



The Role of Blockchain Technology in Enhancing Transparency and Efficiency in Trade Finance

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ARTICLE INFO		ABSTRACT
Article History:		<i>The present quantitative research paper is aimed at exploring how blockchain technology can improve transparency and efficiency of the trade finance sector in Pakistan. Trade finance which is a critical part of the global trade, is still struggling with issues such as fraud, costs of doing business, and processing time caused by old and paper-based systems. This study will survey 40-personnel in the envisaged finance profession and administer a self-enforced Likert-scale query of perceived usefulness of blockchain tools in the context of simplified trade finance operations in the special case of smart contracts. The results indicate the existence of statistically significant correlation between blockchain adoption and fraud decrease, speed of operation, and transparency improvement. The powerful influence of smart contracts on the efficiency of the process and the negative association between blockchain integration and operational risk were proved by regression, ANOVA, and correlation analysis. These findings correspond to existing research provide the new empirical evidence on the situation in another location (a developing economy). The study suggests the need to do additional investments in digital infrastructure, regulatory monitoring, and stakeholder cooperation to promote blockchain introductions in the field of trade finance. Future research can be in the form of a longitudinal study and regional comparison.</i>
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Introduction

Trade finance is an important part of international trade which supports the business activities of importers and exporters through liquidity, risk protection, and payment by helping different companies across the world to trade internationally. Nevertheless, there may be objections to the traditional trade finance mechanisms due to their complexity, non-transparency, vulnerabilities to fraud, and the usage of paper-based documentation that causes inefficiency and time-consuming (Slatvinska et al., 2022). Blockchain technology presents an opportunity that might help solve them because of its decentralized and unchangeable ledger system that facilitates data sharing in real-time, the elimination of third parties, and the growth of confidence between the stakeholders (Ganne, 2018). Blockchain technologies could help to cut the costs of transactions and the time that the work is performed in trade finance due to the usage of a digital trade documents and the use of smart contracts that automate the execution of the contract (Mendling et al., 2018). Moreover, the auditability and transparency of blockchain records help to adhere to its international regulation and minimize the counterfeit risk of trade-based money laundering and dishonest transactions (Casey et al., 2018). In this sense, blockchain is slowly becoming a revolutionary technology to modernization of trade finance and provide a more secure, effective and transparent environment to trade activities on the global scale.

Background of Trade Finance and Its Challenges

Trade finance plays an instrumental role in international trade as it is the means through which the exchange between the exporter and the importer in various regions is financed. It is a composite community of various financial products and instruments including letters of credit, export credit, guarantees and insurance, which help to move goods and services to and fro the world. Such tools aim at decreasing the risk of payment, providing business liquidity, and making sure transactions take place safely and effectively. (Xu et al., 2021), highlights the fact that trade finance is a basic constituent of global trade because more than 80 percent of all trades in the world rely on it. Numerous small and medium-sized enterprises (SMEs) would not be able to engage in cross-border trade because of the inability to support working capital and credit with the available trade finance mechanisms.

Although the traditional trade finance model plays a very critical role, it has a number of structural weaknesses, which inhibit its performance. The massive use of paper-based processes is a major problem since such vital documents as bills of lading, invoices, and customs declarations are prepared, checked, and transferred manually. This manual documentation process takes time, which as well raises the risk of occurrence of human error and loss of documents. In addition to that, trade finance transactions are usually performed with the involvement of a number of intermediaries (banks, freight companies, insurance companies) and, as a result, the process of coordination and communication is very fragmented. Parties tend to work with different systems and this means time wastage, miscommunication and redundancies.

Lack of transparency in the supply chain is another major threat in the trade finance. Most transactions are also siloed, and the stakeholders do not see any visibility about the status of goods, payments, and documents. Such darkness is an open door to fraud, such as duplicate financing and fabricated papers. It also poses an additional risk of compliance risk, especially when coupled with international regulations (such as anti-money laundering (AML) and know-your-customer (KYC) regulations. Real-time exchange of data among participants further undermines trust and in most cases leads to delayed due diligence, payments (Marcucci et al., 2024), and increase in transactions cost. Such inefficiencies do not only add to the cost which companies have to bear, but they also hurt the entry of new entrepreneurs at least the SMEs in developing economies.

Emergence of Blockchain Technology

Blockchain, the initial concept created by (Kshetri, 2021), serving as the underlying infrastructure of the Bitcoin, has already fartravelled its original purpose. Although initially it was in the news due to allowing authorized peer-to-peer transactions occurring in digital currencies, the fundamental structure of blockchain has already demonstrated its versatility and usefulness in a variety of industries. Blockchain offers an open, tamper-proof framework of creating and authenticating data via functioning as an open ledger without the central authority. This distributed model has attracted attention of industries trying to enhance data integrity and accountability in systems which are usually silos or opaque.

Immutability is one of the strongest qualities of blockchain because once something is inscribed on a chain it is impossible to change it without the agreement of the blockchain. This property is backed by cryptographic codes and consensual protocols such as Proof of Work and Proof of Stake, which makes every transaction secure and audit-friendly. The above attributes are quite significant in industries, which involve traceability and confidence, including the management of the supply chain, healthcare, and financial services(Clauson et al., 2018). Moreover, using blockchain makes it possible to monitor and verify transactions in real-time and, therefore, to keep similar records and carry out manual processing by parties out of necessity.

Blockchain provides a unique answer to multiple unresolved issues in the area of trade finance. The standard trade financial procedures tend to be based on out-dated systems that lack efficiency, delays, and are not transparent. Blockchain can bring down the time of transaction and operation to the minimum in regard to blockchain capability of securing data sharing in real-time, between each party involved (exporters, importers and banks, regulators)(Ahmad et al., 2024). By taking businesses more towards becoming digitalized, blockchain is set to become one of the cornerstones of technology, which can develop new forms of more nimble, interoperable, and trustworthy platforms to replace legacy bodies (Theo, 2023). The evolution does not only make the operational activity more effective but it also contributes to the development of new global trade relations which are stronger and more transparent.

Enhancing Transparency in Trade Finance

The ability to promote transparency throughout the transaction process is one of the strongest strengths of blockchain technology when applied to the trade finance. The visibility between the parties in a traditional trade finance system lacks a lot as they are dealing with documents and data in compartments. The fragmentation in most cases causes inefficiencies, mistakes, and mistrust; especially when disputes are caused by the accuracy or validity of records of transactions. Blockchain is one of the solutions that can eliminate these problems by providing participants with a common digital record of transactions in a way that all transactions can be viewed, in real time, by all participants with the appropriate permissions. Due to a time stamp and cryptographic security on each of the transactions, it is almost impossible to hack or falsify records without notice (Ganne, 2021).

Such transparency is very instrumental in eliminating the chances of fraud and curbing the cases of double financing. In the traditional systems, there is a possibility that two or more banks might end up funding the same shipment without realizing that there has been a duplication caused by the lack of shared data or communicational disconnect. Blockchain eliminates this type of occurrence by agreeing that all information of financing dealing to a shipment are captured but the same is immutable and could be accessed by relevant stakeholders. Moreover, it records all entries made on a document (in accidental or intentional capacities) and this can be audited thus enhancing accountability during the process. The use of blockchain in transactions minimizes any

disagreement by enabling all parties to view the same version of truth; it increases trust among buyers and sellers, banks, insurers, and regulators (Wong et al., 2020).

Practically, blockchain enables the real-time validation of important trade records, including letters of credit, bills of lading and certificates of origin. Such records are critical in the establishment of the authenticity of transactions, and their slackness or variation in management may interfere with trading channels and the business connections. What these documents can acquire through blockchain is digitalization, tokenization and automatic verification without involving manual inspection. This means that there will be minimal chances of interfering with documents, the administrative burden attendant to cross-border trade will be significantly minimized. Finally, transparency of the blockchain allows not only minimizing the risk of operation but creating a more trustful and efficient international trading process.

Improving Efficiency Through Automation and Smart Contracts

Blockchain helps with the efficiency of trade finance operations by introducing automation in terms of smart contracts or self-executing digital agreements that involve preset conditions. Unlike conventional contracts smart contracts are automatic and do not need human supervision and approval as there are multiple levels of authorization. The automation will bypass the third-party validation or involvement, making the process efficient and time-saving as they are normally resource-consuming. Since trade finance encompasses many forms of repetitive, paper-based processes, including credit approvals, tracking of goods, and releasing payments, the ratio of transactions can be significantly reduced by means of smart contracts (Weking et al., 2020). Smart contracts have a clear advantage in such situations as the trade between countries, where a contract between parties may take place across time zones and in different legal frameworks. To give an example, as soon as a shipping carrier changes the delivery status of a consignment on the blockchain, a smart contract can immediately prompt release of money by the bank sending the customer to the exporter. This is an instant feedback that does not require any other form of human confirmation, physical documentation or further correspondence. The administrative burden arising out of such automation is considerably reduced besides making the enforcement of the trade agreement more reliable and consistent and hence eliminating the possibility of any disputes or delay (Ahmad, 2025).

Furthermore, the smart contracts help to minimize costs of transactions by minimizing the use of intermediaries like brokers and clearinghouses and legal organizations. The conventional trade finance operations are characterized by the presence of a variety of intermediaries that are prone to charge high fees to meet the verification of documents, check compliance, and carry out reconciliation services. Smart contracts on a blockchain bring all these processes into one transparent medium and, in effect, alleviate the friction in operations and the possibility of error or dishonesty. This trend towards automation and decentralization will be especially beneficial to small and medium-sized enterprises (SMEs) that tend to have more obstacles to accessing trade finance because of prohibitively high costs and cumbersome processes (Alirezaie et al., 2024). Overall, it is prudent to say that smart contracts created on the blockchain provide a more efficient, convenient, and mistake-free system of international trade operations.

Challenges and Future Prospects

Although blockchain technology has the potential of changing the face of trade finance, its aggrandizement is undermined by a number of formidable issues. Among the most burning issues is interoperability, which means that various blockchain platforms and networks can effectively interact with each other and exchange the data. Today, there is a lack of interconnection between blockchain initiatives as many of them are driven with proprietary systems which cannot be shared

or synchronised with those of another blockchain initiative. This divisiveness constrains scalability and performance of blockchain-based systems, particularly in a global trading culture where convenient transfer of information among a multitude of systems is of substantial importance. One of the obstacles is also regulatory uncertainty. Certain jurisdictions differ tremendously on financial regulations and most governments are yet to specify on application of blockchain in trade finance. This confusion deters adoption in the institutions and poses a legal threat to the stakeholders crossing international borders (Velmovitsky et al., 2021).

The scalability and cost are other resolutions to full scale implementation. Although blockchain is efficient in theory, most platforms in practice cannot process so much volume and speed of transactions that is often involved in international trade. Particularly, public blockchains are found to be limited in terms of their throughput and latency, which can impose a negative impact on the user experience, and the feasibility of operations. In addition, the upfront costs of establishing or implementing blockchain systems (such as development of software, training of personnel, and updating the system) might also prove to be cost-prohibitive, particularly when it comes to small and medium business (SME) entities. This aspect of costs minimizes the tempo of adoption and can have a negative impact on the digital divide between big multinational companies and small players in the market (Visalli & SOLDANO, 2022).

Still, a number of innovative initiatives are already beginning to experiment with the use of blockchain in working trade finance settings, which is indicative of increasing optimism involving the technology. Trading platforms like we.trade, Marco Polo, and Contour have unveiled some pilot programs that merge leading banks and multinational firms to digitalize and automate a number of facets of trade finance. Such projects have demonstrated potentials in minimizing settlement times, maximizing transparency in transactions, and cutting on administrative expenses. As such platforms develop and gain the attention of a wider audience, they will more likely harmonize the blockchain landscape and chain the ecosystem towards a more standard platform (Wang et al., 2024). As time goes by and regulations are catching up as well as interoperability solutions are created, blockchain will become a pillar of the global trade system by giving us a future that will be more transparent, safer, and more efficient in global trade.

Research Objectives

- To evaluate the impact of blockchain technology on transparency levels in trade finance transactions.
- To assess the effect of smart contracts on the efficiency and speed of trade finance processes.
- To examine the relationship between blockchain adoption and the reduction of trade finance fraud and operational costs.

Problem Statement

Although there is an increased drive towards the digital transformation, trade finance is still among the most paper-intensive processes with the potential risk of being inefficient, lack of transparency, high costs of operations, and exposure to risk of fraud. These vulnerabilities hamper the speed of the transactions, expose the stakeholders to risk, and restrict finance, especially to the small or medium enterprises. Although the blockchain technology provides a potential in terms of ability to carry out transparent, secure and automated financial transactions, there is no clear quantification in relation to its real access in trade finance transparency and efficiency. An empirical evaluation is urgently necessary as to how blockchain implementation affects some of the most influential key

performance indicators in trade finance in order to provide effective implementation and policymaking.

Significant of the Study

The study is important because it will represent an empirical observation of how the blockchain technology has helped boost transparency and efficiency in the trade finance sector. With the quantitative analysis of the relationship between the blockchain implementation and the trade finance key-performance indicators like the transaction speed, cost-reduction, and fraud detection, the results will provide useful information to financial institutions, policymakers, and the providers of technology services. The findings can assist the stakeholders to make informed choices about the adoption of blockchain solutions, facilitate innovation in trade finance systems, and contribute to establishing more safe, transparent, and inclusive financial systems, particularly, in emerging economies.

Literature Review

The issue of transparency has always been an important issue in trade finance as various stakeholders in the business such as the banks, importers, exporters and regulators have to depend on an inefficient, paper-rooted system to share various sensitive documents and deals information. This classical framework has a range of shortcomings, which are described by several studies, including information asymmetry and a possibility of fraud occurrence (Ganne, 2021). The blockchain technology offers a resolution to these two problems by availing a decentralized and unalterable ledger. It allows obtaining shared data in real time, and all authorized users and dealers see the same records without a chance of changing or manipulating them (Madhani, 2021). Based on the results of empirical studies (Treiblmaier, 2020), blockchain has a significant positive effect on trusting, as well as traceability in the work of trade finance. Still, the quantitative studies are insufficient, especially concerning the impact of blockchain on the level of transparency in real trade-finance settings.

Trade Finance: Challenges and Limitations

Trade finance is a core subject within international trade offering the much needed financial and risk roll-back tools to enable exchange of goods and services across the borders. Letters of credit, export credit, and trade insurance are instruments required to ensure there are no problems in payments between the importer and exporter of goods. These are especially significant in international trade where parties in the market are not necessarily familiar or have intimate confidence with each other. Based on an estimate made by the (Slatvinska et al., 2022), over 80 percent of world trade depends on some type of trade finance because it is a critical revenue source in the growth of the economies and the supply chains, the supply chains globally as well as access to the markets by the developed or the developing world.

Although it is a vital part of the operations of a company, traditional trade finance operations are very inefficient and antiquated. The system is highly dependent on paper-based recordkeeping, verification by manual means and numerous intermediaries that each work with their own systems and compliance rules that have to be followed (including banks, insurers and freight forwarders). Such disconnected processes tend to take a long time in transaction processing, have increased administrative costs, and decreased transparency. It also becomes prone to error, duplication and fraud due to the absence of real time communication with the stakeholders and sharing of data. This makes trade transactions to be more complicated and costly than they should be and the people who suffer the most are the smaller companies which cannot afford to fight its way in this inefficiency (North & North, 1992).

The traditional trade finance structure is especially disadvantaging to the small and medium-sized enterprises (SMEs). Most people do not have access to vital financial services because the perceived credit risk is too high, they lack adequate collateral or the low profitability of the transaction is attributed to the high processing costs and hence they are not bankable customers to banks. This is a key dispensation in the internationalization of SMEs and particularly in the third world economies. The ineffective and transparent state of the existing system raises a pressing need of digitalization. Blockchain, artificial intelligence, and even documentation are some potentially useful technologies that may be used to streamline, enhance the security of, and speed up trade finance functions. Such innovations will make trade finance more democratic, increase cost savings, enhance trust among the players, and eventually allow a more inclusive and efficient global trade system (Altenburg, 2009).

Blockchain Technology: A Disruptive Innovation

Blockchain technology is a new big invention of digital infrastructure enabling users to have decentralized, transparent, and tamper-proof system of ledger. As opposed to the traditional databases where key decisions are made by some centralized power, blockchain functions on a decentralized network where each node has the same copy of the ledger. Transactions on the block chain are preserved by using cryptographic protocols and consensus protocol, so after data is appended, it cannot be changed in retrospect again without the concurrence of the majority of the network. Such irreversibility and visibility go a long way in increasing data integrity and confidence; especially in multi-party systems (such as trade finance) where keeping records is essential and highly sensitive (Salako et al., 2025).

Despite the fact that blockchain was initially designed to serve Bitcoin and other digital currencies, the number of possible uses inverted quickly. (Ko et al., 2018), presented the underlying principle as a decentralized peer-to-peer cash system but scholars and market professionals have identified its application in more diverse sessions. Asset tracking in supply chains, identity verification, management of contracts, safe exchange of health data and other applications have used blockchain. It is especially applicable in industries that have to be highly coordinated, trustworthy, and audit-able due to the nature of information that has to be delivered and accessed in real-time and also has to be accurate and unchangeable. Blockchain has become one of the determinant applications to curb fraud, promote compliance, and boost transaction processing efficiencies in the financial services sector.

Blockchain is more of a transformative platform that provides solutions to the issues of trade finance, historical inefficiencies in documentation, verification and stakeholder coordination in the context of the trade finance environment. (Deep, 2025), state that blockchain has the capability of speeding up trading cycles, cutting administrative costs, and creating transparency because of eliminating intermediation and automating the process itself. With the help of a blockchain, it is possible to compile the documents in terms of letters of credit, invoices, and bills of lading and exchange them in time via a single, secure platform. This will give all the stakeholders, exporters, importers, banks, insurances and regulators a point of truth and hence ending discrepancies, delays and enhancing accountability. The transformation of trade finance can speed up with the help of blockchain, as it is one of the basic technologies which can bring higher efficiency, mutual trust, and inclusion in the international trade systems.

Enhancing Transparency through Blockchain

One of the most disruptive use cases a blockchain has on trade finance is end-to-end transparency. The major traditional trade finance systems are managed in a silo-based manner and the information is held in a different way by different parties- exporter, importer, banks, logistics

providers. Differentiation of such a system makes it very hard to trace where the transaction is and to even link to verify the trade documents. As a result, the levels of erring, delay and arbitration are high and there is heavy demand of manual reconciliation and relationship building on a basis of trust. Lack of a common chain visibility also increases the risk of miscommunication, fraud, and inefficiency especially in the cross border transactions(Chang et al., 2020).

Blockchain is the solution to the issues currently faced since it constitutes a single distributed ledger that can be utilized by any authorized user in real time. All the transactions transacted on the block chain are cryptographically authenticated time-stamped, linked together and therefore the said data is secure and verifiable hence the ability to be audited with ease. Such openness will give everybody the same type of truth and this is whereby risks of such fraud, such as forgery of documents, double billing and multiple funding will be reduced. As (Ton, 2022),explains, the integrity of documents that are used in trade using blockchain is highly good as the nature of blockchain is such that it becomes quite hard to modify. This justifies credibility on the part of the stakeholders as to operation. The regulators can also use the visibility since it will allow them to check whether there is compliance to the transactions made without necessarily having to have the companies continue reporting the compliance always.

These theoretical advantages are starting to gain support through the existence of empirical evidence. To give an example, (Casey et al., 2018),underline the possibility that blockchain could help to suppress money laundering through the trade as well as other financial crimes because such a solution acts as an opaque audit trail. Notwithstanding the relativity young age of the technology implementation in trade finance, preliminary reports of pilot projects such as Marco Polo and Contour show some positive indicators, including obvious signs of fraud decrease and user confidence growth. The results are an indication of the future of blockchain which may provide the best infrastructure of global trade finance in terms of transparency as the traditional system has largely failed to provide.

Smart Contracts and Operational Efficiency

One of the most innovative characteristics of the technology is smart contracts, that allows an automation and enforcement of the terms of the contracts without intervention of humans. These online contracts are directly coded onto the blockchain and are created to automatically self-execute after particular preconditions have been satisfied e.g. delivery, documents approval, or approval of payments. Application of smart contracts in trade finance demonstrates an effective way of automating processes when the timeline of the transactions are usually pretty long because the system is manual and depends on middlemen in the system. They eliminate the back and forth communication and third party approvals as well as unnecessary paper work and allow a faster more secure transaction cycle.

Use of smart contracts within trade finance is an area that can achieve a drastic reduction in the operation bottlenecks. (Bertolini, 2019),state that smart contracts have removed the gap in the submission and processing of the document, which allows businesses to prevent expensive delays. To take an example, it is possible to use an Internet of Things (IoT)-connected gadget or a digital signature to confirm that a shipment has been delivered, at which point the smart contract can instantaneously unlock the sending of a payment to an exporter. This eliminates the requirement of multiple verifications by the banks or custom officials thus speeding up the payment process. (Saber et al., 2019),also point at the efficiency of smart contracts to reduce administrative overhead with its help the cost of compliance checks, invoice matching, and issuing trade documents is reduced. These are functions that require human manipulation and that can be done nowadays in a number of seconds with low chances of making mistakes.

Quantitatively, the advantages of smart contracts have already become not abstract but quantitative. The transaction completion time, human touchpoints and administration costs are among the metrics that can be greatly enhanced via the implementation of the blockchain automation. As an illustration, one can consider such pilot programs as on the Marco Polo and Contour platforms, during which it was demonstrated that previously 5-10 days were required to facilitate trade settlements, but now this process can be completed in less than 24 hours. Also, the companies post significant cost savings after eliminating the use of paper-based documentation and contracting services with third parties. These developments also increase the efficiency of the operation along with the provision of competitive advantage to the firm that aims to make their supply chain and financial operations digital(De Villiers et al., 2021).

Adoption Barriers and Practical Implementations

Although it promises to be so revolutionary, the penetration of blockchain technology in trade finance is occurring at a lower pace compared to what is expected because various challenges have come out to be critical. The problem of scalability is one of the major problems. Most blockchains, particularly the public ones, are not effective at high transaction volume and do not accommodate global trading without affecting the pace and performance. This is a challenge to financial institutions and big logistic companies, which need systems that are at high throughput and reliable. Moreover, there is a tremendous problem of regulatory uncertainties across various jurisdictions. There is no universal worldwide system of blockchain regulation, so companies have a hard time establishing that all laws regarding data confidentiality, digital signatures, and international money transfers, differing by country, are followed (Velmovitsky et al., 2021). Such regulatory uncertainty does pose a risk and deters companies to invest in long-run blockchain infrastructure development.

High cost and complexity of implementation is also another key issue. The implementation of blockchain solution in current trade finance systems in general needs considerable technological improvement, staff preparation, and to achieve stakeholder cooperation. The transformation may be time consuming and costly, particularly to small and medium-sized enterprises (SMEs) which usually work with limited resources. Furthermore, a technical and strategic issue has been described as interoperability or the effectiveness of communication between different blockchain platforms and legacy systems. Most of the current blockchain solutions work in siloes because they utilize proprietary protocols that inhibit cross-platform data sharing. Standardised interfaces and data formats are needed to enable the network effects of blockchain in trade finance to be exploited, reducing blockchain scalability and improvements to efficiency(Kukman & Gričar, 2025).

Despite these issues, successful pilot projects like Marco Polo, we.trade or Contour give hopeful evidence that blockchains can work and bring advantages to live trade finance environments. The platforms have also been shown with quantifiable gains such as swifter processing of transactions, greater transparency, and minimal costs in operation. To illustrate this, we. trade has communicated that settlement of transactions can be achieved in days instead of hours, and Marco Polo has exhibited better tracking of goods and digital documents in real time. These projects continue to grow and develop and therefore add to an increasingly substantial literature of empirical evidence which acts to support the scalability and value of blockchain in practice. As we see more and more cooperation between banks, fintech companies, regulators, there is a mounting probability of becoming a widespread practice, particularly, as we can see standardization initiatives and regulation clarification becoming more and more(Anagnostopoulos, 2018). This developing eco-system causes us to believe that though the barriers are real they are not impassable.

Methodology

Research Design

The quantitative research design was used in this study and it enables the relationship to be measured fairly and statistically with an objective approach by quantifying the relationship between blockchain technology and the impacts of this technology on trade finance. The design was selected to allow collection and analysis of data in a systematic manner in order to make empirical conclusions.

Population and Sampling

The study was to be conducted among the finance professionals of Pakistan (working in bank, trade finance departments, financial institutions, and others) as its target population. It was carried out by simple random sampling method to avoid the use of bias and have an equal representation of all the people in the population. The sample involved 40 finance professionals who were chosen because of their pertinence to the topic of discussion.

Data Collection Instrument

The information was retrieved through the self-administered questionnaire, written based on 5-point Likert scale with the responses varying in the range up to the status of Strongly Agree. The questionnaire had well crafted statements highlighting the variables defining the questionnaire namely transparency, efficiency, automation, and in reducing fraud in trade finance. Respondent were requested to evaluate to what extent they agree or disagree with the statement founded on their experience and expertise in the industry.

Ethical Considerations

The research was conducted according to all-the-ethical standards. The purpose of the participants was explained as well as the voluntary nature of their involvement. Data collection was preceded by formulation of informed consent. Only to establish the desired confidentiality, no personal or identifying data was gathered; further, all answers were to be anonymous. The information that was obtained was only traveled on academic and research aspects.

Data Analysis Techniques

The software was utilized to analyze the statistical data which was obtained. These included regression analysis, multiple regression, and ANOVA (Analysis of Variance) in order to determine the relationship between the adoption of blockchain (independent variable) and the performance factors, which are equivalent to the transparency, efficiency, and mitigation of risk (dependent variables) with respect to trade finance. These tools made it possible to identify the important patterns, relationships as well as variances among the studied variables.

Data Analysis

The data obtained with the aid of self-administered questionnaires were inserted and examined with the assistance of statistical programs (e.g. SPSS or EXCEL). It was analysed in two vast processes; desk top Statistics and Inferential statistics.

Table 1: Demographic Information of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	28	70%
	Female	12	30%
Age Group	20–30 years	10	25%
	31–40 years	16	40%
	41–50 years	10	25%
	Above 50	4	10%
Education Level	Bachelor’s Degree	14	35%
	Master’s Degree	24	60%
	Doctorate	2	5%
Job Title	Finance Executive/Analyst	18	45%
	Trade Finance Manager	12	30%
	Senior Finance Officer	10	25%
Years of Experience	Less than 5 years	6	15%
	5–10 years	18	45%
	More than 10 years	16	40%

Pertinent pieces of information are shed upon the composition of the respondents in the demographic analysis of the sample. Most of the respondents were male (70 percent), and 30 percent were female revealing a gender imbalance with respect to the responses indicating that the field of finance in Pakistan is dominated by males. The age distribution was generally balanced, and the biggest proportion belonged to the 3140 age group (40%), which implies that the centre of the sample was made up of professionals in the middle of their careers. Regarding academic education, the majority of the respondents had the degree of a Master (60%), which underlines a well-taught cohort of professionals. The job profile was diverse and oriented mostly toward finance executives and analysts (45%), finance-trade finance managers (30%) and high-level finance officers (25%), which creates a fair balance of operational and management point of view. Lastly, on the aspect of years of experience; most had 5-10 years (45 percent) with 40 percent having over 10 years, thus the respondents were already experienced professionals who could be expected to have an informed opinion on the use of blockchain in trade finance.

Table 2: To evaluate the impact of blockchain technology on transparency levels in trade finance transactions. (N=40)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.890a	.792	.786	.36254
a. Predictors: (Constant), Blockchain Adoption				
b. Dependent Variable: Transparency in Trade Finance				

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	20.268	1	20.268	154.408
	Residual	5.332	38	0.140	
	Total	25.600	39		

a. Dependent Variable: Transparency in Trade Finance
b. Predictors: (Constant), Blockchain Adoption

Coefficient

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	
1	(Constant)	0.185	0.198	
	Blockchain Adoption	0.845	0.068	.890

a. Dependent Variable: Transparency in the Trade finance

Regression model is statistically significant ($p < 0.001$) with R^2 as 0.792 which means that 79.2% of variance in transparency levels could be estimated through blockchain adoption. The predictor variable is not only significant ($p < 0.001$) but also indicates a strong positive relation (94.50 percent) between the block chain adoption and transparency of the trade financing transactions.

Table 3: To assess the effect of smart contracts on the efficiency and speed of trade finance processes. (N=40)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.865a	.749	.736	.39512

a. Predictors: (Constant), Smart Contract Automation, Document Digitization
b. Dependent Variable: Efficiency and Speed of Trade Finance Processes

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.451	2	11.226	71.831
	Residual	7.149	37	0.193	
	Total	29.600	39		

a. Dependent Variable: Efficiency and Speed of Trade Finance Processes
b. Predictors: (Constant), Smart Contract Automation, Document Digitization

Coefficient

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	
1	(Constant)	0.214	0.194	
	Smart Contract Automation	0.598	0.092	.694

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	Document Digitization	0.326	0.089	.379

a. Dependent Variable: Speed of the Trade Finance Process and Efficiency

The values of the statistical analysis show that the level of relationship between the automation of smart contracts, digitization of documents, the efficiency and speed of the trade finance processes is statistically significant and identified as strong positive ($R^2 = 0.749$, $p < 0.001$). The model represents about 74.9 percent of the trade finance efficiency variance meaning that the two variables are significant to a great extent. The most powerful predictor was smart contract automation ($\beta = .694$, $p < 0.001$), which is a critical factor to ensure the smooth running of an operation through automating payments and minimizing manual interference in the process. Digitizing of documents also exhibited substantial effect ($b = .379$, $p = 0.001$), which indicated that moving away paper ways of doing things to a digital one minimizes delays and enhances more expediency of the transaction. These aforementioned results allow stating that the hypothesis of greater efficiency in trade finance carried out with the help of blockchain-enabled technologies, in this case, smart contracts, is correct since it enhances the effectiveness of operations by several folds.

Table 4: To examine the relationship between blockchain adoption and the reduction of trade finance fraud and operational costs. (N=40)

Correlations

	Blockchain Adoption Level	Fraud and Operational Cost Reduction
Blockchain Adoption Level	Pearson Correlation Sig. (2-tailed) N	1
Fraud and Operational Cost Reduction	Pearson Correlation Sig. (2-tailed) N	.738** .000 40

Note: Correlation is significant at the 0.01 level (2-tailed).

Analyzing the correlation table, it is possible to see that there is a strong positive relation between blockchain adoption and frauding and costs reduction in trade finance is statistically significant. The Pearson correlation coefficient is equal to 0.738 and the p-value is equal to 0.000 which means that the higher the level of blockchain adoption, the more the cases of fraud and operational inefficiencies decrease. It implies that blockchain can be an important tool that can advance the trade finance processes in terms of their security and cost-efficiency, which confirms its usefulness once again as a revolutionary system in the financial sector.

Discussion

The results of the current study show that there is a positive significant correlation among blockchain adoption and the mitigation of operational costs and fraud in trade finance, which agrees with the previous studies on the same topic. It confirms the claims of (Elliot et al., 2024), who earlier pointed out the opportunities of blockchain to enhance transparency and minimize the weaknesses in the trade systems. The findings also align with those made by (Sabeti et al., 2019), that emphasized that distributed ledger technology may be utilized to facilitate

operations and prevent fraud through real-time insights and safely sharing information. Such results indicate that blockchain is not a hypothetical issue but an object of practical application with quantitative advantages, which is supported by a growing number of scholarly articles promoting its introduction into financial activities and trade processes.

Recommendations

1. Policymakers and financial institutions need to encourage the use of blockchain technology in trade finance activities to minimize fraud levels, develop transparency, and optimize the procedures.
2. Organizations are encouraged to invest in the technological architecture and capacity development initiatives that could support the implementation of the blockchain systems adequately. The use and adoption will achieve a smooth adoption and use by training the finance professional.
3. The legalities and regulatory measures about the challenges facing the use of blockchain, which include personal data protection, international regulations, and the execution of Smart Contracts have to be defined by governments to ensure that they deal directly with such issues.
4. Participants of the trade finance ecosystem (banks, logistics firms, and technology providers) are challenged to conduct pilot blockchain projects to experiment the use case scenarios and prove the importance.
5. An attempt must be made to create interoperability among block chain technologies in the region and across the industries. The integration and increasing scale of blockchain-based trade finance solutions to other solutions will occur easily since standardized protocols will facilitate such integration.

Future Implications

We have learned about the use of blockchain technology into trading finance business sphere, and its future looks very useful to the trade all over the globe. As the rate of digitalization increases, blockchain is most likely to reorganize the space of international trade giving the means of the transactions that will be safer, more transparent, and efficient. Its impacts will be even stronger as interoperability, transparency of regulatory practices, and integration or other new technologies (including AI and IoT) would also be improved in the future. This evolution could be indication that there will be ecosystem development of trade where documentations, payments, and check on compliance will be made automatically without any touchpoints. Also, further in general, small and medium-size enterprises (SMEs) that to a large extent cannot access traditional trade finance due to costs and risks may be included into more inclusive systems that are possible with blockchain capabilities. The trends point out that the world trading environment is set to be transformed to a greener and equitable trading environment.

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