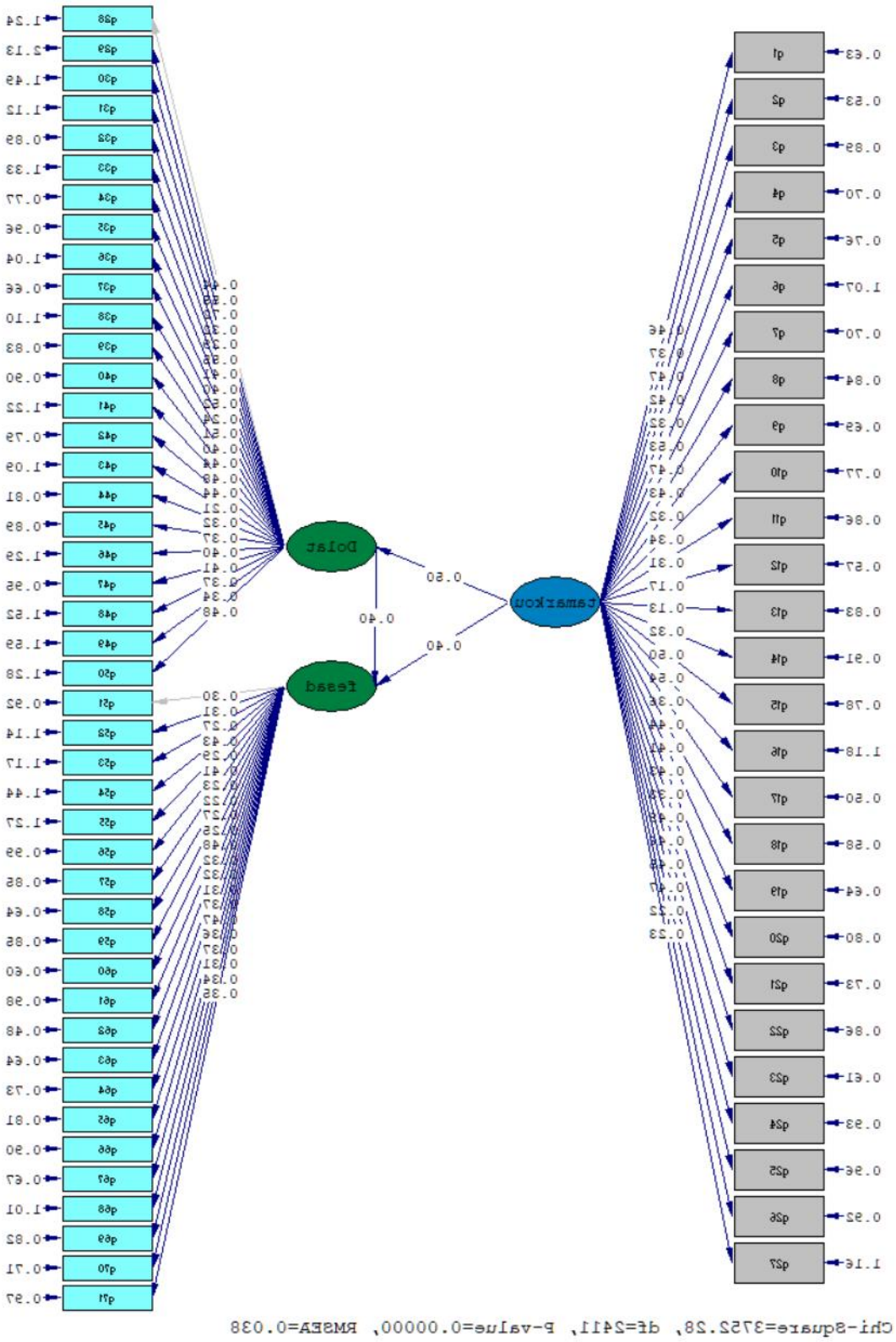


Figure 2: Software Output Based on Standardized Coefficients

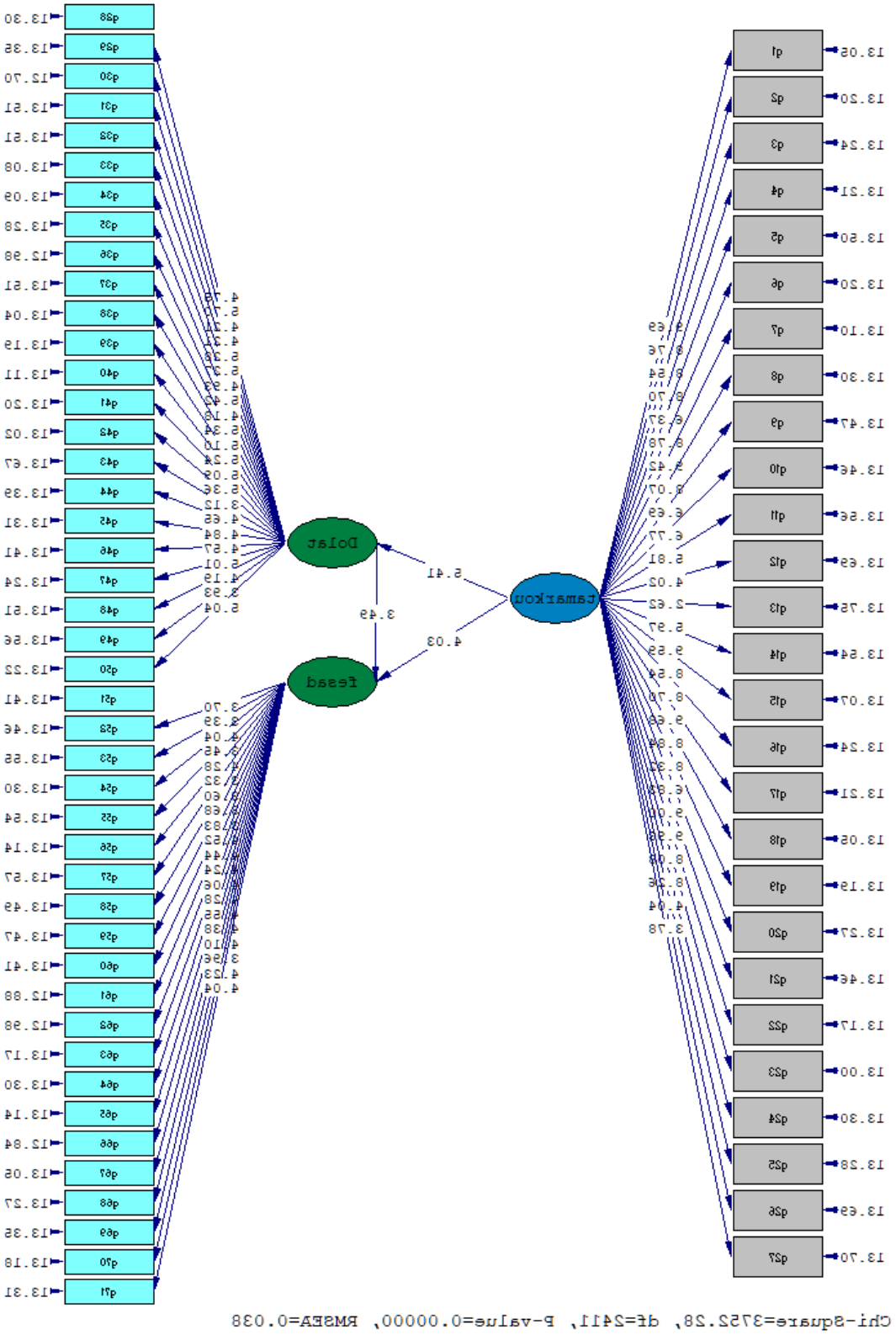


Figure 3: Software Output Based on Coefficients

Main Question: What are the determining factors for the financial and operational oversight model in the country's banking industry?

Table 4: Estimation of coefficients for the indirect effects of financial and operational oversight on reducing banking corruption with the mediating role of implementing electronic banking.

VAF	Independent Variable	Mediating Variable	Dependent Variable	Significant Figure
0.60	Financial and Operational Oversight	Electronic Banking Implementation	Banking Corruption Reduction	4.246

Based on the table above and using the Sobel test, the significance of the effect of government decentralization on reducing administrative corruption, with the mediating role of electronic banking implementation (more than 1.96), indicates that the null hypothesis is rejected, with a 95% confidence level. This shows a meaningful mediating role, with a VAF value of 0.60, representing the intensity of the impact. Therefore, it can be concluded that implementing electronic banking has had a positive influence on the effect of financial and operational oversight in reducing banking corruption.

First Sub-Question: What are the weaknesses in financial and operational oversight by regulatory bodies in the banking sector?

Table 5: Estimation of Direct Effect Coefficients

Variable	Variable	T-Statistic	Coefficient
Reduction of Bank Corruption	Financial Oversight	4.03	0.40

As shown in Table 5, the significance coefficient for the effect of financial oversight on reducing corruption in state-owned banks exceeds 96, indicating that this relationship is statistically significant. Thus, the null hypothesis is rejected, and it can be concluded that decentralization through the implementation of electronic banking impacts the reduction of bank corruption in state-owned banks. Moreover, based on the path coefficients, we can assert that decentralization through financial and operational oversight has an effect on reducing bank corruption in state-owned banks. Specifically, with a one-unit increase in electronic banking decentralization, bank corruption in state-owned banks decreases by 0.40 units.

Second Sub-Question: What are the factors influencing financial and operational oversight by regulatory bodies in the banking sector?

A significance coefficient of more than 96 for the implementation of electronic banking in reducing bank corruption in state-owned banks indicates that this relationship is statistically significant. Therefore, the null hypothesis is rejected, leading to the conclusion that the implementation of electronic banking has an impact on reducing bank corruption in state-owned banks. Moreover, based on the path coefficients, it can be stated that the implementation of electronic banking influences the reduction of bank corruption in state-owned banks. Specifically, a one-unit increase in the implementation of electronic banking is associated with a reduction in bank corruption in state-owned banks by 0.40 units.

Third Sub-Question: What are the practical measures for financial and operational oversight by regulatory bodies in the banking sector?

A significance coefficient of more than 96 for the financial and operational oversight of the central bank on the implementation of electronic banking in state-owned banks indicates that this relationship is statistically significant. Thus, the null hypothesis is rejected, allowing us to conclude that financial and operational oversight has an impact on the implementation of electronic banking within state-owned banking. Additionally, based on the path coefficients, it can be asserted that electronic banking influences the establishment of electronic oversight in state-owned banks. Specifically, a one-unit increase in the decentralization of financial and operational oversight results in an increase in the implementation of electronic banking in state-owned banks by 0.50 units.

4. Discussion and Conclusion

The present study examined the determinants of a financial and operational supervision model in Iran's state-controlled banking sector, with particular emphasis on the mediating role of electronic banking in reducing banking corruption. Overall, the findings confirmed meaningful relationships among financial and operational supervision, electronic banking implementation, and corruption reduction. Most importantly, electronic banking played a significant mediating role in the relationship between financial and operational supervision and the reduction of banking corruption. The Sobel statistic for the indirect effect was 4.246, exceeding the critical value of 1.96, while the variance accounted for (VAF) was 0.60. This indicates that a substantial proportion of the influence of financial and operational supervision on corruption reduction operated through electronic banking. The findings therefore suggest that the effectiveness of banking supervision should not be conceptualized merely in terms of formal monitoring or inspection mechanisms; rather, supervisory effectiveness appears to depend substantially on the technological infrastructure through which banking activities are recorded, communicated, monitored, and evaluated.

The significant mediating role of electronic banking can be explained by the capacity of digital banking systems to increase transparency, traceability, standardization, and accessibility of financial information. In traditional banking environments, supervision may depend heavily on periodic reports, manual documentation, face-to-face processes, and institution-specific information flows. These characteristics can create informational delays and opportunities for discretionary intervention, concealment, or manipulation. Electronic banking systems, by contrast, create digital transaction trails and facilitate the structured storage and retrieval of operational and financial data. This interpretation is consistent with Ivanitsky et al., who emphasized the role of digital technologies in strengthening financial-market monitoring and supervisory activities by increasing the availability and timeliness of regulatory information [14]. Similarly, the application of big data and machine-learning techniques to banking supervision allows supervisory authorities to identify irregular transactions, anomalous patterns, and emerging risk concentrations more efficiently than traditional inspection alone [15]. Thus, electronic banking can be considered an enabling infrastructure through which financial and operational supervision becomes more continuous, information-rich, and resistant to manipulation.

The mediation result also aligns with the broader logic of embedded supervision. Auer argued that advances in digital finance may allow regulatory requirements and supervisory access to be incorporated directly into technological infrastructures, thereby reducing dependence on delayed or selectively prepared reports [18]. Although the banking environment examined in the present study is not equivalent to blockchain-based financial architecture, the underlying supervisory principle is comparable. When transactions, credit processes, commitments, and other financial activities are electronically recorded and made accessible to authorized supervisory bodies, the informational distance between the bank and the regulator is reduced. Supervisors may therefore obtain a more accurate understanding of operational realities rather than relying solely on aggregated or periodically disclosed information. In this sense, electronic banking does not simply automate customer services; it can transform the architecture of supervision itself by making financial activity more observable and auditable.

Another important finding was that financial supervision significantly contributed to the reduction of corruption in state-controlled banks. The reported path coefficient was 0.40, with a t-statistic of 4.03, indicating a statistically significant relationship. This result supports the proposition that robust financial oversight can reduce opportunities for inappropriate allocation of bank resources, manipulation of credit decisions, concealment of

problematic exposures, and non-compliance with regulatory standards. Financial supervision establishes mechanisms through which capital adequacy, credit quality, liquidity, financial reporting, loan performance, and other prudential dimensions can be reviewed systematically. Where supervision is credible and accompanied by enforceable accountability, the expected costs associated with misconduct increase and opportunities for irregular behavior become more limited.

This finding is consistent with the international literature demonstrating that the architecture and quality of banking regulation and supervision influence institutional conduct and financial-system performance. Barth et al. found that regulation, supervisory structures, and monitoring mechanisms can affect bank efficiency, although their effectiveness depends on how such arrangements are designed and implemented [1]. Anginer et al. similarly emphasized that, following the global financial crisis, effective supervisory powers, prudential requirements, disclosure, and market discipline remained essential for the resilience of banking institutions [2]. The present finding extends this logic to corruption reduction in state-controlled banks: financial supervision is not only relevant for solvency or systemic stability but can also function as an institutional mechanism for reducing opportunities for financial misconduct.

The finding can also be interpreted in light of Iranian banking conditions. The effectiveness of financial supervision depends on the legal authority, institutional capacity, and enforcement mechanisms available to the supervisory authority. Tavakoli et al. highlighted the significance of the legal dimensions of the Central Bank's supervisory role within Iran's banking system and the necessity of a coherent regulatory framework for effective oversight [7]. Similarly, Nik Ghalb et al. emphasized the importance of corporate governance and effective supervision within bank credit units, where weaknesses in control and accountability may expose institutions to inappropriate credit decisions and related risks [8]. The current findings are consistent with these perspectives because they indicate that strengthened supervision can contribute to corruption reduction by improving control over banking decisions and increasing the accountability of organizational actors.

The findings concerning supervision are also compatible with the emerging risk-based approach to banking oversight in Iran. Mousavi Ivanaki et al. developed a risk-based supervision model for banks and credit institutions and emphasized the importance of identifying risks systematically rather than applying identical supervisory intensity to all activities and institutions [10]. A related Iranian study also highlighted the multidimensional structure of risk-based supervision and the need to integrate supervisory determinants within a coherent regulatory framework [10]. More recently, structural equation modeling has provided empirical support for the development of a risk-based supervisory model appropriate for banks and credit institutions [11]. From this perspective, the significant association between financial and operational supervision and corruption reduction found in the present study may reflect the broader principle that supervisory resources are more effective when directed toward areas where the probability and consequences of misconduct are greatest.

A further finding demonstrated that implementation of electronic banking significantly affected the reduction of banking corruption. According to the study results, a one-unit increase in electronic banking implementation was associated with a 0.40-unit improvement in the reduction of banking corruption. This relationship may be explained by several interconnected mechanisms. First, electronic processes reduce reliance on informal or undocumented transactions. Second, digital systems can standardize procedures, making deviations from normal patterns easier to identify. Third, automated records facilitate retrospective auditing and attribution of responsibility. Fourth, electronic banking can reduce unnecessary direct interactions between bank employees and customers, thereby narrowing circumstances in which discretionary decisions might be exploited. Finally,

integration of electronic banking databases can provide supervisors with faster access to operational information and thereby strengthen preventive rather than merely corrective monitoring.

The growing use of artificial intelligence and advanced analytics in banking supervision further supports this interpretation. Shirali et al. emphasized that AI can enhance supervisory and auditing capabilities through improved data analysis, anomaly detection, and evaluation of complex banking processes, although such applications also create new legal concerns [16]. Calderón similarly discussed regulatory compliance and supervision in an AI-based environment and drew attention to the increasing importance of automated technologies in financial monitoring [17]. These developments suggest that the effect observed in the present study may become stronger as electronic banking evolves from basic transaction digitization toward integrated supervisory technology, automated compliance systems, and data-driven risk monitoring. Nevertheless, technological systems must be governed carefully because automation without appropriate accountability, security, and data governance could create new forms of operational and regulatory risk.

The present finding is also consistent with broader changes in the nature of banking supervision resulting from digital transformation. McCaul emphasized that digitalization is reshaping banks' business models, risk profiles, operational processes, and technological dependencies, thereby requiring supervisory authorities to develop corresponding capabilities [13]. Digitalization therefore creates both an opportunity and an obligation for supervisory transformation. The results of the present study suggest that electronic banking can contribute to corruption control when its technological advantages are connected to financial and operational supervision. However, if supervisory authorities lack access to electronic data, analytical capability, interoperable information systems, or sufficient technical expertise, digitization alone may not produce meaningful improvements in accountability.

The study also found that financial and operational supervision significantly influenced the implementation of electronic banking. Specifically, a one-unit increase in the decentralization of financial and operational supervision was associated with a 0.50-unit increase in electronic banking implementation. This finding indicates that the relationship between supervision and technology is reciprocal in organizational terms: electronic banking facilitates supervision, but supervisory requirements can themselves promote the adoption and institutionalization of electronic banking systems. When regulators require standardized reporting, timely disclosure, transaction traceability, continuous access to operational information, and stronger controls, banks have greater incentives to digitize their processes. Consequently, supervisory modernization can operate as a driver of technological modernization within the banking sector.

This interpretation is consistent with studies showing that supervision increasingly depends on technologically supported, risk-sensitive information systems. Jagtiani et al. noted that big data and machine learning can significantly reshape how supervisors analyze banks and prioritize regulatory attention [15]. Likewise, Ivanitsky et al. demonstrated the growing relevance of digital technologies for financial-market monitoring [14]. The contemporary supervisory environment is therefore moving away from isolated institutional inspection toward interconnected systems in which data are continuously produced by banking operations and subsequently utilized for oversight. This transition may be particularly relevant for state-controlled banks because technological standardization can reduce variation in implementation and facilitate centralized comparison while permitting operational monitoring across organizational units.

The results can additionally be understood in relation to financial stability and crisis prevention. Effective supervision is expected not only to control misconduct but also to detect excessive risk accumulation. Afzali et al.

demonstrated the relevance of the Basel credit gap as an instrument for banking supervision and crisis prediction in Iran [12]. Such indicators require reliable, timely, and comprehensive financial information, highlighting again the connection between digital information systems and supervisory capacity. International research has likewise shown that supervision interacts with banks' risk-taking behavior [6] and liquidity-creation activities [5]. Accordingly, strengthened financial and operational supervision supported by electronic banking may simultaneously contribute to corruption reduction and broader prudential objectives.

Recent banking crises further reinforce the need for such an integrated approach. Fagetan's analysis of the 2023 banking crisis emphasized emerging supervisory challenges associated with rapid financial-market changes, liquidity pressures, technological interconnectedness, and accelerated information transmission [4]. The post-crisis experience of Iceland similarly demonstrated that credible supervisory reconstruction is critical for rebuilding confidence in the financial system [3]. During extraordinary disruptions such as the COVID-19 pandemic, supervisory institutions were also required to balance prudential discipline against temporary regulatory flexibility and financial-sector support [22]. These studies collectively support the present study's implication that supervision must be adaptable, data-driven, and technologically equipped rather than static and solely compliance-oriented.

The institutional context of Islamic banking adds another dimension to the interpretation of the findings. Mousavian and Meysami emphasized that the supervisory architecture of Islamic banks must account for Sharia requirements in addition to conventional prudential and operational concerns [19]. More recently, Berlianty et al. showed that integrated supervision in Islamic banking requires coordination between regulatory and socio-legal dimensions rather than fragmented oversight [20]. These observations are relevant to Iran because financial and operational supervisory mechanisms must operate within an Islamic banking framework while simultaneously meeting contemporary demands for risk management, technological transparency, and corruption control. The effectiveness of electronic banking as a supervisory mediator may therefore depend partly on the extent to which digital systems are designed to capture both conventional banking risks and the specific regulatory requirements of Islamic financial operations.

The finding regarding the importance of coordinated supervision also accords with evidence concerning centralized supervisory systems and financial stability. Rahmani's analysis of European Central Bank supervision highlighted the potential contribution of integrated supervisory mechanisms to financial stability through more consistent regulatory standards and coordinated monitoring [21]. Although the institutional structure of Iran differs substantially from that of the European banking union, the principle of coordinated and information-based supervision remains relevant. At the operational level, Tabatabaei and Mohammadi further demonstrated that different approaches to supervising banking facilities, including outsourcing arrangements, require systematic evaluation to determine their effectiveness [9]. Therefore, the present results support an integrated supervisory framework in which institutional responsibilities, technological infrastructure, risk analysis, and accountability mechanisms operate in a mutually reinforcing manner.

Taken together, the results indicate that corruption reduction in state-controlled banking cannot be attributed to a single regulatory instrument. Rather, it appears to emerge from the interaction between supervisory quality and technological capability. Financial and operational supervision establish the rules, controls, responsibilities, and monitoring expectations required to constrain misconduct, whereas electronic banking provides the informational and technological infrastructure through which these supervisory expectations can be translated into more transparent and traceable banking practices. This integrated interpretation is consistent with the contemporary shift

toward risk-based supervision [11], digitally enabled supervision [13], data-intensive monitoring [15], and technologically embedded compliance [18]. Therefore, the study contributes to the literature by showing that electronic banking should be regarded not only as an operational innovation but also as an important institutional mechanism connecting supervision with corruption reduction in Iran's state-controlled banks.

Several limitations should be considered when interpreting the findings. First, the study used a cross-sectional and correlational design; therefore, although the structural relationships were statistically significant, definitive causal conclusions cannot be drawn. Second, the study relied primarily on questionnaire-based self-report data, which may be affected by social desirability, response bias, organizational sensitivity, and respondents' willingness to report perceptions related to supervision and corruption. Third, the sample was drawn from employees of the Central Bank and state-controlled banks, which limits the generalizability of the findings to private banks, non-bank credit institutions, fintech companies, and other segments of the Iranian financial system. Fourth, banking corruption is a complex and sensitive phenomenon that may include forms of misconduct that are difficult to measure accurately through perceptual questionnaires. Finally, the study examined electronic banking as a general mediating construct and did not distinguish among specific technologies, such as automated compliance systems, online supervisory dashboards, artificial intelligence, big-data analytics, or real-time transaction-monitoring platforms.

Future studies should examine the proposed relationships using longitudinal designs to determine whether improvements in supervisory systems and electronic banking precede measurable reductions in corruption over time. Comparative research involving state-controlled and private banks would help identify whether ownership structure changes the strength of the relationships among supervision, digitalization, and corruption reduction. Researchers should also test the model in other financial institutions and across different provinces or national banking systems to evaluate its external validity. Further studies could separate financial supervision from operational supervision and examine their direct and indirect effects independently. In addition, specific dimensions of electronic banking and supervisory technology—including artificial intelligence, real-time monitoring, digital audit trails, automated regulatory reporting, data integration, and fraud-detection systems—could be modeled as distinct mediators or moderators. Mixed-method and qualitative investigations involving supervisors, bank managers, auditors, compliance officers, and technology specialists may also clarify the organizational mechanisms through which digital supervision succeeds or fails.

Banking policymakers and supervisory authorities should develop an integrated supervisory infrastructure that links financial and operational oversight directly with electronic banking databases and real-time information systems. Standardized reporting protocols should be established across state-controlled banks so that supervisory bodies can compare credit activities, commitments, non-performing exposures, unusual transactions, and compliance indicators using consistent data definitions. Supervisory access to relevant electronic records should be timely, secure, and sufficiently detailed to enable early detection of irregularities rather than relying primarily on retrospective inspections. Banks should strengthen automated audit trails, segregation of duties, access controls, transaction authorization procedures, and digital documentation of credit decisions. Training programs should also be provided for supervisors and bank employees to improve competencies in data analysis, digital risk management, regulatory technology, and corruption detection. Finally, supervisory reforms should combine technological modernization with clear accountability structures, consistent regulatory enforcement, transparent procedures, and coordinated responsibilities among the Central Bank, state-controlled banks, internal audit units, and other competent oversight institutions.

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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