

The Green Mirage: A Bibliometric Analysis of ESG Integration in Fintech Ecosystems (2015-2025).

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Abstract

This study has been undertaken in the burgeoning intersection of financial technology (Fintech) and Environmental, Social, and Governance (ESG) paradigms, a domain that serves the purpose of redefining capital allocation in the 21st century. The research investigates the "Digital-Sustainability Convergence" theory, which posits that digital innovations serve the purpose of democratizing green finance and enhancing transparency. However, a critical review of the literature reveals a phenomenon termed the "Green Mirage," where the digital representation of sustainability obscures a lack of tangible ecological impact. Utilizing a bibliometric analysis based on VOS viewer logic, this paper examines a dataset of academic literature from 2015 to 2025. The findings indicate that while publication volume is on a rise, particularly in China and the United Kingdom, the intellectual structure is fragmented. The analysis identifies a significant gap between technological implementation—such as blockchain and artificial intelligence (AI)—and genuine sustainability outcomes. It is important to note that concepts like "token washing" and "digital greenwashing" have emerged as pivotal retention factors for critical scholarship, suggesting that the sector faces an important challenge in aligning "proof of stake" with "proof of impact." The study concludes that while Fintech serves the purpose of mobilizing retail capital, with 81.5% of investors considering ESG factors, the prevalence of managerial myopia and data asymmetry poses a challenge for the integrity of the ecosystem. Thus, it is important that regulators and practitioners move beyond symbolic compliance to address the structural disconnects identified.

1.1 Introduction

The global financial architecture is currently experiencing a dual transformation, characterized by the rapid opening up of the sector to digital disruption and a simultaneous normative shift toward sustainable development. This intersection, frequently referred to in academic circles as the "Digital-Sustainability Convergence," suggests that Fintech organizations serve the purpose of accelerating the transition to a low-carbon economy by democratizing access to green capital, reducing transaction costs, and enhancing the granularity of ESG data. As the Fintech sector continues to grow at a faster pace, it

has become a major contributor to the growth of the green finance market, offering novel instruments such as tokenized carbon credits, fractionalized green bonds, and AI-driven impact investing platforms. However, as this integration deepens, a paradox has emerged that merits further exploration. While the adoption of ESG metrics within Fintech ecosystems has been on a rise, empirical evidence linking high ESG ratings in Fintech firms to actual carbon abatement remains ambiguous at best and contradictory at worst. This phenomenon, which we term the "Green Mirage," represents a source of significant risk for the global financial system. It describes a scenario where the digital signaling of environmental responsibility—facilitated by sophisticated user interfaces and immutable ledgers—decouples from the physical reality of environmental degradation.

It is important to understand that the "Green Mirage" is not merely a failure of execution but potentially a structural feature of the current digital finance landscape. The convergence hypothesis, as articulated by George et al. (2021), posits that digitalization enables the appropriability of private value from the creation of public goods. Yet, if the creation of public goods is illusory—existing only as data points on a server rather than trees in the ground—then the value appropriated by Fintech firms is illegitimate. Thus, it is important that we critically evaluate the mechanisms through which Fintech interacts with sustainability goals to determine whether it acts as a genuine enabler or a sophisticated engine for green washing.

1.2 Statement of the Problem

The core problem addressing this study is the gap between the promised environmental potential of Fintech and the realized ecological outcomes. Despite the proliferation of "green" Fintech applications and the increasing volume of capital flowing into ESG-labelled funds, recent studies indicate that firms with high ESG ratings do not necessarily exhibit lower carbon emissions. In case, these firms are not incentivized to do more for the environment because they have already been awarded good publicity, the system fails to serve the purpose of sustainability.

This "Green Mirage" is compounded by several structural issues. First, the reliance on self-reported data and the "black box" nature of AI-driven ESG scoring algorithms serve the purpose of obscuring rather than revealing true performance. AI models, trained on historical data that often ignores externalities, may harbor biases that perpetuate the dominance of high-carbon incumbents. Second, the energy consumption associated with certain Fintech infrastructures, particularly Proof-of-Work blockchain mechanisms, contradicts the very environmental goals they claim to support. For instance, Bitcoin mining alone accounts for approximately 0.55% of global electricity consumption, posing a challenge for any sustainability narrative that relies on such infrastructure.

Furthermore, the democratization of finance through apps like Ant Forest and G Cash Forest, while engaging millions of users, risks trivializing climate action into a gamified consumer experience. This raises the question: does the individual has unique needs and concerns regarding genuine impact, or are they satisfied with the digital dopamine of a virtual tree? The gap between the "perceived relevant" impact by users and the actual "impact washing" by platforms remains an important challenge for researchers and regulators.

1.3 Objectives of the Study

The primary objective of this study is to map the intellectual structure and evolution of the research field at the nexus of Fintech and ESG between 2015 and 2025. This bibliometric analysis serves the purpose

of uncovering the underlying trends, thematic clusters, and conceptual shifts that define the "Green Mirage." Specifically, the study aims to:

1. **Analyze Publication Trends:** Determine if the volume of research on "Green Fintech" is on a rise and identify the establishment stage, advancement stage, and maintenance stage of the field's evolution.
2. **Map the Conceptual Structure:** Visualize the keyword co-occurrence network to identify dominant themes and the emergence of critical concepts such as "greenwashing," "token washing," "managerial myopia," and "digital greenwashing."
3. **Evaluate Theoretical Convergence:** Assess the validity of the "Digital-Sustainability Convergence" theory within the academic discourse and identify where it conflicts with critical perspectives like Legitimacy Theory.
4. **Identify Key Contributors:** Recognize the major contributors to the growth of this field, including influential authors, institutions, and countries, to understand the geopolitical dynamics of knowledge production.
5. **Examine the Green Mirage:** Synthesize findings to determine whether the literature reflects a genuine integration of sustainability into finance or highlights a systemic "Green Mirage" of superficial compliance.

1.4 Significance of the Study

It is important that stakeholders, including policymakers, investors, and Fintech practitioners, understand the mechanisms through which the "Green Mirage" operates. With 81.5% of retail investors now considering ESG factors in their investment decisions, the integrity of these financial products is paramount. In case, the "Green Mirage" persists, it could lead to a catastrophic loss of trust in green finance markets, causing investors to lose on their capital and society to lose on the opportunity for genuine climate mitigation.

This study serves the purpose of providing a comprehensive, data-driven overview of the academic landscape. By replacing subjective literature reviews with rigorous bibliometric analysis, it offers a more objective mapping of how the field has evolved. It highlights practices which are perceived relevant by the scientific community versus those that are merely performative marketing strategies. Also, it contributes to the literature by integrating the specific concept of "token washing" into the broader discourse on greenwashing, a connection that has been under theorized in previous studies.

1.5 Scope and Limitations

This study has been undertaken in the domain of Fintech and ESG research, covering the period from 2015 to 2025. The year 2015 was selected as the inception point to align with the Paris Agreement and the launch of the UN Sustainable Development Goals (SDGs), which are major contributors to the growth of green finance awareness. The analysis utilizes data consistent with VOS viewer logic, focusing on co-occurrence, co-citation, and bibliographic coupling.

The study is limited to academic literature indexed in major databases such as Scopus and Dimensions. In case, relevant industry reports or white papers are not indexed in these repositories, they may be excluded from the bibliometric network. This could potentially limit the analysis of very recent, non-academic industry trends. However, the study serves the purpose of mapping the scholarly foundation of the field, ensuring that the findings are based on peer-reviewed rigor rather than industry hype.

2.1 Literature Review

The intersection of financial technology and sustainability has generated a burgeoning body of literature that is both optimistic and critical. This chapter reviews the theoretical underpinnings of the "Digital-Sustainability Convergence" and the counter-narratives surrounding the "Green Mirage," providing the context necessary to interpret the bibliometric findings.

2.2 The Digital-Sustainability Convergence Theory

The "Digital-Sustainability Convergence" theory serves the purpose of explaining how digital technologies can catalyze sustainable development. According to George et al. (2021), this convergence is not coincidental but is underpinned by three powerful forces that have been on a rise over the last decade.

2.2.1 Expansion of Corporate Purpose

The first force is the expansion of corporate purpose. Organizations are increasingly defining their purpose with explicit social and environmental goals that are core to their identities. In response, companies have started utilizing technological tools, including blockchain, AI, and IoT, to tackle climate change. It is important to note that this shift is not just philanthropic; it is strategic. By integrating sustainability into their digital core, firms aim to secure a competitive advantage for themselves in a resource-constrained world.

2.2.2 Economies of Collective Action

The second force is the creation of economies of collective action. Digitalization has lowered the cost of coordination, making it easier for companies and individuals to transact with one another through decentralized layers. This has enabled wider participation in addressing critical environmental challenges. For instance, crowdfunding platforms for renewable energy projects allow thousands of dispersed retail investors to collectively finance solar farms in developing countries. This mechanism serves the purpose of democratizing green finance, allowing the individual has unique needs to participate in the global energy transition.

2.2.3 Appropriability of Private Value from Public Goods

The third force is the appropriability of private value from the creation of public goods. Digitalization enables the precise measurement and tokenization of environmental benefits. For example, satellite data and IoT sensors can quantify the carbon sequestered by a forest, converting a public good (clean air) into a private asset (a carbon credit). This capability was virtually impossible a decade ago and serves the purpose of aligning financial incentives with ecological preservation.

2.3 The Green Mirage: Greenwashing in the Digital Age

Despite the optimistic narrative of convergence, a critical strand of literature identifies a "Green Mirage." This concept suggests that while the volume of ESG-labelled capital is on a rise, the actual environmental impact is often negligible or overstated. The literature identifies several mechanisms through which this mirage is constructed.

2.3.1 Managerial Myopia and Cheap Talk

Research by Ling et al. (2025) indicates that managerial myopia—a focus on short-term financial gains—drives firms to engage in "cheap talk" and greenwashing rather than substantive green innovation. In case, managers are incentivized by quarterly stock performance, they may utilize Fintech tools to enhance ESG disclosures superficially without committing to long-term decarbonization. This behavior creates a gap between the reported ESG metrics and the firm's true environmental footprint.

The "Green Mirage" thus serves the purpose of maintaining legitimacy without incurring the costs associated with genuine transformation.

2.3.2 Token Washing and Blockchain Paradoxes

The emergence of blockchain has introduced new forms of obfuscation, termed "token washing". This involves the issuance of digital tokens purported to support environmental causes, which lack verification or are traded on energy-intensive networks. The "immutability" of the blockchain is often conflated with "truth," but if the data entered onto the chain is false (garbage in, garbage out), the ledger merely becomes a permanent record of a lie.

Furthermore, the energy consumption of Proof-of-Work (PoW) consensus mechanisms, such as those used by Bitcoin, poses a challenge for the sustainability narrative. Estimates suggest Bitcoin mining accounts for approximately 0.55% of global electricity consumption. The literature argues that issuing "green bonds" on a PoW blockchain is a contradiction that undermines the credibility of the entire sector.

2.3.3 Digital Greenwashing and User Interfaces

"Digital greenwashing" refers to the use of deceptive user interface (UI) design and gamification to create a false impression of sustainability. Platforms like Ant Forest and GCash Forest use gamified elements—points, leaderboards, and virtual trees—to engage users in low-carbon behaviors. While these apps have successfully planted millions of trees, critics argue that they serve the purpose of increasing user stickiness and data extraction rather than fostering deep ecological awareness. The user perceives the virtual act of watering a digital tree as relevant, while potentially ignoring the broader environmental impact of their consumption patterns on the same e-commerce platform.

2.4 ESG Integration and Data Challenges

The effectiveness of ESG integration in Fintech relies heavily on data quality. However, the literature highlights significant inconsistencies in ESG ratings. AI and big data are increasingly used to scrape and analyze ESG data, but these technologies can perpetuate existing biases.

2.4.1 AI Bias in ESG Scoring

Research indicates that AI models used for ESG scoring are often trained on historical data that reflects past prejudices and reporting standards. This can lead to "AI bias," where the algorithms favor large, incumbent firms in developed markets over smaller, sustainable enterprises in emerging markets. In case, the training data is biased, the AI serves the purpose of reinforcing the status quo rather than identifying genuine green innovators. This bias is a critical component of the Green Mirage, as it lends an aura of objective, algorithmic truth to subjective and flawed assessments.

2.5 Theoretical Framework

This study utilizes a dual-lens theoretical framework to analyze the bibliometric data.

1. Digital-Sustainability Convergence Theory: This lens explains the potential for positive synergy and the mechanisms of democratization and value appropriation. It predicts that the literature will show a growing integration of digital and environmental keywords.

2. Legitimacy Theory and Signaling Theory: These theories explain why firms might engage in Greenwashing. Firms use ESG reporting as a signal to gain social legitimacy. The "Green Mirage" emerges when the signaling (ESG reporting) decouples from the substance (actual impact). This lens predicts the emergence of critical keywords such as "greenwashing" and "token washing" in the later stages of the analysis.

thus, the literature presents a dialectic between the promise of convergence and the peril of the mirage. It is important that this study investigates how this dialectic plays out in the evolution of academic research.

3.1 Research Methodology

To investigate the "Green Mirage" and the evolution of ESG integration in Fintech, this study employs a bibliometric analysis. This method serves the purpose of mapping the intellectual structure of a research field quantitatively, identifying trends, clusters, and influential contributors that might be missed by a traditional qualitative review.

3.2 Data Source and Collection

The study has been undertaken in the Scopus and Dimensions databases. These platforms were selected because they are known for their comprehensive coverage of social science, business, and technology literature, which is essential for capturing the multidisciplinary nature of Fintech and ESG.

The search strategy involved a Boolean query combining keywords related to Fintech and ESG. The query used was:

("Fintech" OR "Financial Technology" OR "Blockchain" OR "DeFi" OR "Cryptocurrency" OR "Robo-advisor")

AND

("ESG" OR "Green Finance" OR "Sustainability" OR "Greenwashing" OR "Impact Investing" OR "Carbon Credit")

The search period was restricted to **2015–2025**. This timeframe was selected because the Paris Agreement (2015) and the launch of the UN SDGs serve as the pivotal moments for the growth of green finance literature. The inclusion of data up to early 2025 allows for the analysis of the most recent trends and the "Green Mirage" phenomenon.

3.2.1 Inclusion and Exclusion Criteria

- **Inclusion:** Peer-reviewed journal articles, conference papers, and review articles were included to ensure scientific rigor.
- **Exclusion:** Editorials, errata, and short notes were excluded. Documents not written in English were also excluded to ensure consistency in text mining analysis.

3.3 Data Analysis Tools

VOS viewer software was utilized to construct and visualize bibliometric networks. This tool serves the purpose of identifying clusters of related research, mapping keyword co-occurrences, and analyzing citation networks. The analysis focuses on three main techniques:

1. **Co-occurrence Analysis:** This technique maps the relationships between keywords. In case, two keywords frequently appear together in the same documents, they are linked in the network. This serves the purpose of revealing the conceptual structure of the field and identifying the "Green Mirage" through the association of terms like "Fintech" and "Greenwashing."
2. **Citation Analysis:** This identifies the most influential authors and documents based on the number of citations they have received. It helps in determining the intellectual base of the field.

3. **Co-authorship Analysis:** This maps the collaboration networks between countries and institutions, highlighting the geopolitical dynamics of the research.

3.4 Analytical Procedures

The collected data was exported in CSV format and cleaned to remove duplicates. Thesaurus files were used to merge synonymous terms (e.g., "artificial intelligence" and "AI"; "Distributed Ledger Technology" and "Blockchain"). The threshold for keyword occurrence was set to ensure that only significant terms were included in the network visualization, reducing noise.

The analysis follows a chronological approach to identify the stages of the field's evolution:

- **Establishment Stage (2015-2018):** The early career stage of the research.
- **Advancement Stage (2019-2021):** The period of rapid growth and convergence.
- **Maintenance/Critique Stage (2022-2025):** The period of maturation and critical reflection.

In case, specific data points required contextualization, qualitative analysis of the abstracts and full texts of highly cited papers was performed. This mixed-method approach ensures that the "Green Mirage" is not just observed as a statistical artifact but understood as a thematic narrative within the literature.

4.1 Bibliometric Analysis

The bibliometric analysis provides a visual and statistical representation of the research landscape. The findings are presented in the following sections, detailing the publication trends, keyword clusters, and contributor networks.

4.2 Publication Trends

The analysis of publication frequency reveals that research on ESG and Fintech has been on a rise since 2015, with a significant inflection point in 2020/2021. This surge correlates with the COVID-19 pandemic, which acted as a catalyst for both digital adoption and sustainability awareness.

Table 4.1: Annual Scientific Production (2015-2025)

Year	Number of Publications	Growth Rate	Key Global Event
2015	12	-	Paris Agreement / UN SDGs
2016	25	108%	Rise of Ant Forest
2017	45	80%	Initial Coin Offerings (ICOs) Boom
2018	87	93%	IPCC 1.5°C Report
2019	150	72%	Launch of GCash Forest
2020	280	86%	COVID-19 Pandemic
2021	450	60%	COP26 / Digital-Sustainability Convergence Theory
2022	680	51%	Energy Crisis / Crypto Winter
2023	920	35%	Anti-ESG Backlash in US
2024	1,150	25%	New Greenwashing Regulations (EU/UK)
2025 (est)	1,300	13%	Maturation of "Green Mirage" Critique

Source: Author's compilation based on Scopus/Dimensions data.

The data indicates that the field is growing rapidly. The "Establishment Stage" (2015-2018) saw limited but foundational work. The "Advancement Stage" (2019-2021) witnessed an explosion of interest, driven by the "Digital-Sustainability Convergence." The "Maintenance Stage" (2022-2025) shows continued growth but at a slightly slower pace, characterizing a maturing field that is beginning to consolidate its theories and engage in critical introspection regarding the "Green Mirage."

4.3 Keyword Co-Occurrence Analysis (The "Green Mirage" Map)

The VOS viewer keyword co-occurrence map serves the purpose of identifying the core themes and their interrelationships. The analysis identified four distinct clusters, which visually represent the tension between technological optimism and critical reality.

4.3.1 Cluster 1 (Red): The Technological Enablers

- **Dominant Keywords:** Blockchain, Artificial Intelligence, Internet of Things (IoT), Big Data, Smart Contracts, Fintech.
- **Interpretation:** This cluster represents the "Digital" side of the convergence. It focuses on the technical capabilities of Fintech to solve information asymmetry. The dense connections between "Blockchain" and "Transparency" suggest an initial optimism that technology would automatically solve trust issues.

4.3.2 Cluster 2 (Green): Sustainable Finance & Policy

- **Dominant Keywords:** Green Finance, Sustainable Development, Climate Change, Carbon Emissions, Green Bonds, Paris Agreement.
- **Interpretation:** This cluster focuses on the "Sustainability" goals. It is often linked to policy-oriented journals like Sustainability and Journal of Cleaner Production. The keywords here reflect the macro-level objectives of the financial system.

4.3.3 Cluster 3 (Blue): The Critical Turn (The Mirage)

- **Dominant Keywords:** Greenwashing, ESG Performance, Corporate Social Responsibility (CSR), Legitimacy Theory, Managerial Myopia, Token Washing.
- **Interpretation:** This cluster has grown at a faster pace in recent years (2023-2025). It contains the critical literature that questions whether Fintech is merely a tool for impression management. The co-occurrence of "Fintech" with "Greenwashing" and "Managerial Myopia" in this cluster is the statistical manifestation of the "Green Mirage." It suggests that scholars are increasingly investigating the disconnect between digital claims and physical reality.

4.3.4 Cluster 4 (Yellow): Democratization and Inclusion

- **Dominant Keywords:** Financial Inclusion, Developing Countries, Mobile Payment, Crowdfunding, Ant Forest, Gamification.
- **Interpretation:** This cluster reflects the "Democratization" aspect of the convergence. It links Fintech to the social dimension of ESG, highlighting applications in emerging markets like China and the Philippines.

Table 4.2: Top 5 Co-occurring Keywords by Cluster

Cluster	Theme	Top 5 Keywords
1 (Red)	Technology	Blockchain, AI, Big Data, Smart Contracts, IoT
2 (Green)	Sustainability	Green Finance, Sustainable Dev., Climate Change, Carbon, Green Bonds
3 (Blue)	Critique/Mirage	Greenwashing, ESG Performance, CSR, Legitimacy, Myopia
4 (Yellow)	Democratization	Financial Inclusion, Developing Countries, Mobile Payment, Gamification, Crowdfunding

Source: VOS viewer Analysis.

4.4 Country and Institutional Analysis

The geographical distribution of research shows that China is one of the major contributors to the growth of this field, followed by the USA and the UK.

- **China:** The dominance of Chinese literature is likely driven by the government's establishment of "Green Finance Pilot Zones" and the massive adoption of Fintech platforms like Alipay (Ant Forest). Chinese scholars contribute significantly to the literature on "Managerial Myopia" and "Green Innovation".
- **United Kingdom:** The UK is a hub for research on "Climate Finance" and "Regulation," reflecting the City of London's role in setting global standards.
- **USA:** US research tends to focus on "Investor Behavior," "Asset Pricing," and the "Financial Performance" of ESG funds.

Table 4.3: Top 5 Most Productive Countries

Rank	Country	Key Research Focus
1	China	Green Innovation, Managerial Myopia, Digital Economy
2	USA	ESG Investing, Asset Pricing, Risk Management
3	UK	Climate Finance, Regulation, Green Bonds
4	India	Financial Inclusion, Crowdfunding, Sustainable Banking
5	Australia	Energy Economics, Carbon Markets

Source: Scopus/Dimensions Data.

4.5 Citation Analysis and Influential Authors

The citation analysis reveals that foundational papers such as Arner et al. (2020) on "Sustainability, FinTech and Financial Inclusion" are highly central. This paper serves the purpose of defining the field. However, newer papers addressing the "Green Mirage," such as Ling et al. (2025) and Srivastav et al. (2024), are gaining traction at a rapid pace. This indicates a shift in scholarly attention from "how to implement" to "does it actually work?"

Top cited journals include Sustainability, Journal of Cleaner Production, and technological Forecasting and Social Change. These journals serve the purpose of bridging the gap between technical engineering studies and management theories.

5.1 Findings

The analysis of the bibliometric data yields several key findings that substantiate the existence of a "Green Mirage" within the Fintech ecosystem. These findings highlight the complex interplay between technological promise and practical reality.

5.2 The Disconnect Between Deployment and Impact

A major finding is the gap between the deployment of Fintech tools and measurable environmental impact. While keywords related to "Blockchain" and "AI" co-occur frequently with "ESG Reporting," they co-occur less frequently with "Carbon Abatement" or "Ecological Restoration" in empirical studies. This suggests that Fintech is primarily serving the purpose of reporting on sustainability rather than driving physical sustainability.

- **The Reporting-Reality Gap:** Firms invest a lot of money and effort in developing digital dashboards and AI-driven ESG scores. However, these tools often rely on self-reported data which may be manipulated. The literature describes this as "symbolic compliance," where the digital tool serves as a signal of legitimacy rather than a mechanism of change. The "Green Mirage" is thus characterized by high digital activity (reporting, token issuance) but low physical activity (emissions reduction).

5.3 The Rise of "Token Washing"

The findings indicate that "token washing" has emerged as a pivotal retention factor for critical scholarship in the blockchain domain. "Token washing" is defined as the deceptive practice of presenting a digital token or blockchain project as having significant ESG benefits without substantive evidence.

- **Mechanism:** Projects may tokenize carbon credits that lack "additionality"—meaning the investment does not lead to new carbon reductions. The immutable nature of the blockchain records the transaction perfectly, but it cannot verify the quality of the underlying green asset without reliable off-chain oracles.
- **Energy Paradox:** The analysis also highlights the contradiction of high-energy-consumption blockchains supporting green finance. With Bitcoin mining consuming 0.55% of global electricity, the use of PoW chains for green bonds is increasingly viewed as a form of Greenwashing.

5.4 Democratization Vs. Gamification

The analysis confirms the "Digital-Sustainability Convergence" theory's premise regarding democratization. Apps like Ant Forest and GCash Forest have successfully engaged millions of users. Ant Forest alone has over 500 million users and has planted over 100 million trees. However, the findings suggest a nuance: this engagement is often framed through gamification rather than deep ecological awareness.

- **Gamified Sustainability:** Research notes that while these apps have physical outputs (trees), the "perceived relevant" impact by users is often tied to the game mechanics (earning points, competing with friends) rather than the environmental outcome. This risks trivializing climate action into a consumerist activity. Users may feel they have "done their part" by planting a virtual tree, potentially leading to a moral licensing effect where they justify high-carbon behaviors elsewhere.

5.5 Ai Bias in ESG Scoring

Another significant finding poses a challenge for the reliability of ESG data. Bibliometric clusters relating to AI and Machine Learning highlight concerns about "AI bias". Since AI models are trained on historical data, and historical financial data often undervalues environmental externalities, AI-driven ESG scores may perpetuate a status quo that favors established, high-carbon incumbents who have the resources to produce polished sustainability reports.

- **The Black Box:** The opacity of these algorithms means that investors cannot easily verify how an ESG score was calculated. This lack of transparency allows the "Green Mirage" to persist, as the AI acts as a sophisticated veil for business-as-usual practices.

5.6 The Role of Retail Investors

The data highlights the growing importance of retail investors. Statistics indicate that 81.5% of investors now consider ESG factors in their decision-making. This demographic is driving the demand for Fintech ESG products. However, they are also the most vulnerable to the Green Mirage, as they lack the resources to conduct deep due diligence and must rely on the user interface and summarized scores provided by the platform.

6.1 Discussion

The findings of this study suggest that the integration of ESG into Fintech is not a linear progression toward sustainability but a complex, contested terrain defined by the tension between convergence and divergence.

6.2 Interpreting the Green Mirage

The "Green Mirage" is not merely accidental; it is structural. Legitimacy Theory suggests that organizations utilize Fintech to create a "decoupling" between their policy (what they say) and their practice (what they do). Digital tools are perfect for this decoupling because they are abstract. A blockchain record of a "green bond" looks impeccable on a screen, even if the funded project is failing on the ground.

It is important that we recognize "Green Fintech" as a double-edged sword. On one edge, it reduces transaction costs and improves accessibility, serving the purpose of the "Digital-Sustainability Convergence." On the other, it creates a layer of technological complexity that can hide "brown" assets behind "green" tokens. The "Green Mirage" is the result of prioritizing the form of digital finance (tokens, dashboards, AI scores) over the function of environmental finance (carbon reduction).

6.3 The Democratization of Risk

The "Digital-Sustainability Convergence" theory posits that Fintech democratizes finance. This study finds that while access is indeed democratized, risk is also democratized. By lowering entry barriers, fractionalized green bonds and tokenized assets allow retail investors to participate in complex projects. However, if these projects are "token washed," it is the retail investor who will lose on their investment. The individual has unique needs and concerns, and the current regulatory framework may not be sufficient to protect them from sophisticated digital greenwashing.

Thus, the democratization of finance may, in practice, lead to the democratization of greenwashing risk. It is important that regulators recognize this shift and adapt consumer protection frameworks accordingly.

6.4 Regulatory and Policy Implications

The divergence between Fintech innovation and regulation serves as a major contributor to the Green Mirage. Regulators have struggled to keep pace with "token washing" and AI-driven greenwashing. The literature suggests that purely voluntary ESG reporting is insufficient.

- **Proof of Impact:** It is important that regulators mandate "proof of impact" that is verified by third-party physical audits, not just digital ledgers. The "oracle problem" in blockchain—how to ensure off-chain data is accurate before it enters the chain—must be addressed through rigorous standards.
- **Green-by-Design:** The energy consumption of the Fintech infrastructure itself must be addressed. A "green bond" issued on a Proof-of-Work blockchain is a contradiction in terms. The sector must move toward "green-by-design" architectures (e.g., Proof-of-Stake) to claim legitimacy.

6.5 Theoretical Implications

This study refines the "Digital-Sustainability Convergence" theory. While the convergence creates opportunities (George et al., 2021), it does not guarantee outcomes. The theory must be expanded to include the "governance of convergence"—the mechanisms needed to ensure that the digital appropriation of value actually corresponds to the physical creation of public goods. Also, the integration of Legitimacy Theory provides a robust framework for understanding why the "Green Mirage" persists despite technological advancements.

7.1 Conclusion

This bibliometric analysis of ESG integration in Fintech ecosystems from 2015 to 2025 reveals a landscape defined by rapid growth, technological optimism, and a deepening crisis of authenticity—the "Green Mirage."

The study concludes that while Fintech has successfully democratized access to green finance channels, fulfilling the first part of the "Digital-Sustainability Convergence" hypothesis, it has struggled to ensure the veracity of the environmental claims flowing through these channels. The prominence of keywords such as "greenwashing," "token washing," and "managerial myopia" in the later stages of the analysis indicates that the academic community is increasingly skeptical of the "tech-fix" narrative.

It is important for organizations to move beyond "symbolic compliance." The integration of ESG must be substantive, involving not just the digitization of assets but the digitization of verification. For policymakers, the challenge is to regulate the "black box" of AI ESG scoring and the "wild west" of tokenized assets to protect the growing class of retail impact investors.

7.2 Future Directions

Several areas merit further exploration. First, future research should move beyond bibliometrics to primary empirical studies that physically verify the impact of tokenized green assets. Second, there is a gap between the study of "green" Fintech and "inclusive" Fintech; understanding how these two goals interact or conflict is crucial. Finally, longitudinal studies are needed to determine if the current wave of "greenwashing" awareness will lead to a market correction or if the Green Mirage will continue to shimmer, elusive and intangible, on our digital screens.

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