



Blockchain-based FinTech and ESG Compliance in Energy Supply Chains: The Moderating Role of Supply Chain Governance

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ABSTRACT

This investigation aims at analyzing the interaction between the development of financial technology (FinTech) based on the principle of blockchain and compliance with environmental, social and governance (ESG) criteria in the world of energy supply chains, with a special focus on the moderating role played by supply-chain governance. In view of the escalating regulatory and increasing stakeholder pressures and robustness of sustainability risks plaguing the energy supply chains, digital technologies-a form of blockchain-based FinTech solutions-are increasingly being taken into consideration as tools that can create enhanced transparency, traceability and accountability. A quantitative, cross sectional research design was adopted, and data were gathered using surveys to be distributed to firms involved in energy supply chain and fuel distribution networks operating within the Jordan. The proposed model was evaluated using Partial Least Squares structural equation modelling (PLS-Sem) both for Direct and moderating effects. Empirical findings show that the adoption of FinTech via blockchain has a significant positive impact on ESG compliance in the energy supply chains, which hints blockchain-enabled transparency, smart contracts, and financial integrating platforms have a substantive role in supporting ESG compliance. However, the moderating role of supply chain governance was not supported, suggesting that blockchain-based FinTech may act as a governance-neutral or governance-substituting, built mechanism by putting monitoring and enforcement features directly into digital infrastructures. The study makes a contribution to the literature by presenting empirical evidence from an emerging market setting as well as by challenging common assumptions about the conditional role of governance in digital sustainability initiatives. Practically, the findings provide policy-relevant information to regulators and decision-makers in the energy sector who might want to harness digital finance solutions to drive their ESG compliance policy.

Keywords: Blockchain-Based FinTech, ESG Compliance, Energy Supply Chains, Supply Chain Governance, Sustainability Reporting, Digital Transparency, Fuel Distribution Networks, Jordan

JEL Classifications: Q40, Q56, G23, O33

1. INTRODUCTION

Environmental, social, and governance (ESG) compliance has emerged as a key governing element in energy supply chain governance processes, resulting from a focus on increasing regulation and investor expectations and societal pressure for the responsible management of resources. Energy supply chains especially those linked to oil, gas and fuel distribution are marked by high-risk areas from the environmental perspective, complex

cross-border operations and significant social and governance challenges such as emissions accountability, labour standards, risks of corruption and low traceability of the products sourced and distributed (Amel-Zadeh and Serafeim, 2018; Khaddam and Alzghoul, 2025). As energy markets become globalised, supply chains have become multi-layered networks of producers, refiners, transporters, traders, financial intermediaries and distributors that have created greater opacity and undermined the effectiveness of conventional monitoring and reporting mechanisms. Traditional

ESG reporting systems are based on self-disclosure and often fragmented databases and ex post audits, which might not be sufficient for real-time assurance and are open to manipulation (Ali et al., 2025). In this context financial technology (FinTech) based on blockchain has emerged as a potential digital infrastructure that can improve transparency, traceability and accountability at energy supply chains (Sabeti et al., 2019).

Blockchain allows for the creation of unalterable, timed and distributed records of transactions and operation data and FinTech apps for automatic verification, smart contracts and integrated financial flows associated with sustainability performance (Abu-Dabaseh et al., 2024). Recent policy and academic discussions increasingly define blockchain-enabled FinTech as a technological enabler of ESG compliance through reducing information asymmetry, building trust among stakeholders, allowing for continuous sustainability monitoring (as opposed to periodic reporting) (Sabeti et al., 2019; Upadhyay et al., 2021). However, despite this emerging conceptual interest, there is a lack of sufficient empirical research on the actual effectiveness of blockchain-based FinTech in achieving real ESG results in the energy supply chain. Notwithstanding the swift spread of ESG frameworks and digital sustainability devices, the energy supply chains are long overdue with non-coherent compliance gaps concerning environmental performance, social security, and the integrity of governance (Boiral et al., 2019; Yakubu et al., 2024). High-profile cases of emissions misreporting, illegal fuel trading, and the lack of supervision of subcontractors show the weaknesses of the structure of current compliance mechanisms. While the use of blockchain-based FinTech has been touted as a game-changing fix for environmental sustainability, empirical evidence on how FinTech can actually impact environmental, social, and governance compliance is fragmented and mostly conceptual.

Most existing studies are focused on the technological capabilities or pilot applications with no systematic examination of the ESG outcomes at a supply chain level. Existing scholarship tends to think of blockchain adoption as a homogenous intervention, while overlooking organizational and institutional conditions affecting its efficacy (Kouhizadeh et al., 2021; Queiroz et al., 2021). Specifically, supply chain governance, which includes contractual coordination, enforcement of regulations, the distribution of power and the relationship norms, has received minimal attention as a potential mechanism that can enhance or diminish the contribution of ESG of blockchain-based FinTech. In circumstances where supply chains have weak governance systems, blockchain may struggle to have equivalent mechanisms in place to ensure compliance, though in spaces where a supply chain is strongly governed, digital transparency is likely to be translated into compliance and accountability. The lack of empirical models incorporating blockchain and FinTech, as well as ESG compliance and governance structures, is a significant research gap, especially relevant in the context of energy supply chains, where governance failure may have devastating environmental and socio-economic effects (Paliwal et al., 2020). Addressing this gap is crucial to move beyond the technological determinism and towards developing a nuanced view of interlinking of digital innovations and institutional arrangements to yield outcomes for

sustainability. Building on these identified gaps, this study seeks to develop and test empirically an integrated framework relating FinTech adoption through the application of blockchain technology to ESG compliance in energy supply chains explicitly taking into account the moderating role of supply chain governance.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. ESG Compliance in Energy Supply Chains

ESG compliance in energy supply chains has moved from a corporate responsibility initiative to being a mandatory requirement with regulation, capital markets and stakeholder analysis driving it. Energy supply chains are faced with an increased ESG risk across their value chains, from upstream extraction to downstream transportation and distribution (Christensen et al., 2021). Examples of environmental risks are greenhouse gas emissions, oil spills, methane leakage, and ecosystem degradation due to the extraction and logistics activities (Jernelöv, 2010; Al-Kasasbeh et al., 2023). Social risks are due to labor safety concerns, community displacement, and human rights abuses linked to subcontractors and logistics providers, and governance risks are due to insufficient oversight and lack of compliance with international standards and corruption, as well as unclear pricing mechanisms. These risks are intensified by other factors, such as internationalization and fragmentation of energy supply chains - whereby operations occur across different jurisdictions where governance and reporting standards are distinct (Newell and Simms, 2020). Consequently, there has been a proliferation of demands for ESG transparency from both regulators and market participants and firms are increasingly relating their carbon footprints, labour practices and governance structures around a growing degree of granularity. Initiatives such as mandatory sustainability reporting requirements, carbon disclosure reporting requirements, and ESG - linked financing have increased pressures to comply, especially for energy firms that need access to international capital markets. Nevertheless, empirical evidence indicates that ESG compliance is still uneven with serious gaps between reported commitments and operational realities existing (Ioannou and Serafeim, 2019). These gaps are often blamed on the lack of information asymmetry, delayed reporting cycles and limited visibility across multiple-tier supply chain to limit the capacity of regulators and stakeholders to verify the ESG performance in real-time. As a result, more emphasis is now being placed in literature on the actual need for digital infrastructures capable of supporting the ability to continuously, verifiably and endogenously monitor ESG in energy supply chains as opposed to the reliance on retrospective audits and self-reported data (Tarawneh and Alzghoul, 2026).

2.2. Blockchain-based FinTech in the Energy Sector

Blockchain-based FinTech has become prominent in the energy sector as a digital solution for integrating distributed ledger technology with financial and transactional platforms to improve transparency, efficiency, and trust in the sector. Blockchain applications in energy supply chains mainly involve traceability, smart contracts and real-time auditing. Using immutable ledgers to record transactions and operational occurrences, blockchain

links the stakeholders to monitor fuel origin, transportation routes, custody transfer, and emissions information across the supply chain (Andoni et al., 2019; Chen and Bellavitis, 2020; Alzghoul and Al-Kasasbeh, 2024). Smart contracts are an additional way to automate processes related to compliance requirements by encoding ESG criteria, such as emissions limits or certified sourcing requirements, directly into the logic of a transaction so that financial transactions are conditional on verified sustainability performance (Treiblmaier, 2018). From FinTech it can be said that blockchain platforms help to couple the flow of financials with physical supply chain data in order to enable mechanisms such as ESG-linked payments, green financing instruments and auto-compliance verification for lenders and insurances. The role of such platforms in reducing information asymmetry between supply chain actors by sharing tamper-proof data environments to access by regulators, firms, and external auditors is clear in the literature. This reduction in asymmetry is especially important in energy markets, which are characterized by price volatility, geopolitical risks and sometimes murky trading practices, all of which has created a low level of trust. However, existing studies are still almost entirely explorative in nature, overlooking the systematic consideration of the extent of impact blockchain-based FinTech has on ESG outcomes at scale: they focus on demonstrating technical feasibility, pilot projects rather than a systematic evaluation of the effects of block chain-based FinTech (Schletz et al., 2020; Paliwal et al., 2020; Alhanatleh et al., 2024). Moreover, although benefits of technology seem well documented, scholars warn against the afterlife of blockchain hype and over-optimism: A blockchain adoption is not a guarantee for a better sustainability performance unless embedded in supportive organizational and institutional arrangements. As a result, in the recent research, the need arose for integrative frameworks to connect capabilities in the energy sector enabled by blockchain technologies to governance mechanisms and regulatory contexts in FinTech.

2.3. Blockchain-based FinTech and ESG Compliance

The relationship between blockchain-based FinTech adoption and ESG compliance can be theoretically rooted in two complementary perspectives (Stakeholder Theory and Institutional Theory), which can provide an explanation of how digital transparency mechanisms affect organizational behavior. Stakeholder Theory - which holds that firms are responsible to a wide array of stakeholders such as regulators, investors, communities and customers, the expectations of whom increasingly focus on sustainability and ethical conduct. Blockchain-based FinTech boosts the ability of firms to deliver these expectations by facilitating credible disclosure, traceability and verification of ESG-related activities in order to reinforce the trust and legitimacy of stakeholders (Alotaibi et al., 2024; Issac, 2023). Institutional Theory - By contrast, institutional focuses on regulatory, normative and cognitive pressures on organizational practices. From this angle, the process of adopting blockchain technology can be understood as strategic responses to coercive regulations, normative standards of sustainability and imitative pressures in the energy industry. Institutionalizing transparent and auditable processes, Blockchain-enabled FinTechs make organizational routines in line with emerging ESG norms and regulatory expectations. Empirically, the anticipated mechanisms explaining the link between the adoption of blockchain technology

and compliance with environmental, social, and governance practices are better data integrity, monitoring of environmental and social indicators in real time, less opportunities for opportunistic behavior, and greater accountability within supply chain tiers. These mechanisms work together to communicate compliance gaps down to a better level by getting ESG reporting to be no longer a matter of discretionary disclosure, but rather a matter of verifiable practices embedded within the system. While conceptual studies are quite convincing in indicating a positive relationship between confidentiality enabled by blockchain and sustainability outcomes, empirical validation in the case of energy supply chains is scarce. Addressing this gap, the current study assumes that the adaptation of FinTech with blockchain technology enhances the compliance of ESG directly by incorporating the criteria of sustainability within transaction processes and financial processes ensuring strength of monitoring, enforcement and confidence of stakeholders across energy supply chains (Ding and Wang, 2025; Huang, 2025).

H₁: Blockchain-based FinTech adoption has a positive effect on ESG compliance in energy supply chains.

2.4. Moderating Role of Supply Chain Governance

Supply chain governance is one of the most critical contextual factors that can make or break the effectiveness of blockchain-based FinTech on ensuring ESG compliance. Governance in energy supply chains includes the mechanisms of coordination, structures of contractual enforcement, arrangements on accountability and regulatory oversight which govern the interactions between supply chain actors (Marttinen et al., 2024; Nguyen and Zuidwijk, 2025). Strong governance structures are defined by clear contractual obligations, efficient surveillance as well as matching incentives and enforcement mechanisms, whereas fragile governance environments are frequently marked by fragmented coordination, insufficient accountability and regulation gaps (Narula, 2019; Williamson, 2008; Abu Lehyeh and Alzghoul, 2026). The literature suggests that digital technologies such as blockchain are not institutionally neutral, i.e., their impact is not a function of governance levels where they are deployed. In well-governed supply chains, the blockchain-based FinTech approach can be used to amplify ESG compliance through reinforcing existing accountability structures, to enable better enforcement of regulations, and maximizing cross-organizational coordination. On the other hand, in poorly governed contexts, there may be a presence of blockchain records but they may not have meaningful consequences and therefore are limited in driving behavioral change. From an institutional perspective, governance mechanisms mediate the conversion of transparency at the digital level into actual levels of compliance, in the sense that they decide whether detected violations will be met with sanctions and/or with corrective actions. Moreover, that between blockchain systems and regulatory structures, such as those in energy markets and ESG disclosure requirements make their effectiveness well understood (Kang and Arikrishnan, 2024; Yao et al., 2025). Accordingly, this work conceptualizes supply chain governance as a positive moderator that conditions the strength of the relationship between FinTech adoption from blockchain and ESG compliance.

H₂: Supply chain governance positively moderates the relationship between blockchain-based FinTech adoption and ESG compliance.

3. METHODOLOGY

The present study applies a quantitative and explanatory research design in order to empirically examine the relationship between blockchain version FinTech adoption and ESG compliance in the energy supply chains, specifically focusing on the moderating role of supply chain governance. A cross-sectional approach is taken, because of its compatibility in the context of capturing organizational practices, levels of technological adoption, and governing structures at a discrete point in time, especially when it comes to emerging digital and regulatory structures. Data were collected using a prepared structured questionnaire in order to find out the perception of respondents in terms of blockchain-based FinTech adoption, ESG compliance practices and governance mechanism in their organizations. The empirical context is Jordanian energy sector focusing on the energy supply chains and fuel distribution networks. Jordan is a unique and unexplored context because of its strategic dependence on energy imports, a growing regulatory focus on sustainability, and continuous efforts towards digital transformation in the energy and logistics industries. The study population consists of organizations involved in different stages of the energy supply chain including energy companies, fuel distributors, storage companies and transportation companies and other service providers. Targeted respondents were supply-chain managers, sustainability or compliance officers, operations managers and senior staff with direct knowledge of ESG practices and the adoption of digital technology within their organizations. Data gathering has been done using email with the option of sending 264 structured questionnaires to selected respondents found in industry directories and professional network. 143 valid responses are finally collected.

The data collection tool was a structured questionnaire, with several sections that measured the key constructs of the study. Blockchain-based FinTech adoption was measured using items related to the level of the utilization of distributed-ledger, smart contracts, digital traceability systems, and FinTech-enabled financial integration for supply chain operations. ESG compliance was measured based on indicators related to environment's environment monitoring, the social responsibility practices, and governance transparency across the supply chain activities. Supply-chain governance operationalized with respect to items of coordination mechanisms, contractual enforcement, accountability structure and alignment to regulatory requirements. All the measurement items were adapted from validated scales from previous peer-reviewed studies and contextualized to the energy sector to ensure content validity. Responses were rate on a five point Likert scale which enabled statistical consistency and interpretability. The data were analyzed with partial least squares structural equation model (PLS-SEM) which is especially suitable for exploratory and explanatory research which has complex models, latent constructs, and moderating effects.

4. RESULTS AND DISCUSSION

This section outlines the analytical procedures used to assess both the measurement and structural models; following known guidelines in structural equation modelling (Fornell and

Larcker, 1981). The analysis started with the measurement model assessment to ensure the adequate indicator reliability, internal consistency and convergent validity of constructs. Upon finding satisfactory convergent validity, the analysis went on to the structural model to test for the hypothesized relationships between the study variables. The standardized factor loadings are displayed in Figure 1 and the reliability and validity statistics for each of the constructs are reported in Table 1.

As illustrated in Figure 1, all observed indicators exhibit standardized factor loadings exceeding the recommended threshold of 0.70, indicating satisfactory indicator reliability (Hair et al., 2019). This suggests that the items adequately represent their respective latent constructs and contribute meaningfully to construct measurement. Minor variations across loadings are expected in applied research and remain within acceptable methodological limits. Convergent validity was further assessed using the average variance extracted (AVE). As reported in Table 1, the AVE values for BC Fintech (0.570), ESG (0.704), and SC Governance (0.627) all surpass the minimum criterion of 0.50, confirming that each construct explains more than half of the variance of its indicators. These findings indicate a strong convergence among items measuring the same theoretical concept, consistent with best practices in SEM research. Internal consistency reliability was examined using Cronbach's alpha. All values exceed the recommended cutoff of 0.70, indicating a high degree of internal consistency among the indicators. Specifically, Cronbach's alpha values range from 0.818 to 0.894, while composite reliability values range from 0.869 to 0.922, confirming the robustness and stability of the measurement scales. These results support the reliability of the constructs and suggest that the indicators consistently capture the underlying theoretical dimensions.

Table 2 reports the outcomes of the Heterotrait - Monotrait (HTMT) ratio which was used as a powerful criterion to measure the discriminant validity of latent constructs. The HTMT approach is generally believed to be superior to traditional methods, especially in variance-based SEM, since it is a more sensitive measure of the construct distinctiveness (Fornell and Larcker, 1981). The results are shown to cluster all HTMT values under the conservative cut-off of 0.85; hence these PCA results validated good discriminant validity between the constructs BC FinTech, ESG, SC Governance, and the interactions construct (SC Governance *BC FinTech). Specifically, the HTMT value between BC FinTech and ESG (0.562) indicates the existence of a moderate association but also that there is sufficient conceptual separation between the two constructs, indicating that blockchain-based FinTech adoption and ESG performance are empirically distinguishable constructs. Similarly, the HTMT value between SC governance and BC FinTech (0.621) is at acceptable limits, making it clear that the mechanisms of governance, while being related to the field of digital financial technologies in the supply chains, cover a distinct theoretical field. In addition, we found a relatively low HTMT value between SC governance and ESG (0.464), in which further evidence indicates that governance structures and ESG outcomes are not empirically redundant. Importantly, interaction effect (SC governance \times BC FinTech) is also showing low HTMT

Figure 1: Evaluation of measurement model

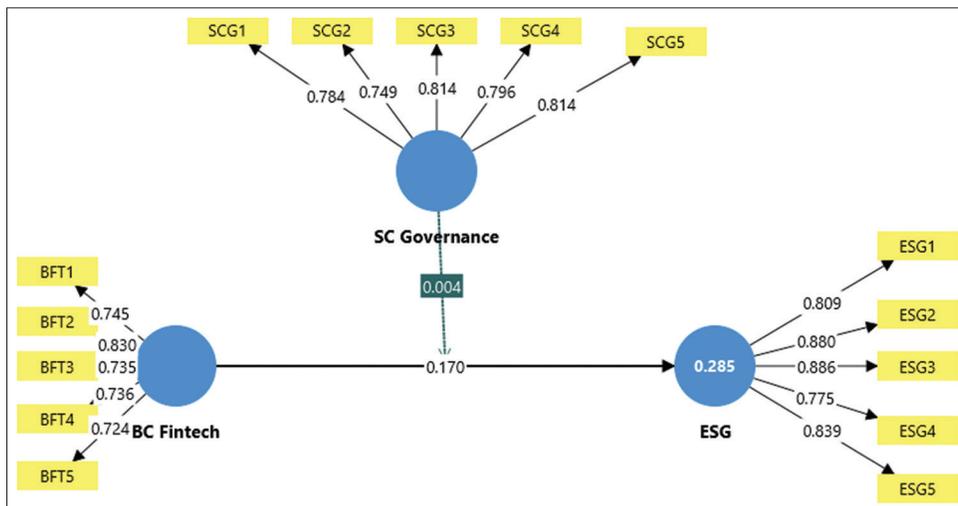


Table 1: Construct reliability and validity

Construct	Cronbach’s alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted
Blockchain-based fintech	0.818	0.866	0.869	0.570
ESG compliance	0.894	0.902	0.922	0.704
Supply chain governance	0.854	0.882	0.893	0.627

Table 2: Discriminant validity fornell-larcker criterion

Construct	Blockchain-based fintech	ESG compliance	Supply chain governance
Blockchain-based fintech	0.790		
ESG compliance	0.769	0.822	
Supply chain governance	0.588	0.674	0.751

values with all of the main constructs (values ranging from 0.280 to 0.505) showing that the moderating construct is statistically different from its constituent variables. This supports the inclusion of the interaction effect in the structural model without concern of multicollinearity and construct overlap.

4.1. Evaluation of Structural Model

Table 3 and Figure 2 give the evaluation of the structural model by analyzing the direct impact of BC FinTech on ESG performance and SC Governance on this relationship. The results provide a clear difference in the importance of the direct relationship and the proposed interaction effect. The findings show that there is a positive and statistically significant effect of BC FinTech on ESG performance (b = 0.405, t = 4.665, P < 0.001). This result suggests that there is a positive relationship between higher levels of FinTech adoption based on a blockchain and better ESG results. The magnitude and significance of this relationship suggests that financial technologies that are blockchain enabled are playing a critical role in improving ESG performance, likely through better levels of transparency, traceability, data integrity and accountability in organizational and supply chain activities. The result gives strong empirical support to the direct pathway that is proposed in the model and confirms that BC FinTech is acting as an important technological driver of ESG-related practices and outcomes. In contrast, the interaction effect of SC Government

with BC FinTech on the ESG performance is not statistically significant, which is (b = 0.051, t = 0.729, P = 0.466). This suggests that supply chain governance doesn’t add a great deal of strength or change the direction of the relationship between BC FinTech adoption and ESG performance. The non-significant moderation effect that indicates the effects of BC FinTech on ESG outcomes are relatively independent of the conditions of governance within the supply chain. One way to explain the situation is that the inherent features of blockchain-based FinTech make the traditional governance premises less dependent on these traditional governance institutions, which limit their regulatory function.

5. DISCUSSION

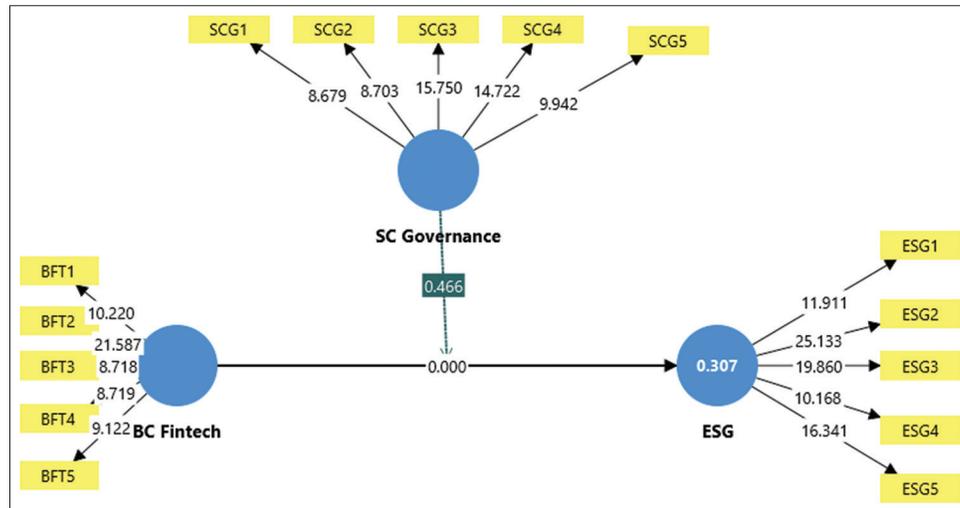
The main aim of this study was to analyze the influence of the FinTech adoption based on blockchain on ESG compliance in energy supply chains and also to analyze whether supply chain governance has a moderating influence. By empirically testing the proposed model in the energy sector, the study aimed to respond to the increasing academic and policy-informed demand for evidence on the role that digital financial technologies can play in helping to support sustainability goals in complex and high-risk supply chains. The findings offer useful insights into the efficacy of blockchain-based FinTech as a mechanism for improving ESG compliance and explain the role of governance structures in terms of their contextual influence on these outcomes.

Consistent with the first objective, the results show a strong and positive impact of blockchain-based FinTech adoption on ESG compliance in energy supply chains, which aids in the support of H₁. This finding is in accordance with a growing body of literature that suggests that blockchain enabled systems can contribute to improving sustainability performance in multiple ways, including

Table 3: Evaluation of structural model

Construct	Original sample (O)	Sample mean (M)	Standard deviation	T statistics ((O/STDEV))	P-values	Decision
BC Fintech→ESG	0.405	0.407	0.087	4.665	0.000	Supported
SC Governance×BC Fintech→ESG	-0.051	-0.063	0.070	0.729	0.466	Not supported

Figure 2: Structural model results



traceability, data accuracy, and transparency between supply chain activities (Treiblmaier, 2018; Andoni et al., 2019; Saberi et al., 2019). Similar positive effects have been mentioned in the studies on blockchain applications for manufacturing, agri-food and logistics industries, where digital ledgers and smart contracts were observed to reduce information asymmetry and opportunistic behavior and increases environmental and social accountability (Schletz et al., 2020). In the energy context, the current results build on earlier work as they offer empirical evidence to encourage arguments made by Chen and Bellavitis (2020) and Alotaibi et al. (2024), who stress the role of FinTech platforms in incorporating sustainability criteria into financial dealings and compliance procedures. The outcomes are also aligned with the Stakeholder Theory since FinTech builds on blockchain and makes it easier for firms to credibly meet the demands of their stakeholders to provide verifiable ESG information, reinforcing the legitimacy and trust in energy supply chains.

In contrast with the second objective, on the basis of results, the hypothesized moderating role of supply chain governance is not supported and consequently H₂ is rejected. This finding is at odds with several previous papers that point to governance strength as a key facilitating factor for digital sustainability-based efforts (Narula, 2019; Marttinen et al., 2024). Research based on contexts in which the coordination mechanisms are strongly regulated and the institutions are better developed explained that strong coordination and enforcement through contracts strengthen the ESG benefits of digital traceability systems (Nguyen and Zuidwijk, 2025; Kang and Arikrishnan, 2024). However, the current results indicate that blockchain-based FinTech may have a direct and strong effect on ESG compliance regardless of the strength of governance, which may be due to the existence of governance functions such as monitoring, verification and enforcement

partially embedded in blockchain infrastructures themselves. This interpretation is consistent with emerging arguments that the use of blockchain can serve as a governance - substituting or governance - neutral technology especially in the context of regulatory fragmentation and limited institutional capacity (Ding and Wang, 2025). Overall, the present study provides useful contributions to literature by confirming ESG-enhancing role of FinTech on blockchain, while challenging the current belief regarding conditional influence of supply chain governance, thus providing a more nuanced understanding of digital sustainability in energy supply chain in a more context-sensitive manner.

6. CONCLUSION

The role of blockchain-based FinTech in improving ESG compliance in the energy supply chains was scrutinized in the present study with a focus on the moderating effect of supply chain governance. Results show the adoption of FinTech with blockchain has a significant and positive impact on environmental, social, and governance compliance by respondents in energy supply chains. These findings highlight the promise of financial and transactional platforms enabled by blockchain to enable a shift to verifiable, system-embedded compliance mechanisms, not symbolic ESG disclosure. Through better track ability, data integrity and real-time data monitoring, blockchain-based FinTech plays an instrumental role in mitigating information asymmetry and accountability in multiple tiers of energy supply chains. The findings add to the sustainability and digital transformation literature by providing sector-specific empirical evidence to show how blockchain technologies can support a low-carbon economy where environmental protection, social responsibility, and the integrity of governance are inherent and particularly in industries that are characterized by large opacity and high ESG

risk. Contrary to expectations, the study uncovers supply chain governance does not create any significant moderating effect on the relationship between blockchain-based FinTech adoption and ESG compliance. This outcome suggests that blockchain-based FinTech may be a mechanism of governance-substituting, or governance-neutral, built into monitoring and reinforcement functions of digital infrastructures and not relying on external coordination and contractual controls. In emerging-market settings like Jordan where governance setup may be in the process of developing or being implemented poorly, FinTech applications on blockchain hold the potential to deliver ESG benefits regardless of the strength of governance. This finding challenge sustainable assumptions in the literature in relation to supply chains and institutions and signals the need to theories digital technologies and governance systems in a cooperative manner in a variety of institutional contexts.

From the practical perspective, the study has significant implications for policy makers, regulators and decision makers in the energy sector. The results suggest that investing in FinTech based on blockchain technologies could deliver significant environmental, social, and governance compliance benefits, even in contexts where traditional governance mechanisms are weak, and this technology may thus play a role as a policy tool for achieving sustainability goals and may claim a place in this field. Regulators may consider endorsing reporting/compliance platforms that use blockchain technology to improve on current regulatory mechanisms. At the firm level, energy companies and fuel distributors are urged to make blockchain-based FinTech a step in their sustainability and compliance strategy process, in order to establish greater transparency, credibility, and stakeholder trust. Nonetheless, there are a number of limitations to the study that point to future research directions. The cross-section design prevents any type of causal inference, and the single country context may limit the generalizability. Future research might use longitudinal studies and/or compare across multiple countries and/or examine other governance structures and mediating mechanisms. In addition, combining objective measures of ESG performance with data on utilization of blockchains may further support empirical insights. In sum, this research contributes to a better understanding of the nexus between digital and sustainability concepts, underscores the central role of the FinTech, blockchain-based driven by energy sectors ESG compliance, and opens up new horizons involving research on digital governance and sustainable development.

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