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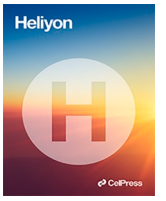

Research article

Influence of blockchain and artificial intelligence on audit quality: Evidence from Turkey

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ABSTRACT

This study aims to investigate the influence of blockchain and artificial intelligence on the audit quality of firms from Turkey. Primary data from 300 respondents are collected through random sampling to attain the study's objectives. PLS-SEM is used to investigate the relationship between exogenous and endogenous variables. Our findings show that blockchain technologies and artificial intelligence (AI) utilization in their financial system positively impact audit quality by assisting in the audit process and the detection of fraud, which also improves financial reporting. Blockchain and Artificial Intelligence in the financial system create confidence for investors, stakeholders, and legislators. Moreover, this study advocated significant implications for investors, government, firms, and policymakers. Investors can make investment decisions based on the accuracy of the financial accounts; the government and policymakers can improve the governance mechanism by using the study's findings.

1. Introduction

Audits play a vital role in ensuring compliance with laws, regulations, and accounting standards. Companies are subject to various regulatory requirements and must adhere to accounting principles and reporting frameworks [1]. High-quality audits provide independent assurance that these compliance requirements are met, reducing the risk of penalties, legal consequences, or reputational damage [2]. Quality audits contribute to effective corporate governance by holding management accountable and independently assessing the company's financial reporting [3]. By examining internal controls and risk management processes, audits help identify weaknesses and areas for improvement, enhancing organizational transparency and accountability. Audits protect the interests of various stakeholders, including employees, customers, suppliers, and lenders [4]. By assuring the accuracy and reliability of financial statements, audits help safeguard the investments, jobs, and contractual relationships associated with a company. This promotes trust and stability in the business environment.

Auditing quality is an interesting research problem and is influenced by many factors such as the blockchain, Artificial Intelligence, professional skepticism, auditor independence, audit firm size, regulatory environment, technological advancements, and the adoption of innovative audit tools. Professional skepticism plays a pivotal role in audit quality [5]. Auditor independence, ensuring auditors maintain an unbiased stance, is fundamental for objective and reliable audit outcomes [6]. The audit firm size has been identified as a factor, with larger firms often having more resources and expertise to deliver higher-quality audits [7]. The regulatory environment

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and oversight mechanisms significantly impact audit quality, as stringent regulations and effective oversight contribute to a more robust auditing process [8]. Technological advancements and the adoption of innovative audit tools have emerged as crucial factors shaping audit quality in the contemporary business landscape [9]. Understanding the intricate interplay of these factors is essential for advancing research and enhancing the overall quality and effectiveness of auditing practices. Therefore, these factors are widely discussed in the previous literature in different demographic contexts but lack the investigation on Artificial Intelligence (AI) and blockchain technology in relation to audit quality in the modern world.

However, Artificial Intelligence (AI) and blockchain technology have the potential to significantly impact audit quality as this gap identified by Ref. [10] that the blockchain affects the accounting process while AI affects the audit process and provide directly to investigate both blockchain and AI impact on the audit quality instead of the audit process. However, AI analyzes vast amounts of data quickly and efficiently. Auditors use AI-powered tools to perform advanced data analytics and identify patterns, anomalies, and trends in financial data. This enables auditors to gain deeper insights, identify potential risks, and focus their efforts on areas that require further investigation, ultimately improving the quality and effectiveness of the audit [11]. Automation also enables auditors to review larger data sets, increasing the scope of the audit and enhancing its quality [12]. Therefore, it is important to investigate the influence of both blockchain and Artificial Intelligence on audit quality, especially in emerging market firms.

Our study comprises two main objectives. The first objective is to investigate the influence of blockchain technologies on audit quality in the auditing process. The second objective includes the investigation of the influence of the Artificial Intelligence (AI) used in the audit process on the audit quality. These two objectives are being investigated by employing different statistical methods and surveys in the context of Turkey.

Our findings show that blockchain technologies and artificial intelligence (AI) utilization in their financial system positively impact audit quality by assisting in the audit process, assisting in the timely detection of fraud, and improving financial reporting. Blockchains and Artificial Intelligence in the financial system create confidence for investors, stakeholders, and legislators. Moreover, this study advocated significant implications for investors, government, firms, and policymakers.

Our study contributed to the existing body of knowledge by providing insights into the application and implications of AI and blockchain technologies in the audit profession, especially in Turkey. It highlighted how these technologies influence audit quality, improve efficiency, enhance fraud detection, and strengthen corporate governance practices. This study identifies best practices and guidelines for integrating AI and blockchain into the audit process. It can provide valuable recommendations on how auditing firms can leverage these technologies effectively, address implementation challenges, and ensure compliance with regulatory requirements. The findings of the study offered evidence-based insights to policymakers and regulatory bodies. It helped policymakers understand the potential benefits and risks associated with the adoption of AI and blockchain in auditing. By exploring the impact of AI and blockchain on audit quality, the study contributed to the enhancement of audit practices. It highlighted opportunities to leverage technology for automation, data analytics, and continuous auditing. The findings also guided auditors in leveraging AI and blockchain to improve risk assessment, fraud detection, and overall audit effectiveness. The research provided recommendations for maintaining auditor independence, ensuring data privacy, and upholding professional skepticism in the context of AI and blockchain integration. Finally, the study has the potential to provide valuable insights, recommendations, and implications for the audit profession, regulatory bodies, and other stakeholders and contribute to the advancement of knowledge, inform decision-making, and foster the effective and responsible adoption of these technologies in auditing.

The rest of the paper is structured as follows: Section 2 provides a review of the related literature and the theoretical background. Section 3 explains the methodology used in this study. Section 4 presents the datasets used and reports the main empirical findings with their discussion. Section 5 discusses the conclusion and recommendations, and policy implications are also discussed in section 5.

2. Literature review and theoretical framework

When discussing the impact of artificial Intelligence (AI) and blockchain on audit quality, several theories and frameworks provide a foundation for research and analysis. Agency theory examines the relationship between principals (such as shareholders) and agents (such as management) and focuses on aligning their interests. In the context of audit quality, this theory can be used to explore how AI and blockchain technologies can help reduce information asymmetry, mitigate agency conflicts, and enhance the monitoring and accountability of management. The technology acceptance model (TAM) explores the factors influencing individuals' acceptance and adoption of new technologies [13]. It can be applied to investigate auditors' attitudes and perceptions toward AI and blockchain and their willingness to integrate these technologies into audit procedures. TAM can identify factors that may facilitate or hinder the adoption of AI and blockchain in auditing and contribute to understanding the human aspects of technology implementation. The diffusion of innovations theory examines how new ideas, technologies, or innovations spread and are adopted within a social system [14]. In the context of AI and blockchain in auditing, the diffusion of innovations theory can help understand the factors that influence the adoption and diffusion of these technologies across auditing firms, regulatory bodies, and other stakeholders in the audit ecosystem. Control theory focuses on the mechanisms and processes used to ensure an organization achieves its objectives. Within the context of audit quality and technology adoption, this theory can be used to explore how AI and blockchain technologies provide enhanced controls, such as automated checks, real-time monitoring, and data integrity verification. It can examine how these technologies strengthen the control environment and contribute to improved audit quality [15]. Institutional theory examines how social and cultural norms, rules, and structures influence organizations and individuals. In the context of AI and blockchain in auditing, institutional theory can be used to explore the external pressures and institutional forces that drive or impede the adoption and acceptance of these technologies in the audit profession. It can shed light on the role of professional bodies, regulatory bodies, and industry norms in shaping the use of AI and blockchain in audits [16].

These generally accepted theories provide us with the theoretical frameworks for understanding and analyzing the adoption, impact, and implications of AI and blockchain in audit quality. We draw upon these theories to guide their investigations and provide theoretical grounding to their research findings. Moreover, the Technology Acceptance Model provides the most abundant support to the study in different contexts. However, the Technology Acceptance Model has found widespread application in audit quality, acting as a theoretical framework for understanding auditors' acceptance of technology and its consequences for audit process performance. TAM characteristics, notably perceived ease of use and perceived usefulness, have regularly been shown in research to shape auditors' attitudes and intentions about adopting new technologies [17]. [18] stated that the auditors' perceptions of the ease with which technology may be integrated into their work and the perceived benefits of these technological tools influence their acceptability and utilization. According to Ref. [19], a positive relationship between favorable TAM characteristics and technology adoption has been connected to audit quality improvements ranging from improved data analysis efficiency to more effective risk assessments and decision-making procedures.

[17] investigated additional aspects impacting auditors' adoption of technology in the context of audit quality and the main TAM characteristics. Training and education initiatives targeted at enhancing auditors' technological skills and the compatibility of new technology with established audit methods are among these variables [20]. Previous studies such as [20] give useful insights into the complicated interplay between auditor perceptions, technological adoption, and the resultant impact on audit quality by studying these intricacies. Overall, the use of TAM psychology in audit quality has contributed to a better understanding of the dynamics surrounding technology acceptance within the auditing profession, shedding light on improving audit processes and outcomes through effective integration of technological innovations.

2.1. Blockchain and audit quality

Several studies have examined the potential implications of blockchain technology for improving audit quality. According to Ref. [21], blockchain technologies affect audit quality because they have great potential to benefit auditors and the audit firm by detecting fraud and saving time. Audit quality can be achieved through blockchain utilization in the process [22]. He also concluded that blockchain technologies had a positive impact on audit quality due to the reduction of errors and reduced time consumption. The chances of mistakes are reduced by using blockchains [23]. In contrast [24], found the opposite findings and concluded that using blockchain technologies reduces the quality due to the misutilization and unskilled professionals, which have a negative impact.

Blockchain technology provides a decentralized and immutable ledger where transactions are recorded and verified [25]. This feature ensures data integrity and reduces the risk of manipulation or fraudulent activities. Studies suggest that blockchain can enhance the reliability and accuracy of financial information, leading to improved audit quality by providing auditors with a trustworthy data source [23]. Blockchain's real-time recording and transparency allow for continuous auditing, enabling auditors to access up-to-date and accurate information [26]. This enhances the timeliness of audits, reduces information asymmetry, and provides auditors with a more complete and precise understanding of a company's financial position [27]. Blockchain's transparent and traceable nature enhances the audit trail [26]. Each transaction recorded on the blockchain leaves an immutable digital footprint, enabling auditors to reconstruct the sequence of events and verify the accuracy of transactions. This strengthens accountability and transparency within the audit process, improving audit quality [9]. Blockchain can automate and streamline audit processes, reducing the reliance on manual and time-consuming tasks. By enabling secure and efficient data sharing between auditors, companies, and regulators, blockchain can enhance the efficiency of audit procedures, resulting in cost savings [28]. Improved efficiency allows auditors to allocate more resources to risk assessment, fraud detection, and other critical audit activities, ultimately improving audit quality [29].

Smart contracts, which are self-executing agreements stored on the blockchain, offer potential benefits for audits [30]. Auditing smart contracts can provide real-time verification of compliance with contractual obligations and ensure accuracy in financial transactions [31]. Research suggests that using blockchain in auditing smart contracts can enhance transparency, reduce errors, and improve audit quality [32].

Despite the potential benefits, previous literature also highlights some challenges and limitations of blockchain in audit quality [33]. These include scalability concerns, regulatory and legal uncertainties, privacy issues, technical complexities, and the need for standardized protocols and frameworks. Addressing these challenges is crucial for realizing the full potential of blockchain in enhancing audit quality [34]. As technology evolves and adoption increases, further research is needed to provide more robust evidence and insights into the implications of blockchain for audit quality [35].

Blockchain simplifies and streamlines audit procedures by automating data verification and reconciliation processes. Instead of relying on manual data collection and reconciliation, auditors can access real-time transaction data stored on the blockchain [36]. This automation reduces errors, saves time, and improves the efficiency of audits, enabling auditors to focus on higher-value tasks such as risk assessment and analysis.

The real-time nature of blockchain enables continuous auditing, where auditors can monitor transactions and financial activities in real-time [37]. This allows auditors to identify anomalies or irregularities promptly and take appropriate actions. Real-time auditing improves fraud detection capabilities and enables auditors to provide timely insights to stakeholders, enhancing the overall audit quality [29]. On the ground of the previous literature, we developed the following hypothesis.

Hypothesis (1). Blockchain technology utilization has a positive impact on audit quality by providing auditorial assistance during the audit process.

2.2. Artificial intelligence (AI) and audit quality

There is a large amount of evidence in the literature about the benefits of using artificial intelligence (AI) in finance and economics, especially in the audit process. According to Ref. [38], AI improves the audit quality by detecting the frauds. Previous literature has extensively examined the impact of artificial intelligence (AI) on audit quality. AI technologies, such as machine learning and data mining algorithms, have shown the potential to improve auditors' analytical capabilities [39]. [40]. has found that AI-based data analytics tools can enhance the effectiveness and efficiency of audits, leading to improved audit quality. AI can automate repetitive and time-consuming audit tasks, such as data entry, data validation, and documentation. This automation reduces the risk of human error and allows auditors to focus on more complex and judgment-based activities [41]. [42] has shown that the automation of routine tasks through AI can enhance audit quality by improving accuracy, increasing efficiency, and freeing up auditors' time for higher-value activities. AI enables continuous auditing and monitoring of financial transactions and systems. Through real-time data analysis and monitoring, AI can promptly identify potential risks or anomalies [15]. This continuous monitoring capability enhances auditors' ability to detect and respond to emerging risks, contributing to improved audit quality by reducing information asymmetry and providing timely insights to stakeholders [43]. AI can support auditors in conducting more accurate risk assessments and predicting potential audit risks [43]. By leveraging historical data, industry trends, and advanced predictive analytics techniques, AI can identify areas of higher audit risk and help auditors prioritize their efforts accordingly [44]. suggests that AI-based risk assessment tools can enhance audit quality by improving risk identification, resource allocation, and audit planning.

AI-powered decision support systems can assist auditors in complex decision-making processes. These systems can provide auditors with real-time insights, recommendations, and risk assessments based on advanced algorithms and data analysis [45]. [46] has shown that AI-based decision support systems can improve auditors' decision-making accuracy and contribute to better audit quality. Moreover, previous literature suggests that AI has the potential to enhance audit quality by improving analytical capabilities, automating routine tasks, enabling continuous auditing, supporting risk assessment, and providing decision support [47]. However, further research and practical implementation are needed to fully understand and realize the benefits of AI in improving audit quality and addressing associated challenges.

Hypothesis: *The use of Artificial Intelligence (AI) has a positive impact on the audit quality by providing support during the audit process.*

The conceptual framework provides the roadmap of the research. The independent variables and dependent variables are shown in the figure. Fig. 1 shows the conceptual framework of the study.

3. Material and methods

To meet the study's objective, we used different dimensions of blockchain technology, as used by Ref. [48], and the exact dimensions are used to measure blockchain technology in another study [22]. We used the most significant eight dimensions on the grounds of the multiple factors related to technological, economic, and societal issues. The technical dimension, for example, includes scalability, security, and interoperability [49]. The economic factor entails assessing cost-effectiveness, efficiency improvements, and the possibility of disintermediation in diverse businesses [50]. Interorganizational trust, a social component, is critical for comprehending the impact of blockchain on participant interactions [51]. Governance and regulatory compliance are two more social elements to consider when looking at the role of governments and regulatory organizations in regulating blockchain applications [52]. The environmental dimension investigates blockchain network energy consumption and sustainability [53]. User experience, which investigates the usability and accessibility of blockchain apps, and the legal dimension, which addresses issues such as smart contract enforceability and intellectual property rights, are additional dimensions [54]. Moreover, the questions related to these dimensions are based on the 5 Likert scale.

Moreover, thirteen different dimensions are used to measure the influence of artificial intelligence (AI), as measured by Refs. [38, 55]. Similarly, we used the 13 dimensions measuring the AI. Accuracy, interpretability, and scalability are all technical elements of AI [56]. Fairness, accountability, and transparency are all ethical factors [57]. The influence on employment and the potential for AI to

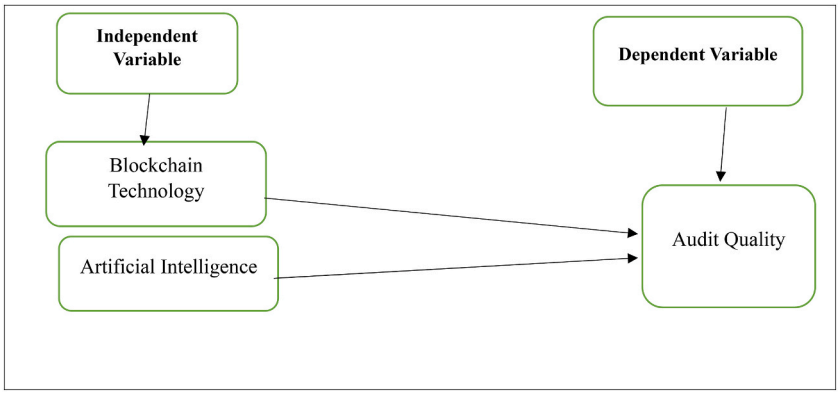

Fig. 1. Conceptual framework.

aggravate or alleviate existing inequities are dimensions. The legal dimension investigates legislative frameworks that regulate AI applications as well as liability and responsibility issues [58]. Another component is human-AI collaboration, which assesses how well AI systems integrate with human decision-making processes. Security and privacy concerns are critical elements to address when addressing potential vulnerabilities and protecting sensitive data. Furthermore, the environmental impact of AI technologies, energy usage, and sustainability concerns are becoming more widely acknowledged [59]. Moreover, the questions related to these dimensions are based on the 5 Likert scale.

Audit quality is also measured through nine different dimensions as measured by Ref. [60]. These dimensions are auditor independence, professional skepticism, competency, due professional care, ethical behavior, transparency, audit firm size, regulatory compliance, and reporting accuracy, which is all important considerations. These factors jointly contribute to the audit process's dependability, credibility, and effectiveness. Moreover, the questions related to these dimensions are based on the 5 Likert scale.

Random sampling techniques collect the data of the 300 respondents from 100 different firms. Random sampling is applied from all sectors working in Turkey. The three people from each firm are selected on the grounds of removing the data biases. The selection of the 3 different people from each organization is based on the three levels, such as top, middle and lower level, because Top-level management data is essential for understanding strategic decisions, resource allocations, and the overall organizational vision regarding the integration of AI and blockchain in audit processes. Middle-level management data helps in assessing how these technologies are implemented, coordinated, and monitored within specific departments or functional areas. Lower-level operational data provides insights into the day-to-day use of AI and blockchain technologies in audit procedures, potential challenges faced by staff, and the practical implications for the quality of audit outcomes. A comprehensive approach that incorporates data from all levels ensures a nuanced understanding of the organizational, managerial, and operational dynamics, leading to more effective strategies for leveraging these technologies to enhance audit quality. The questionnaire method is used for the descriptive study. Moreover, different statistical tools such as exploratory factor analysis, confirmatory analysis, reliability and validity tests, discriminant, and convergent are applied to attain our research objectives. These statistical tools are more reliable and provide accurate directions and intensity of the relationship between the variables.

4. Findings and discussion

4.1. Results and findings

In Table 1, the indirect and total effect is given, which indicates less than 0.50, which shows the accurate and valid effect of the variables in the regression. Moreover, Table 2 describes the loading of each variable of the Blockchains and the Artificial Intelligence (AI). The weight for the variable is given in Table 3. Some assumptions would be necessary for the accuracy of the models' fitness.

The correlation matrix in Table 4 shows that all the correlation values are less than 80 %, which means that there is a low level of correlation between the endogenous and exogenous variables, and the assumption for the statistical analysis is fulfilled. There is a 66.2 % correlation between audit quality and AI. Moreover, there is a 60.6 % correlation between blockchains and the AI. The covariance between the variables is shown in Table 5.

In Table 6, reliability and validity, the Cronbach's Alpha value is sufficient. It is greater than 0.90, which shows that construct reliability and validity exist between the variables and fit for the regression. If their values are less than 0.50, then we have to validate our data first, and we can conclude using quantitative methods. Table 7 also represents the discriminant validity criteria that also shows the reliability. Moreover, Table 8 provides the cross-loadings of the variables.

Table 9 represents the multicollinearity test results through Heterotrait- Monotrait Ratio (HTMT)

That is favorable and shows no multicollinearity exists between the variables. Moreover, Table 10 provides the VIF values for each dimension that is used as a measurement.

All the tests discussed previously are satisfied, and Fig. 2 shows the diagram of the measurement model that shows the model loadings and validity of the estimations in the study.

Table 11 shows that the Chi-Square is favorable, showing the model fitness. Moreover, our results are shown in Table 12, indicating that artificial Intelligence (AI) has a significant positive at a 1 % level of significance, indicating that AI improves audit quality by assisting in the way of the financial record maintenance and the auditing process. It also means that when the utilization of AI in the financial system of firms leads to a rise in the 0.584 audit quality. Moreover, Blockchain technologies also have a significant positive impact at a 1 % level of significance, indicating that the blockchain also positively influences audit quality. Audit quality improved through the utilization of blockchain technologies. Moreover, Fig. 3 shows the diagram of the structural model.

Table 1
Indirect effect and the total effect.

Indirect Effects	Artificial intelligence_	Audit Quality_	Blockchain Technology_
Artificial intelligence_	–	0.465	–
Audit Quality_	–	–	–
Blockchain Technology_	–	0.325	–
Total Effects			
Artificial intelligence_	–	0.465	–
Audit Quality_	–	–	–
Blockchain Technology_	–	0.325	–

Table 2
Loading of the variables.

Loadings	Artificial intelligence_	Audit Quality_	Blockchain Technology_
AI1	0.793		
AI10	0.622		
AI11	0.782		
AI12	0.740		
AI13	0.724		
AI2	0.760		
AI3	0.749		
AI4	0.806		
AI5_	0.683		
AI6	0.706		
AI7	0.698		
AI8	0.798		
AI9	0.755		
AQ1_		0.715	
AQ2		0.759	
AQ3		0.766	
AQ4		0.804	
AQ5		0.751	
AQ6		0.769	
AQ7		0.749	
AQ8		0.770	
AQ9		0.825	
BC1_			0.734
BC2			0.649
BC3			0.787
BC4_			0.810
BC5_			0.784
BC6_			0.780
BC7_			0.808
BC8_			0.777

Table 3
Weight of the variable used in regression.

Outer Weights	Artificial intelligence_	Audit Quality_	Blockchain Technology_
AI1	0.118		
AI10	0.078		
AI11	0.114		
AI12	0.088		
AI13	0.103		
AI2	0.105		
AI3	0.103		
AI4	0.113		
AI5_	0.110		
AI6	0.112		
AI7	0.090		
AI8	0.108		
AI9	0.102		
AQ1_		0.128	
AQ2		0.134	
AQ3		0.137	
AQ4		0.138	
AQ5		0.125	
AQ6		0.156	
AQ7		0.147	
AQ8		0.170	
AQ9		0.164	
BC1_			0.195
BC2			0.139
BC3			0.166
BC4_			0.156
BC5_			0.150
BC6_			0.148
BC7_			0.178
BC8_			0.172

Table 4
Correlation matrix.

Latent Variable Correlations	Artificial intelligence_	Audit Quality_	Blockchain Technology_
Artificial intelligence_	1.000		
Audit Quality_	0.662	1.000	
Blockchain Technology_	0.606	0.607	1.000

Table 5
Covariance among variables.

Latent Variable Covariances	Artificial intelligence_	Audit Quality_	Blockchain Technology_
Artificial intelligence_	1.000		
Audit Quality_	0.662	1.000	
Blockchain Technology_	0.606	0.607	1.000

Table 6
Reliability and validity Test.

Construct Reliability and Validity	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Artificial intelligence_	0.931	0.934	0.940	0.550
Audit Quality_	0.913	0.917	0.928	0.590
Blockchain Technology_	0.900	0.903	0.920	0.589

Table 7
Discriminant validity.

Fornell-Larcker Criterion: Discriminant Validity	Artificial intelligence_	Audit Quality_	Blockchain Technology_
Artificial intelligence_	0.741		
Audit Quality_	0.662	0.768	
Blockchain Technology_	0.606	0.607	0.768

4.2. Discussion

The incorporation of cutting-edge technologies such as big data, machine learning (ML), Artificial Intelligence (AI), and blockchain into the accounting domain has resulted in substantial changes to the accounting profession [61]. These developments have resulted in the reengineering of accounting procedures, reduced accounting information mistakes and distortions, increased accounting efficiency, and promoted a paradigm shift in the structure of accounting careers [62]. Blockchain technology has demonstrated the potential to improve audit quality through its unique features and capabilities. Our research findings concluded that blockchains provide transparency and immutability, which are essential for ensuring the integrity of financial data. The decentralized nature of blockchain networks ensures that all transactions are recorded transparently and tamper-resistantly [63]. This transparency reduces the likelihood of fraudulent activities going undetected, as multiple network participants can trace and verify every transaction [64].

Additionally, using smart contracts on blockchain platforms enables the automation of audit processes [65]. Smart contracts are self-executing contracts with the terms of the agreement directly written into code [66]. They can be programmed to trigger predefined actions based on specific conditions, streamlining and automating various audit procedures [67]. This type of automation reduces the potential for human error and increases the efficiency and accuracy of audits.

Furthermore, blockchain technology facilitates real-time monitoring and detection of anomalies or suspicious activities [68]. By continuously recording and updating transactions on the blockchain, auditors can access up-to-date and reliable information for analysis [69]. This enables timely identification of potential frauds or irregularities, enhancing the effectiveness of audit procedures.

Previous studies have explored the benefits of blockchain in auditing. In this way, our findings are similar to the findings of [10], who concluded that blockchain technology can improve audit efficiency, accuracy, and effectiveness by providing a reliable and tamper-resistant audit trail. Moreover, our findings are consistent with the previous findings [70], and they also concluded that blockchain-enabled audits can enhance transparency, reduce fraud risks, and improve the reliability of financial reporting.

Moreover, previous findings indicate that blockchains can improve audit quality by assisting and facilitating the timely detection of fraud [71]. In this way, we contributed to the existing literature in the text of the country Turkey. Similarly, blockchain technology's transparency, immutability, automation, and real-time monitoring capabilities contribute to enhanced audit efficiency, accuracy, and effectiveness, ultimately benefiting the accounting profession as a whole [10].

Our findings show that artificial intelligence positively impacts audit quality by improving the systematic change in the audit

Table 8
Cross Loading of variables.

Cross Loadings	Artificial intelligence_	Audit Quality_	Blockchain Technology_
AI1	0.793	0.557	0.519
AI10	0.622	0.369	0.333
AI11	0.782	0.535	0.472
AI12	0.740	0.416	0.368
AI13	0.724	0.485	0.493
AI2	0.760	0.495	0.462
AI3	0.749	0.483	0.403
AI4	0.806	0.534	0.502
AI5_	0.683	0.516	0.439
AI6	0.706	0.528	0.434
AI7	0.698	0.422	0.449
AI8	0.798	0.508	0.487
AI9	0.755	0.480	0.441
AQ1_	0.457	0.715	0.393
AQ2	0.455	0.759	0.446
AQ3	0.501	0.766	0.405
AQ4	0.475	0.804	0.453
AQ5	0.427	0.751	0.416
AQ6	0.550	0.769	0.491
AQ7	0.492	0.749	0.500
AQ8	0.600	0.770	0.536
AQ9	0.576	0.825	0.520
BC1_	0.495	0.551	0.734
BC2	0.352	0.394	0.649
BC3	0.458	0.470	0.787
BC4_	0.465	0.440	0.810
BC5_	0.440	0.424	0.784
BC6_	0.448	0.420	0.780
BC7_	0.562	0.503	0.808
BC8_	0.468	0.486	0.777

Table 9
Multicollinearity test.

Heterotrait- Monotrait Ratio (HTMT)	Artificial intelligence_	Audit Quality_	Blockchain Technology_
Artificial intelligence_			
Audit Quality_	0.707		
Blockchain Technology_	0.653	0.658	

Table 10
VIF values.

Outer VIF Values	VIF	Outer VIF Values	VIF
AI1	2.524	AQ3	2.121
AI10	1.775	AQ4	2.514
AI11	2.462	AQ5	2.052
AI12	2.29	AQ6	2.042
AI13	2.141	AQ7	1.984
AI2	2.319	AQ8	2.037
AI3	2.052	AQ9	2.536
AI4	2.535	BC1_	1.755
AI5_	1.916	BC2	1.492
AI6	1.937	BC3	2.2
AI7	2.138	BC4_	2.504
AI8	3.221	BC5_	2.343
AI9	2.389	BC6_	2.16
AQ1_	1.957	BC7_	2.273
AQ2	2.207	BC8_	2.023

process. Moreover, artificial intelligence (AI) has shown great potential in improving audit quality through its ability to provide assistance and timely detection of fraud. Previous research and findings support this notion [72]. One of the key ways AI enhances audit quality is by analyzing large volumes of data. AI-powered algorithms can process vast amounts of financial data quickly and accurately, identifying patterns, anomalies, and potential fraud indicators. This enables auditors to focus on high-risk areas and

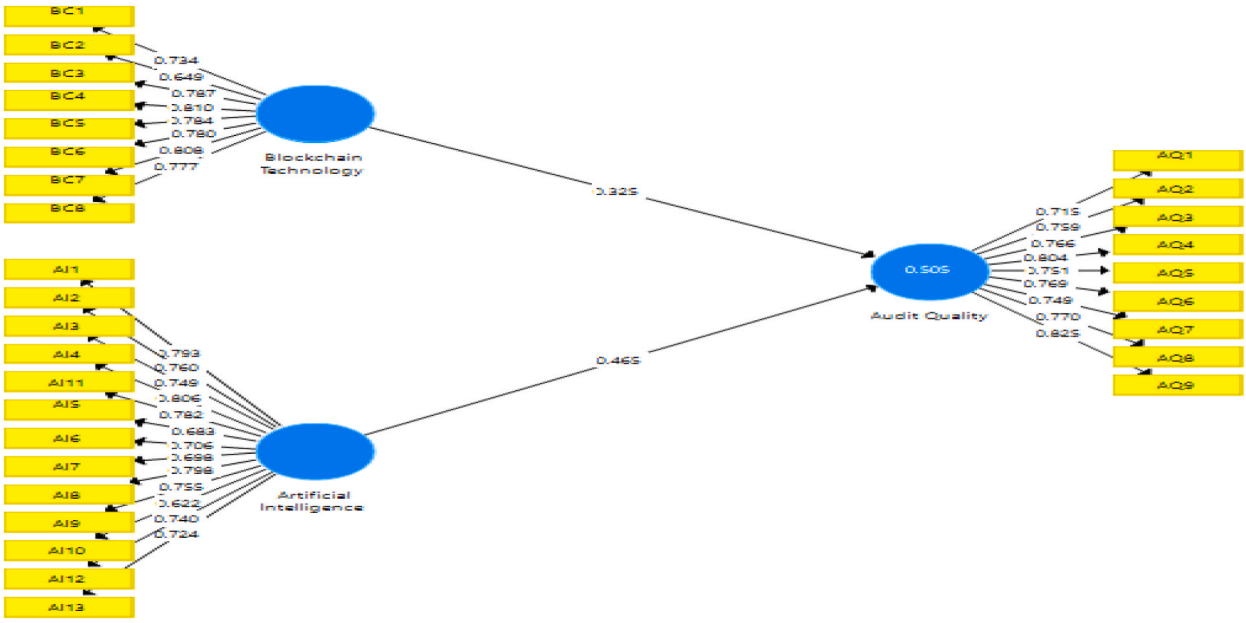

Fig. 2. Measurement model.

Table 11
Summary of model fitness.

	Saturated Model	Estimated Model
SRMR	0.058	0.058
d_ULS	1.552	1.552
d_G	0.704	0.704
Chi-Square	1250.07	1250.07
NFI	0.837	0.837

Table 12
Testing of hypothesis.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Artificial Intelligence_ - > Audit Quality_	0.465	0.469	0.055	8.472	0.000
Blockchain Technology_ - > Audit Quality_	0.325	0.326	0.060	5.456	0.000
	Original Sample (O)	Sample Mean (M)	2.5 %	97.5 %	
Artificial Intelligence_ - > Audit Quality_	0.465	0.469	0.367	0.584	
Blockchain Technology_ - > Audit Quality_	0.325	0.326	0.199	0.435	

allocate resources more efficiently.

Moreover, AI can aid auditors in identifying previously unknown fraud patterns by applying advanced analytics techniques [73]. Machine learning algorithms can learn from historical data to identify complex fraud schemes and detect suspicious activities that may go unnoticed through traditional audit methods. This proactive approach allows auditors to stay ahead of fraudulent practices and respond swiftly. Furthermore, AI-based technologies can continuously monitor transactions and detect potential fraud in real-time. By leveraging techniques such as anomaly detection and predictive analytics, AI systems can flag unusual or suspicious transactions as they occur, enabling auditors to intervene promptly. This timely detection helps minimize the financial impact of fraud and enhances the overall effectiveness of audits. Several studies have explored the benefits of AI in auditing. Our findings are consistent with the previous findings of [38], who concluded that AI-powered techniques, such as natural language processing and machine learning, can improve audit quality by increasing the effectiveness of fraud detection.

5. Conclusion and recommendations

Our findings show that AI improves audit quality by providing assistance and timely fraud detection. AI's data analysis capabilities, ability to identify complex fraud patterns, and real-time monitoring contribute to more effective and efficient audits. As AI advances, it holds tremendous potential to enhance auditing practices' overall quality and effectiveness. This study provides specific insights into

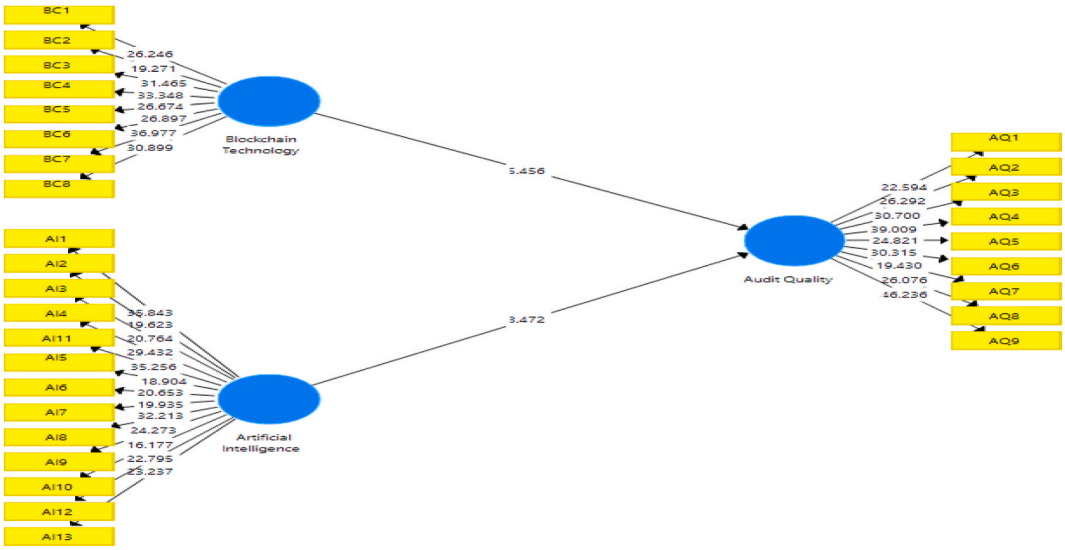

Fig. 3. Structural model.

the implications of these technologies within Turkey and also other varieties of implications for investors, management, stakeholders, and policymakers. The study assessed the level of adoption and readiness of Turkish auditing firms to embrace blockchain and AI technologies. It identified the factors influencing the adoption process, including organizational culture, infrastructure, resources, and regulatory environment. Understanding the current state of technology adoption in Turkey sheds light on the potential implications for audit quality.

The implications of blockchain and AI on fraud detection and risk assessment practices in Turkish audits can be explored. The study assessed how these technologies improve the ability to detect and prevent fraud, including identifying unusual patterns, real-time monitoring of transactions, and using predictive analytics. It can also examine the impact of risk assessment methodologies and the ability to assess risks accurately. The investor can invest by seeing the audit quality of the firms within Turkey to protect their investment, and the government can make the legislation in the weakness and delayed audit without enjoying the blockchain technologies and the other factors. Future research should be conducted on the efficiency of blockchain technology that is effective in the accounting system and preparation of the financial system that makes it easier for the technologies to improve the audit quality. Some more Blockchain units should be included in further research. Due to the limitation, we included one economy in our investigation; future research should include more than one and compare each economy, the use, and the efficiency of the artificial intelligence system.

Data availability statement

Data are available on the demand.

Ethics statement

The study complies with all regulations and informed consent was obtained from the participants in collecting the samples. This study will not cause privacy or personal harm to the respondents, and there is no ethical risk. This study has been approved by Academic Ethics and Morals Committee of Lebanese French university, Kurdistan region, Iraq (ethical number: DAR/21903069/Saeed).

CRediT authorship contribution statement

Khowanas Saeed Qader: Writing – review & editing, Writing – original draft, Resources, Methodology, Formal analysis, Data curation, Conceptualization. **Kemal Cek:** Validation, Supervision, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e30166.

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