



Greenwashing vs. Green Trust: The Role of Blockchain in Ensuring Transparency and Accountability

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Abstract

This paper investigates the convergence of blockchain innovation and Ecological, Social, and Administration (ESG) responsibility, zeroing in on battling greenwashing. It inspects how blockchain's permanence, straightforwardness, and recognizability can upgrade ESG detailing, encouraging "green trust" among partners. The survey dissects existing writing, contextual analyses, and exact discoveries to resolve key inquiries with respect to blockchain's effect on ESG straightforwardness, reception hindrances, and its capability to enhance or supplant conventional frameworks. The exploration features blockchain's possible in different areas, including supply chains and green money, while recognizing difficulties like administrative vulnerability and industry opposition. It reasons that blockchain, while not a panacea, offers a practical pathway towards dependable supportability claims, stressing the requirement for cooperative endeavors to normalize and execute blockchain-based ESG structures.

Keywords: Blockchain, ESG, Greenwashing, Sustainability, Transparency.

Introduction

As ecological, social, and administration (ESG) standards gain noticeable quality in corporate and speculation scenes, worries over greenwashing-the deceptive depiction of maintainability endeavors-have strengthened. While organizations and monetary establishments are under expanding strain to line up with manageability objectives, the absence of normalized announcing structures and confirmation instruments has permitted tricky practices to thrive. Many organizations misrepresent their ecological responsibilities, prompting wariness among shoppers and financial backers. This developing trust deficiency highlights the pressing requirement for straightforwardness and responsibility in ESG revealing and feasible strategic approaches. Blockchain innovation has arisen as a promising answer for battle greenwashing by giving unchanging, irrefutable, and straightforward records of manageability claims. Through decentralized records, brilliant agreements, and continuous recognizability,

blockchain offers an option to ordinary ESG exposure frameworks, which frequently experience the ill effects of conflicting information, absence of outsider check, and corporate predisposition. By guaranteeing that supportability claims-whether in carbon exchanging, moral obtaining, or green money-are carefully designed and auditable, blockchain encourages "green trust" and reinforces purchaser trust in economical items and ventures. In areas like food supply chains, design, and money, where manageability claims are much of the time examined, blockchain can verify item starting points, affirm moral creation practices, and upgrade responsibility. Essentially, in green money, blockchain-based stages can reform carbon credit markets, green security issuances, and ESG speculations, guaranteeing that reserves truly support natural targets as opposed to filling in as simple advertising apparatuses. Regardless of its true capacity, in any case, blockchain reception in maintainability detailing faces difficulties like administrative vulnerabilities, mechanical boundaries, and opposition from ventures profiting from murky practices. This audit paper investigates the crossing point of blockchain innovation and ESG responsibility, dissecting how blockchain can alleviate greenwashing gambles while cultivating certified maintainability responsibilities. By fundamentally analyzing existing writing, industry contextual analyses, and observational discoveries, this study intends to address key inquiries:

- How does blockchain improve ESG straightforwardness and corporate responsibility?
- What are the boundaries to blockchain reception in manageability check?
- Could blockchain actually supplant or supplement existing ESG announcing frameworks?

By resolving these inquiries, this paper adds to the continuous talk on moral supportability practices and features the ground-breaking capability of blockchain in moving ESG drives from greenwashing to green trust. The research delves into the ways U.S. companies are integrating blockchain technology within their sustainability frameworks. It examines their interactions with local ecosystems and explores how geographic factors influence their sustainability initiatives. To identify firms leveraging blockchain for sustainable practices, the study employed cutting-edge text mining and deep learning techniques. This novel methodology not only highlighted companies committed to sustainability through blockchain but also assessed the degree of their dedication. The study further analyzed how these companies fit into broader ecosystems by using large-scale web scraping, natural language processing (NLP), and deep learning to analyze corporate websites. It also mapped hyperlink networks between these sites, offering valuable insights into how geographic and ecosystem-specific factors shape sustainability efforts linked to blockchain innovation (**Kinne et al., 2024**).

A growing trend is the rise of green initiatives, particularly among oil and gas companies, with many announcing net-zero goals. However, concerns about greenwashing have emerged, especially regarding the authenticity of such claims. This research explores the evolving study of greenwashing, focusing on deceptive communication practices. Pathways Alliance, a key industry player, has faced scrutiny for misleading statements, including incomplete disclosures and inappropriate comparisons, raising doubts about the credibility of their net-zero commitments (**Aronczyk, McCurdy, Russill 2024**). In the context of FinTech,

blockchain is enhancing financial transactions by streamlining processes such as mobile payments, digital banking, and more. This aligns with the study's exploration of blockchain's role in fostering sustainability in food supply chains. Blockchain is shown to offer opportunities for reconciling financial success with sustainability goals, promoting shared value creation and supporting more equitable supply chain practices. Its decentralized nature holds promise for addressing sustainability barriers and enabling the creation of more sustainable food supply systems (Dunbar, Sarkis, Treku 2024). One area that remains underexplored is the intersection of blockchain and additive manufacturing in symbiotic networks. This study attempts to fill that gap by modeling blockchain adoption and analyzing its potential to optimize value flows and improve operational efficiencies, offering transformative insights for industrial processes (Friedman, Ormiston, 2022).

Literature Review

Yip & Bocken (2018) explored sustainable business models within the banking industry, categorized them into distinct archetypes, and assessed customer loyalty and receptiveness to these models. Sustainability in banking involved delivering financial services that meet customer needs, protected the environment, and maintained profitability, aligning with the triple bottom line of People, Planet, and Profit (Fisk, 2010). It also emphasized stakeholder engagement both internally and externally (Freeman, 2010). The study's key contribution lay in proposing new archetypes tailored to the banking sector, fostering innovation and enabling systematic analysis of sustainable practices. Additionally, the findings on customer preferences provided valuable insights for banks in Hong Kong, guiding them to adopt the most favoured sustainable models. This approach helped banks achieve a balance between financial success and positive social and environmental impact, promoting the concept of “doing good while doing well.”

Kofos et al. (2022) examined knowledge gaps by exploring how digital infrastructures could enhance circular economy (CE) monitoring. It aimed to develop a CE visibility evaluation framework for blockchain-enabled infrastructures. The framework helped governments, businesses, and technology providers identify existing data coverage and determine additional data needs to improve CE monitoring and visibility. By integrating data from multiple platforms, it highlighted how comprehensive insights could be achieved. Using the design science research method and examining three blockchain-enabled platforms, the study developed a practical evaluation framework. This tool was intended to assist policymakers, customs authorities, banks, and auditing firms in gaining greater visibility into CE flows, ultimately improving decision-making and monitoring processes. The framework provided guidance for combining data from diverse platforms, offering a structured approach to assess and enhance digital infrastructures for effective CE management.

Adamkiewicz et al. (2022) research on the primary focus of this study was to examine greenwashing practices within the fashion industry, particularly in the context of a circular and sustainable economy. The research aimed to assess how greenwashing impacts consumer perceptions, specifically in terms of green consumer confusion, perceived risks, and trust in sustainable claims. Due to the environmental damage caused by the fashion industry, there

has been increasing pressure for the sector to adopt more sustainable business models. These changes serve as a catalyst for developing technical solutions and redefining regulations to facilitate a smoother transition to more sustainable practices throughout the value chain. By fostering a cultural shift among both companies and consumers, the fashion industry can boost the appeal and acceptance of products derived from a circular economy, where resources are used more responsibly. Greenwashing, from an environmental, social, and ethical perspective, is unacceptable, but it can also push consumers towards more genuine, sustainable fashion options. Both brands and consumers must collaborate for a truly sustainable fashion industry, with transparent and trustworthy certification systems ensuring sustainability.

Bager, Singh, Persson (2022) research on this study aimed to explore the practical application of blockchain technology in enhancing sustainability within coffee supply chains, identifying both challenges and opportunities. Multinational corporations had increasingly relied on various governance mechanisms, such as voluntary sustainability standards (VSS) like Fair Trade, Rainforest Alliance, and organic certifications, to address sustainability issues. These mechanisms, including codes of conduct, corporate social responsibility programs, and direct trade relationships, have been pivotal in promoting ethical practices (Bager and Lambin, 2020; Lambin and Thorlakson, 2018; Thorlakson et al., 2018). Our research assessed how blockchain could drive sustainability by improving traceability and transparency in coffee supply chains. While our pilot implementation demonstrated some clear advantages, it also highlighted that blockchain was not a cure-all solution for sustainability in coffee production. Instead, the real value of blockchain and decentralized technologies lies in digitizing supply chains to enhance efficiency, reduce costs, minimize disputes and fraud, and provide comprehensive insights into product provenance and chain-of-custody information.

Wan et al. (2023) examined the evolution of Environmental, Social, and Governance (ESG) research through a bibliometric analysis. Data was sourced from the Web of Science Core Collection, and analytical maps were generated using VOS viewer and Cite-Space software. While findings varied with different databases or timeframes, bibliographic coupling, keyword co-occurrence, and co-citations helped identify research clusters and emerging trends. The study suggested that future reviews adopt more flexible threshold settings to uncover deeper connections between ESG subtopics. By analysing publication networks, citation structures, authors, institutions, countries, and journals, the research provided a comprehensive understanding of ESG literature. The findings contributed to identifying key research patterns and trends, offering valuable insights for academics and policymakers. The study highlighted ESG's growing significance in global sustainability discussions and provided a foundation for further research into its impact across industries and regions.

Wang & Lassi (2023) examined the role of Biodiversity Impact Disclosures (BIDs) in protecting biodiversity and human health within the Belt and Road Initiative (BRI). It addressed challenges in voluntary reporting and advocated for mandatory BID clauses in BRI agreements to enhance corporate responsibility, investment decisions, and regulatory compliance. The study critiqued China's CERDS ESG Disclosure Standards and the UN's

voluntary biodiversity reporting guidelines, highlighting their limitations. By mandating BIDs, the study proposed a standardized framework to improve transparency, corporate accountability, and sustainability. Establishing a dedicated biodiversity sector within the BRI ensured that critical data was disclosed, benefiting ecosystems, investors, and businesses. These measures not only strengthened investor confidence but also encouraged responsible investment and prepared companies for evolving environmental policies. Ultimately, integrating mandatory BIDs into BRI agreements drove long-term ecological and financial sustainability.

Cozzio (2023) used a mixed-method approach, combining experiments with qualitative evidence, to explore why consumers value traceability through blockchain and the challenges suppliers face in adopting this technology. As the final actors in the supply chain, consumers were increasingly concerned about food traceability, seeking clear information on product origins, production methods, and sustainability practices. Blockchain technology offers a potential solution by ensuring the secure and transparent flow of immutable data across the supply chain. With evolving consumer tastes and preferences, blockchain can meet the growing demand for transparency. To better understand the perspectives of key stakeholders, we conducted a mixed-method study, integrating both quantitative and qualitative research. This approach provided valuable insights into the adoption of blockchain in the hospitality food supply chain and highlights the barriers and opportunities for its implementation.

Atak (2024) research on Environmental, social, and governance (ESG) factors, while similar to corporate social responsibility (CSR), represent an investment strategy focused on a company's commitment to sustainability, social impact, ethical governance, and long-term growth. ESG considerations were increasingly shaping the financial sector, driven by evolving regulations, emerging economic opportunities, risk management needs, and ethical responsibilities. As these factors influence financial practices, it became crucial to understand their broader implications across different markets. This study examined the relationship between ESG sentiment and implied volatility (IVOL) in the Turkish market, employing an innovative NLP-based approach to analyse corporate disclosures. Our research provided valuable contributions to the growing body of literature on ESG and firm performance, offering fresh insights into the dynamics of ESG sentiment and its impact on risk in emerging markets. This work adds to the understanding of how ESG factors interacted with market volatility and firm behaviour in specific economic contexts.

Zhu & Liu (2024) explored the key factors limiting the quality of ESG (Environmental, Social, and Governance) information disclosure. Blockchain technology, with its features of immutability and traceability, along with distributed accounting and cross-chain interaction technologies, offers solutions to these challenges. By creating private chains within enterprises that connect with external alliance chains, companies can enhance the transparency and reliability of ESG disclosures. The concept of ESG was first introduced by the United Nations in 2004, encompassing environmental, social, and governance aspects. It served as a foundation for information disclosure, rating, and investment guidance frameworks. Globally, establishing a robust ESG disclosure system has become a priority. For China to meet its 2030 carbon peak target, a well-defined system is essential. However,

inconsistent standards and unreliable information remain significant obstacles in China's ESG disclosure landscape.

Boumaiza & Maher (2024) explored the potential for optimizing energy consumption patterns and significantly reducing carbon emissions through blockchain-based decentralized energy trading. The comparison between traditional systems and the proposed framework highlighted the benefits of adopting blockchain for carbon trading, a market mechanism designed to reduce greenhouse gas emissions by pricing carbon pollution. Entities that emitted greenhouse gases could buy credits from those who reduced emissions, incentivizing emission reductions and fostering innovation in low-carbon technologies. The blockchain-based peer-to-peer (P2P) platform empowered energy prosumers-individuals who both produced and consumed energy-enhancing sustainability while promoting carbon reduction. By ensuring secure, transparent, and tamper-proof transactions through blockchain, the platform minimized fraud and manipulation, providing a trustworthy system for energy distribution. This approach could have played a crucial role in advancing the low-carbon economy and offering a reliable method for reducing carbon footprints over time.

Hasan et al. (2024) researched on optimizing the certification process for farmers while highlighting broader challenges in agricultural sustainability. Despite its primary aim, the platform did not address other agricultural aspects or accommodate diverse food certifications. Within the EU, efforts targeted agriculture, food production, consumption, and waste reduction to ensure food security, environmental protection, and public health. Traditional farming practices often involved synthetic fertilizers and pesticides, causing harm to human health and ecosystems by polluting soil and water. Emphasizing sustainable food solutions became essential to maintain land fertility and ensure future food security. The integration of IoT, blockchain, and IPFS offered a transformative approach by eliminating deceptive labelling practices and enhancing transparency. With smart contracts and tamper-proof records, the framework fostered accountability and trust, enabling transparent decisions on farming practices and food certifications. Consumers benefited from reliable methods for tracing agricultural products throughout the supply chain.

Huang et al. (2024) explored the impact of fintech on green bond issuance, highlighting its role in facilitating issuance through intermediaries and enhancing environmental awareness. It examined how regional fintech development influenced green finance and assessed variations based on bond ratings, refinancing, issuer type, and region. The research contributed to existing literature by extending fintech discussions to green bonds, a rapidly growing investment avenue. While prior studies focused on fintech's role in sustainability ventures, green education, and land restoration, this study empirically established a strong link between fintech and green bond issuance. Using robust econometric models, including two-stage least squares estimation, Heckman's two-stage regression, and a staggered did approach leveraging fintech initiatives in Chinese cities, the study validated its findings. It also offered policy insights for promoting sustainable finance, reinforcing fintech's significance in driving eco-friendly investments and advancing global financial sustainability.

Research Methodology

This survey paper utilized a complete writing audit philosophy to look at the convergence of blockchain innovation and Ecological, Social, and Administration (ESG) responsibility, especially in tending to greenwashing. The exploration included efficiently assembling information from trustworthy data sets utilizing important watchwords, bringing about an underlying ID of 59 papers, with 21 chosen for top to bottom investigation in view of consideration standards zeroed in on observational pertinence and systemic meticulousness. A topical and similar examination of the writing was directed to blend key experiences concerning blockchain's part in improving ESG straightforwardness, its expected boundaries to reception, and its suggestions for cultivating "green trust." This strategy highlights the extraordinary capability of blockchain in advancing manageability while recognizing the requirement for additional exploration to explore its difficulties.

Conclusion and Discussion

As organizations and monetary foundations endeavor to meet natural, social, and administration (ESG) assumptions, worries about greenwashing-where organizations overstate or distort their maintainability endeavors-have become more critical. While numerous associations guarantee to be pursuing manageability, irregularities in revealing, absence of normalized check processes, and deluding claims keep on debilitating shopper and financial backer trust. Resolving this issue is basic, and blockchain innovation has arisen as a promising arrangement by bringing straightforwardness, dependability, and responsibility to supportability divulgences. In conclusion, this study offers a comprehensive analysis of how U.S. companies are harnessing blockchain technology to promote sustainability, highlighting their involvement with local ecosystems and the influence of geographic factors. By employing innovative techniques such as web text mining and deep learning, the research identifies and evaluates the level of commitment companies have toward sustainability through blockchain initiatives (Zhu F, Liu D, 2024). The study also explores the integration of these companies within broader ecosystems, utilizing large-scale web scraping and NLP to understand how their online presence reflects their sustainability efforts. Additionally, mapping the hyperlink connections between these corporate websites provides valuable insights into how geographical and ecosystem-based networks shape blockchain-driven sustainability efforts. The rising adoption of "green" initiatives, particularly in sectors like oil and gas, has sparked concerns over greenwashing, with companies like Pathways Alliance facing scrutiny for misleading communication practices. This research emphasizes the need for transparent, credible reporting to ensure that net-zero commitments are both authentic and achievable (Aronczyk, McCurdy, Russill, 2024). Moreover, the study illustrates how blockchain technology can address sustainability challenges in sectors like food supply chains, promoting shared value creation and enabling more equitable and sustainable supply networks. The decentralized nature of blockchain presents opportunities to overcome barriers to sustainability, particularly in the context of circularity and environmental impact. (Bager, Singh, Persson, 2022). Finally, the research underscores the transformative potential of blockchain in enhancing value flows and operational efficiencies, especially when integrated

with emerging technologies like additive manufacturing. While challenges remain, this study offers significant insights into how blockchain can revolutionize industrial processes, offering new pathways for businesses to meet both financial and sustainability objectives. **(Kinne J et al., 2024)**. This survey features the extraordinary capability of blockchain-based arrangements, which influence decentralized records, brilliant agreements, and ongoing following to make more solid ESG detailing frameworks. In ventures like food supply chains, finance, and moral obtaining, blockchain assumes a significant part in improving discernibility, limiting misrepresentation, and empowering moral strategic policies. Moreover, in the green money area, blockchain-fueled drives, for example, carbon credit exchanging and green securities can assist with coordinating speculations toward genuinely economical undertakings, diminishing the dangers related with deceiving ESG claims in monetary business sectors. **(Friedman, Ormiston, 2022)**. In any case, notwithstanding its true capacity, a few impediments thwart the far reaching reception of blockchain for ESG responsibility: Administrative Vulnerability-The absence of worldwide rules and arrangements for blockchain-based ESG revealing makes difficulties in accomplishing boundless acknowledgment.

Innovative Boundaries-High execution costs, framework incorporation intricacies, and interoperability issues make it challenging for associations to take on blockchain-based ESG systems. Industry Opposition-A few partnerships, profiting from non-straightforward ESG detailing, may oppose embracing an innovation that implements more noteworthy responsibility. **(Cozzio et al., 2023)**. While blockchain alone can't completely dispose of greenwashing, its capacity to give sealed, auditable, and decentralized records presents a practical pathway toward building "green trust." Pushing ahead, encouraging joint effort among controllers, innovation specialists, organizations, and supportability backers will be fundamental for refining blockchain-based ESG structures and guaranteeing that manageability claims satisfy the most elevated guidelines of validity **(Huang et al., 2023)**.

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