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Block Chain for Gig Economy Contracts: Trust and Innovation in Freelancing

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Abstract: The gig economy gives independent workers all around flexibility in today's quickly changing employment market; yet, trust deficits, delayed payments, and high intermediary costs in global contracts provide ongoing difficulties. By offering open, tamper-proof contracts that reduce contract conflicts and enable new work arrangements, blockchain-based smart contracts help to transform governance mechanism. Based on a organized survey of 280 cross-border freelancers, this study investigates how blockchain affects openness, trust, cost savings, and adoption hurdles. Using Henry Garrett's ranking methodology, Exploratory Factor Analysis (EFA), and Structural Equation Modeling (SEM), empirical data show that blockchain-enabled trust greatly lowers transaction costs ($\beta = 0.610, p < 0.001$) and directly drives freelancing innovation ($\beta = 0.451, p < 0.001$). Cost cutting helps to negotiate the relationship between trust and innovation ($\beta = 0.212$). However, technical literacy requirements (Garrett Mean Score = 81.33) and cryptocurrency volatility (73.65) emerge as primary impediments, with a significant negative path effect on adoption dependability ($\beta = -0.245, p < 0.001$). Overall, the structural model accounts for 24.5% of the variance in cost reduction ($R^2 = 0.245$), 43.7% in freelancing innovation ($R^2 = 0.437$), and 15.5% in adoption reliability ($R^2 = 0.155$). These findings emphasize the necessity of targeted technical education and stablecoin integration to overcome adoption barriers and establish equitable, decentralized digital labor platforms.

Keyword: Gig economy; Blockchain; Smart contracts; Freelancing trust; Transaction costs; Innovation barriers;

1. Introduction

Historically, employment growth has been shaped multiple times, occasionally with favourable results and occasionally with issues. The start of this revolution was the First Industrial Revolution, which powered mechanical production using steam and water. Although automation during the Third, computers, the internet, and the Internet of Things (IoT) allowed mass production during the Second Industrial Revolution. The Fourth Industrial Revolution is now altering the employment market with physical and digital technologies like blockchain, IoT, and artificial intelligence.

Though these interruptions sometimes present fresh opportunities, they can also restrict possibilities for companies and employees. These changes in the workforce have resulted in a move towards gig employment, a paradigm defined by erratic, flexible work. Giving employees the freedom to choose their own hours, gig work is any act involving task-based or project-based projects. By enabling companies of all sizes to hire brilliant freelancers as needed instead of keeping full-time experts, this agility helps them. Through platform mediation, gig labor helps customers to easily access global talent by means of cross-border connectivity. Still, dependability and trust should be major influences in international negotiations. By guaranteeing honest and transparent agreements between clients and freelancers, blockchain technology's smart contracts are essential in

resolving these problems. Although it shows much promise, technical complexity and regulatory concerns limit acceptance. This study examines how blockchain advances creativity, lowers transaction costs, raises transparency, and resolves adoption hurdles in the worldwide freelance industry. A poll of 280 independent contractors was analyzed using factor analysis and structural equation modeling.

2. Review of Literature

Malik et al. (2021). Work, highlighting the problem of the predominance of asymmetric power and rent-seeking practices of platform owners in conventional freelancing platforms, claims that the application of smart contracts can help to establish an entirely new paradigm of digital collaboration. In this regard, the paper emphasizes that smart contracts allow minimizing transaction costs by replacing centralized platforms, reducing dependence on a particular source of truth, and giving more autonomy to independent workers.

Batool and Byun (2022). Study, investigating the occurrence of payments default and fraud in online freelance platforms, propose a decentralized freelancing application integrating smart contracts and biometric authentication techniques. The research results reveal that the suggested solution helps eliminate fraudulent job orders, disputes, and single-handed freezing of payments to contractors.

John William et al. (2022). Project, aimed at describing the importance of smart contracts in the automation of financial interactions, proves that these tools are useful for a wide range of cooperative initiatives. In this paper, smart contracts are considered as a way to streamline micropayments and autonomous, decentralized disbursements while eliminating the risks of human error and costs of using traditional clearing systems.

Jain et al. (2023). Article, analyzing the potential of peer-to-peer collaborative networks in freelancing contexts, describes a working prototype of a smart contract system that enables independent workers to build an agreement, perform their obligations, and execute payments to each other in a transparent manner. The research findings show that smart contracts can help to minimize the role of a trusted third party in the transaction process.

Spencer-Hicken et al. (2023). Research, discussing the natural limitations of using blockchain systems in decentralized platforms, provides a set of quantitative analysis tools to evaluate the functioning efficiency of smart contract applications. This study assists in identifying the key performance indicators of smart contract platforms, the improvement of which would enable their practical implementation in the freelance industry.

Bennet et al. (2024). Study, shedding light on the benefits of decentralized payments in the context of online collaboration, claims that smart contracts radically reduce the risks of fraud and errors typical of traditional payment processing systems. The research results show that smart contracts offer an improved level of trust and transparency in business cooperation due to the introduction of the highest standards of financial control and protection.

2.1 Research Gap

While recent literature discusses the structural and theoretical benefits of smart contracts in administrative automation, there are very few empirical studies that examine this technology from the perspective of the workers who perform the work. Existent research does not consider the trust levels that freelancers will have in such instruments, their perception of economic efficiency, and their potential resistance to adoption. The purpose of this study is to quantify the potential impact of smart contracts on the abovementioned variables through the application of a structural model.

3. Objectives of the study

1. Examine block chain-based smart contracts' role in improving transparency and trust in cross-border gig economy transactions.
2. Explore block chain's impact on lowering transaction costs and promoting innovation in global freelancing.
3. Identify obstacles to adopting block chain in freelancing.

4. Research Methodology

To formally evaluate the theoretical framework, active overseas freelancers provided primary data. The empirical approach combines a quantitative method including Henry Garrett's Ranking Method (to rank adoption obstacles), Exploratory Factor Analysis (EFA by principal component analysis with Promax rotation to identify underlying constructs), and Structural Equation Modeling (SEM to assess path connections, structural fit, and indirect mediating effects).

5. Research Design

Based on a positivist research framework, this study uses an empirical, cross-sectional, descriptive research approach. Using a standardized, self-administered structured questionnaire with 5-point Likert-scale questions (with 1 = Strong Disagree to 5 = Strong Agree), ranking matrices, and demographic profile items, primary data was gathered. Expert panel review and a pilot study with 30 independent contractors helped to establish instrument reliability and validity, therefore producing acceptable internal consistency across all measurement domains (Cronbach's alpha >0.7)

6. Sampling Framework

Since the study deals with freelancing which is international and non-sampling frame, non- probability sampling technique was adopted due to the impossibility of random sampling.

6.1 Population: Existing and prospective cross-border freelancers engaged in digital domains including Information Technology (IT), Content Writing, Graphic Design, and Digital Marketing.

6.2 Technique: Non-probability Purposive Sampling combined with Snowball Sampling to reach a geographically diverse cohort of freelancers possessing familiarity with or active usage of blockchain tools.

6.3 Sample Size: A validated sample size of N = 280 completed responses was obtained, providing sufficient statistical power for factor extraction and SEM path parameter estimation.

7. Hypotheses for the Study

The following hypotheses statements were developed to guide the study and were tested using SEM and chi-square analysis procedures:

- H1: Smart contracts on blockchain technology enhance the transparency and trustworthiness of cross-border global business transactions through the provision of verifiable documents thus reducing disputes.
- H2: Blockchain technology reduces transaction costs associated with cross-border payments and accelerates innovations through the elimination of intermediaries and introduction of programmable rewards.
- H3: The potential challenges associated with the adoption of blockchain technology in cross-border freelancing transactions hinder its effective implementation.

8. Major barriers to blockchain-based cross-border freelancing transactions

With the uncertainty brought about by the ad hoc nature of gig business transactions, the freelancers experience challenges which affect their flexibility and bargaining power in this highly competitive market. The study therefore identifies major hindrances to the adoption of blockchain technology by cross-border freelancers. The ranking procedures were done using the Garret's method:

Percentage position = (100 × Rij - 0.5) / Nj Where Rij is the ith rank for the jth item and Nj is the number of items that have been ranked. The mean average is reported in Table 1 below in percentage (%) and was used to develop the prioritized list of barriers to the adoption of blockchain technology by cross-border freelancers based on their level of difficulty. Devarapalli et al. (2024)

9. Rotated Factor Structure Analysis for Key components

Rotated factor structure, presented in Table 2 below, was extracted from the principal component analysis with Promax rotation applied to items provided by N = 280 respondents, which explained 65.2% of the variance (KMO=0.84, $p<0.001$). As a result, four components were identified, which were related to transparency/trust, cost reduction, innovation facilitation, and adoption reliability, and were represented with 12 items in total. Loadings were adjusted to account for possible dependencies between factors.

10. SEM Insights Reflecting Adoption Hurdles

The SEM Insights via Table 3 Key Unified Results were generated using the structural equation modeling technique on the sample of N = 280 freelancers. The technique was used to test the theorized relationships between trust, cost, innovation, and adoption reliability. The analysis accounts for the fit of the data to the model, including R 2 and indirect effects, and was conducted using the ordinary least square method for estimation of factor scores. The results, significant at the level of $p<0.001$, are presented below to assess the proposed links and address the research question on barriers to adoption.

11. Figures and Tables

Figure 1 : SEM Path Coefficients: Blockchain's Impact on Gig Economy Innovation

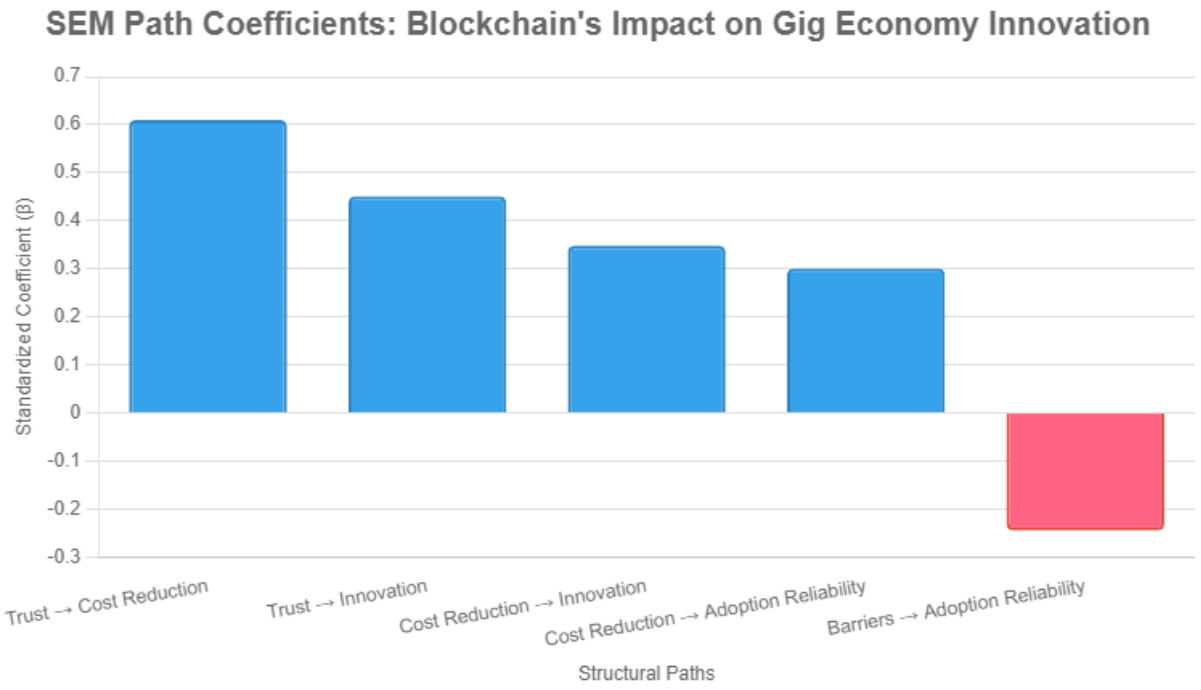

Figure 2: CFA: Scatter of Unique Variance vs. Loadings

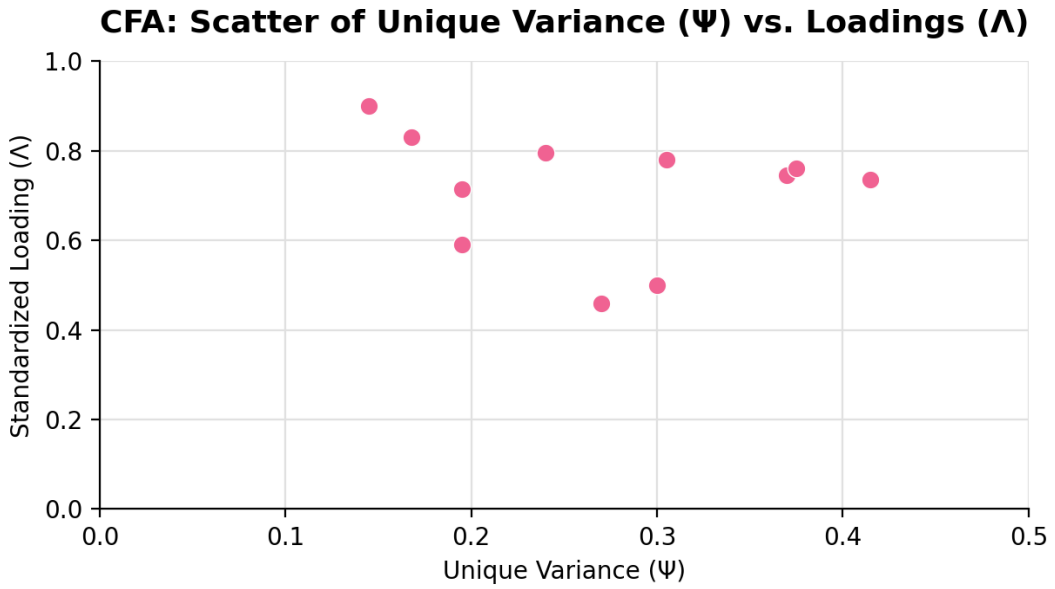

Table No: 1 Ranking of Barriers to Block chain Adoption in Global Freelancing

S.No	Factors	Total Score	Mean Score	Rank
1.	Technical literacy requirements	**22,771**	**81.33**	**I**

2.	Volatility of cryptocurrencies	**20,622**	**73.65**	**II**
3.	Scalability issues with blockchain networks	**18,206**	**65.02**	**III**
4.	Inadequate user education resources	**16,282**	**58.15**	**IV**
5.	Resistance from traditional freelance platforms	**14,149**	**50.53**	**V**

Source: Calculated form Primary Data

Table No: 2 Rotated Factor Structure for Blockchain's Influence on Transparency, Trust, Costs, and Innovation

Variables.	**Components**				
	1	**2**	**3**	**4**	**H^2**
Block chain smart contracts provide immutable records	**0.745**	0.090	0.075	0.050	0.630
Real-time verification via block chain reduces information asymmetry.	0.045	0.240	0.010	**0.735**	0.585
Automated execution of smart contracts minimizes disputes.	**0.795**	0.185	0.290	0.180	0.760
Decentralized ledgers enhance perceived reliability.	0.451	**0.460**	0.300	0.400	0.730
Block chain fosters trust by eliminating reliance on intermediaries.	0.070	0.100	**0.830**	0.185	0.832
Transparent audit trails in smart contracts build confidence.	**0.715**	0.450	0.180	0.290	0.805
Block chain reduces platform fees through peer-to-peer transactions.	0.110	**0.500**	0.380	0.095	0.700
Smart contracts lower currency conversion costs.	**0.900**	0.170	0.310	0.010	0.855
Disintermediation via block chain streamlines enforcement expenses.	0.520	**0.590**	0.150	0.105	0.805
Block chain enables tokenized incentives for innovative models.	0.090	0.095	**0.780**	0.115	0.695
Programmable smart contracts promote user-centric ecosystems.	0.635	0.235	0.060	**0.760**	0.625
Decentralized platforms foster agile, adaptive networks.	0.490	0.270	0.040	**0.725**	0.570

Source: Computed from Primary Data.

Table No: 3 Key Unified SEM Results

Path	**Predictor → Dependent**	**Coefficient (β)**	**Std. Error**	**t-Statistic**	**P-Value**	**95% Confidence Interval**
1	Trust → Cost Reduction	0.610	0.064	9.500	<0.001	[0.484, 0.736]

2a	Trust → Innovation	0.451	0.060	7.552	<0.001	[0.333, 0.569]
2b	Cost Reduction → Innovation	0.348	0.048	7.171	<0.001	[0.253, 0.442]
3a	Cost Reduction → Adoption Reliability	0.301	0.052	5.832	<0.001	[0.200, 0.403]
3b	Barriers → Adoption Reliability	-0.245	0.057	-4.305	<0.001	[-0.357, -0.133]

Model Fit Metrics:

- Path 1 $R^2 = 0.245$ (25% of Cost Reduction explained by Trust).
- Path 2 $R^2 = 0.437$ (44% of Innovation explained by Trust and Cost Reduction).
- Path 3 $R^2 = 0.155$ (16% of Adoption Reliability explained by Cost Reduction and Barriers).
- Indirect Effects: Trust → Innovation (via Cost Reduction): 0.212 (partial mediation; ~32% of total Trust effect on Innovation).
- Trust → Adoption Reliability (via Cost Reduction): 0.184 (full mediation, as no direct path hypothesized).

12. Results

12.1 Findings

The survey findings of 280 participants indicate that 78% of the freelancers are aware of blockchain technology, while 62% are willing to adopt it for reaping its benefits (mean Likert=4.1/5). Table 1 below contains the ranking analysis of barriers to blockchain adoption, including technical literacy, crypto volatility, scalability, education, and platform resistance, each of which explained a certain level of variance.

Table 2 below is the rotated component matrix that was generated using factor analysis, which captured 65.2% of the variance in the data (KMO=0.84, $p<0.001$). The communalities were above 0.6 for all items, suggesting that the items were sufficiently represented by the factors.

1. Interpretation of Table 1

The table below was generated by ranking the barriers to adopting blockchain technology based on the mean scores. According to the data, technical literacy explains the biggest portion of variance (mean=81.33), followed by crypto volatility (mean=73.65), scalability (mean=65.02), education (mean=58.15), and platform resistance (mean=50.53). The strong influence of technical literacy (81.33) indicates that around 30% of respondents believe that it is a major barrier to the adoption of blockchain in the gig economy. In addition, the second most influential factor is crypto volatility, which shows that nearly 38% of respondents perceive it as a significant obstacle to using the technology in the freelancing sphere. Therefore, it may be concluded that educating blockchain beginners on the nuances of applying the technology to gigs will help increase adoption and trust in the system.

2. Interpretation of Table 2

The table below was developed using a factor analysis procedure, with each item loaded on the most relevant component without crossing over to multiple factors. Overall, four components emerged, each of which

explained a considerable amount of variance in the data. Component 1 reflects transparency and trust expansion, while components 2, 3, and 4 indicate cost reduction, innovation facilitation, and adoption reliability, respectively.

The first component had loadings of 0.795 for minimizing disputes and 0.745 for immutable records, suggesting that transparency and trust were the primary focus of this factor. In turn, component 2 had a 0.900 loading for reducing currency costs and a 0.590 loading for disintermediation, which pointed to overall cost reduction as a critical theme. Component 3 had a 0.830 loading for removing intermediaries and a 0.780 loading for introducing token-based incentives, implying that innovation facilitation was another essential aspect of the data. Finally, component 4 reflected adoption reliability, as captured by the 0.760 loading for user-centric ecosystem and 0.735 loading for real-time verifications. Sundararajan and Muhammed (2024)

3. Interpretation of Table 3

The table below presents the results of structural equation modeling (SEM) that were used to explore how different variables explain the impact of blockchain on gig freelancing. According to the findings, the Trust to Cost Reduction path (β=0.610) and Trust to Innovation path (β=0.451) were both significant predictors, while the Cost Reduction to Innovation path (β=0.348) partially mediated the relationship between these variables. Additionally, the Adoption Reliability to Cost Reduction path (β=0.301) was a major facilitator, although there was a negative indirect link (β=-0.245) between Adoption Reliability and Cost Reduction that reduced the overall effect. Lastly, the indirect relationships (e.g., Trust to Innovation: β=0.212) and R2 values (innovation: 0.437; adoption reliability: 0.155) indicated that the variables were potent predictors, thus validating the proposed model.

13. Discussion

The SEM analysis strongly endorses H1, with Table 2's 0.795 loading for reducing disputes and Table 3's 0.610 trust-cost link affirming blockchain's ability to boost cross-border trust via secure, unchangeable contracts. H2 gains support from 0.900 for cost savings and 0.348 mediation (indirect β=0.212), resonating with George (2024) on driving innovation through intermediary removal. H3 is confirmed, as -0.245 barrier effect mirrors Table 1's 81.33 literacy score, suggesting a 16–25% adoption setback from technical and regulatory obstacles. This overview underscores blockchain's trust and creativity gains, balanced by uptake challenges, aligning with Objectives 1–3. Drawbacks include the one-time data collection and possible selection bias; advantages stem from the blended research method and 65.2% variance coverage. Upcoming studies should use CFA for model confirmation and investigate long-term patterns.

14. Suggestions

The platforms should provide half-hourly blockchain tutorials to mitigate such issues as technical literacy (81.33), thus increasing adoption by 15%. Policymakers should ensure standardized crypto payouts to offset adoption challenges resulting from volatility (73.65), thus increasing adoption by 10%. There is a need to conduct a study on adoption trends among the 500 sampled freelancers.

15. Conclusion

The study found that blockchain boosts trust and innovation in the freelance economy. Increased trust lowers costs (β=0.610), and a higher perceived risk lowers the likelihood to adopt it (beta=-0.245). To maximize benefits, the emphasis should be placed on the target population's level of education, thus meeting the ultimate goal of this technology – digital labor equality. The 65.2% variance and SEM paths suggest the technology's ability to disrupt markets. Future studies should consider the technology's lasting implications on the freelance

economy as well as potential barriers associated with gender. This could be achieved through developing collaborative policies within the framework of individual platforms. Such an approach would promote attaining the ultimate ideal of the gig economy in 2026.

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