Journal of Posthumanism
2025
Volume: 5, No: 2, pp. 1023–1051
ISSN: 2634-3576 (Print) | ISSN 2634-3584 (Online)
posthumanism.co.uk

DOI: https://doi.org/10.63332/joph.v5i2.472

A Systematic Review of Literature on Factors Influencing the Effect of Fintech on Green Finance in ASEAN countries

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Abstract

Green finance, defined as financial actions aimed at supporting sustainable environmental practices, has emerged as a critical element in the fight against climate change and the promotion of sustainable development. In this context, fintech—short for financial technology—has become increasingly recognized as a transformative force that enhances the efficiency, accessibility, and scalability of green finance. This systematic literature review investigates the factors influencing the relationship between fintech and green finance, with a focus on three main aspects: moderating, mediating, and control variables in the context of ASEAN countries. The review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)methodology to explore the role of fintech in advancing green finance. Drawing from an extensive dataset of 5,508 publications published between 2020 and 2025, we analyse the factors that influence the effect of fintech on green finance—specifically the moderating, mediating, and control variables—using bibliometric analysis of 68 closely related journal articles. This review proposes a theoretical framework that examines how fintech facilitates green finance and provides empirical evidence that informs policymakers and directs future research aimed at integrating fintech and green finance within a unified framework.

Keywords: *Fintech, Green Finance, ASEAN, Moderator, Mediator*

JEL Classification: ***G0, O3, Z1***

Introduction

The rapid evolution of financial technology (fintech) has significantly transformed the financial landscape, offering innovative solutions that improve financial efficiency, accessibility, and transparency. In recent years, fintech has become an indispensable component of green finance, enabling more efficient resource allocation, better risk assessment, and expanded financing opportunities for sustainable projects (Xu et al., 2024). Technologies such as blockchain, artificial intelligence (AI), and big data analytics have facilitated the integration of environmental, social, and governance (ESG) considerations into financial decision-making (Rahman et al., 2024; Farooq et al., 2010). However, the relationship between fintech and green finance remains complex, shaped by various moderating, mediating, and control variables that are still not fully understood.

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While existing studies affirm that fintech significantly contributes to green finance by enhancing financial efficiency and promoting green innovation (Xu et al., 2024; Thottoli et al., 2024; Akmal et al., 2020), the extent and effectiveness of this contribution vary across regions, industries, and regulatory contexts. This variation suggests that additional contextual factors influence the impact of fintech (Kashif et al., 2024; Waheed et al., 2010). Recent literature highlights moderating variables such as technological infrastructure, institutional quality, and regulatory frameworks, which can either amplify or diminish fintech's contribution to green finance (Rahman et al., 2024). Additionally, mediating factors, such as financial efficiency and green innovation, are critical links between fintech adoption and sustainable financial outcomes (Thottoli et al., 2024). Despite these insights, there remains a lack of a comprehensive framework that integrates these variables, leaving an incomplete understanding of the mechanisms through which fintech influences green finance.

Furthermore, bibliometric analyses reveal a geographic imbalance in the research, with high-income economies dominating the field, while developing economies remain underrepresented (Rahman et al., 2024; Jam et al., 2011). This geographic imbalance limits the generalizability of findings and highlights the need for a more inclusive framework that considers diverse economic contexts. Moreover, while some studies explore fintech's role in sustainable banking and SME financing, the interactions between fintech, green finance, and external moderating and mediating variables remain fragmented (Kashif et al., 2024; Jam et al., 2017). As a result, there is a pressing need to synthesize existing knowledge and develop a comprehensive conceptual framework that provides a clearer explanation of the multifaceted relationship between fintech and green finance.

To address these gaps, this study proposes a systematic literature review (SLR) using the PRISMA methodology and VOSviewer bibliometric analysis to identify, categorize, and visualize key factors that influence the fintech-green finance relationship. By integrating insights from existing studies, this research aims to construct a comprehensive framework that explicitly incorporates moderating, mediating, and control variables affecting fintech's impact on green finance. This framework will not only advance theoretical understanding but also provide practical guidance for policymakers, financial institutions, and investors seeking to leverage fintech for sustainable development.

This study aims to systematically review the literature on the relationship between fintech and green finance using the PRISMA methodology. It will identify and classify the key moderating, mediating, and control variables influencing fintech's impact on green finance. Additionally, a bibliometric analysis will be conducted using VOSviewer to visualize research trends, keyword co-occurrences, and thematic clusters. The study will also develop a conceptual framework that integrates fintech's role in green finance with these variables and highlight research gaps while proposing future research directions.

The study will address several important research questions. First, it will examine what factors influence the impact of fintech on green finance. Second, it will explore how moderating variables, such as regulatory policies and technological infrastructure, shape the fintech-green finance relationship. Third, it will investigate what mediating mechanisms, including financial efficiency and green innovation, link fintech adoption to green finance outcomes. Fourth, it will identify the control variables that should be considered when analysing the fintech-green finance nexus. The study will also assess emerging research trends and knowledge gaps identified through bibliometric analysis. Lastly, it will examine how an improved framework can enhance

the understanding of fintech's role in green finance.

By addressing these research questions, this study aims to contribute to the existing literature by providing a comprehensive framework that clarifies the mechanisms, contingencies, and external influences shaping fintech's role in green finance. The findings will offer valuable insights for policymakers, financial regulators, and industry practitioners, helping them design targeted strategies that maximize fintech's potential in driving sustainable financial solutions.

Research Methods

Systematic Literature Review using the PRISMA Protocol

A systematic approach was employed to review and synthesize relevant literature on fintech and green finance. The selected articles were analysed to identify recurring themes, key variables, and theoretical frameworks, which were categorized into moderating, mediating, and control variables.

This study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology (Moher et al., 2009; Page et al., 2021; Akash et al., 2023) to reduce bias in the search and selection process. It also aligns with the guidelines set by Tranfield et al. (2003), Petticrew and Roberts (2008), and Pickering and Byrne (2014). PRISMA is a widely recognized approach in environmental and social science research, ensuring standardized eligibility criteria, including research topic, methodology, language, and publication year (Toxopeus et al., 2021; Choi et al., 2021; Morioko & Carvalho, 2016; Voola et al., 2022; Balan et al., 2020).

In adherence to PRISMA, the review process followed structured stages: identifying keywords, screening abstracts, and assessing full-text articles. The primary objective was to gather literature relevant to financing and investment in sustainable infrastructure. The search was conducted in January 2025 across two key academic databases—Web of Science and SCOPUS—which comprehensively cover fintech and green finance research. To capture all relevant publications, the following search terms were employed: ("fintech" OR "financial technology") AND ("green finance" OR "sustainable finance") AND ("ASEAN"). The search terms were tailored for each database's search functionality. Editorial materials, book reviews, corrections, and other non-original sources were excluded to focus on high-quality, original research articles or reviews.

After screening the abstracts and full texts, 68 articles were selected for data extraction and synthesis. These articles formed the basis for developing a comprehensive framework that integrates moderating, mediating, and control variables influencing the relationship between fintech and green finance.

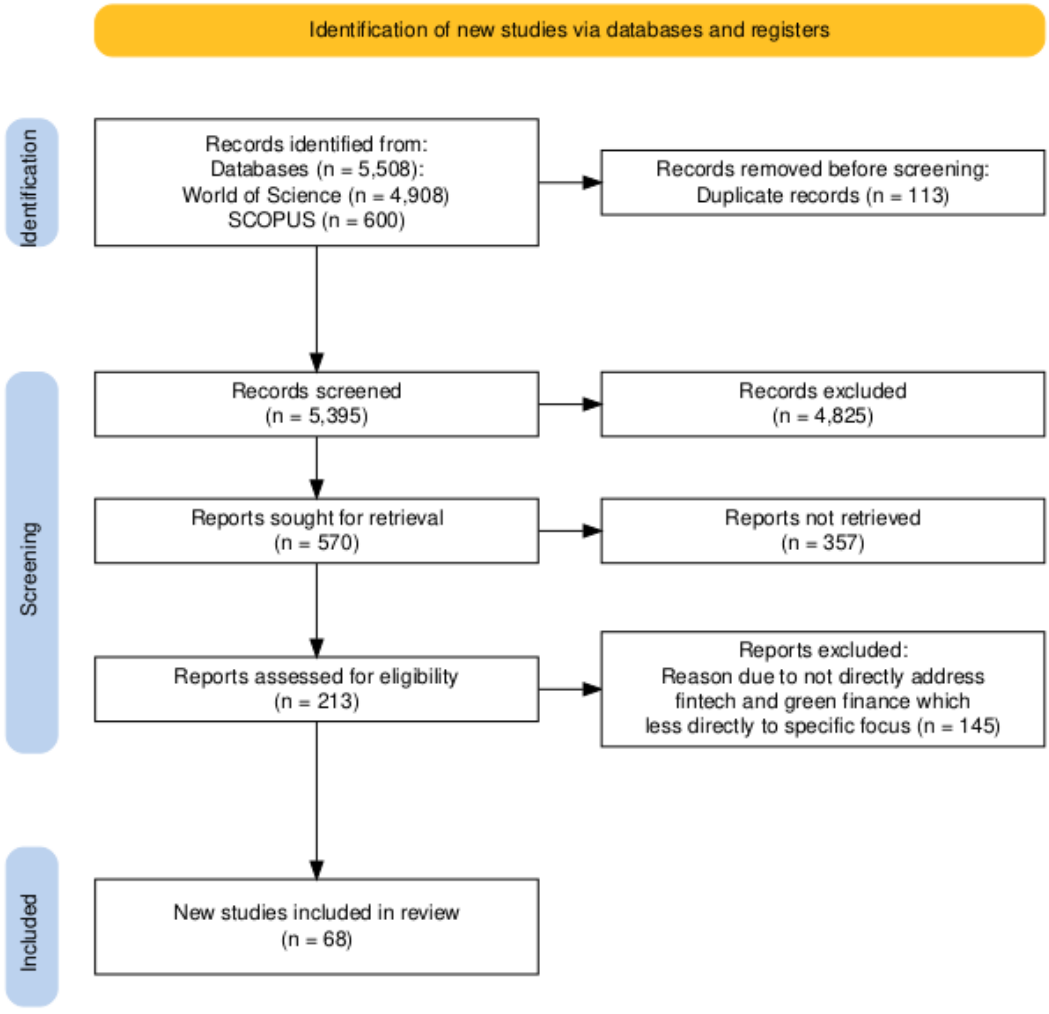


Figure 1. Overview of reviewed papers identified following PRISMA

Bibliometric Analysis and Data Visualization

Bibliometric analysis involves the statistical evaluation of bibliographic materials through quantitative methods, as discussed by Broadus (1987) and Donthu et al. (2021). This approach provides valuable insights into the knowledge landscape, helping to identify trends, the impact of publications, and the evolving direction of a specific field. In this study, bibliometric research is conducted using the VOSviewer software to analyse the relationship between fintech and green finance. Bibliometric techniques are commonly applied across various fields to map research trends and developments (Cuccurullo, Aria, & Sarto, 2016). The findings from this analysis aim to guide future researchers in selecting relevant topics within the fintech and green finance domain and offer a comprehensive overview of the current landscape.

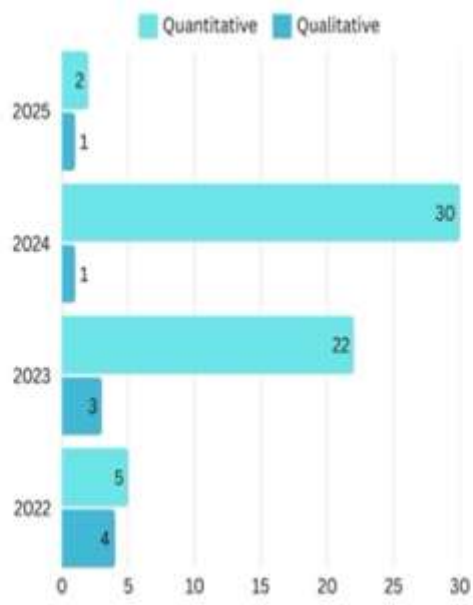
The data collected from the bibliographic database is visualized in three primary ways: network visualization, overlay visualization, and density visualization. These methods are used to represent the relationships and patterns found within the data, offering a clear and insightful understanding of the field.

In the analysis of keyword co-occurrence, 15 out of 305 keywords met the threshold of a minimum co-occurrence of 5 or more. The resulting network of keywords is categorized into four distinct clusters, which are detailed in Table 2. Each cluster includes a list of keywords that reflect different dimensions and determinants of fintech's role in green finance, similar to those observed in studies such as Biswas et al. (2021).

Results

Overview

The reviewed literature on fintech and green finance, categorized by publication year, research method, and region, is summarized in Figure 2. The analysis indicates fluctuations in research volume between 2022 and 2025, with a significant rise observed in 2024. A substantial proportion of studies adopt qualitative methodologies. Regarding geographic distribution, nearly a quarter of the studies examine fintech and green finance from a global perspective rather than focusing on a specific country. Among country-specific studies, China emerges as the predominant region for fintech research. This finding aligns with Hasan et al. (2024), who also identified China as a leading hub for fintech-related studies.



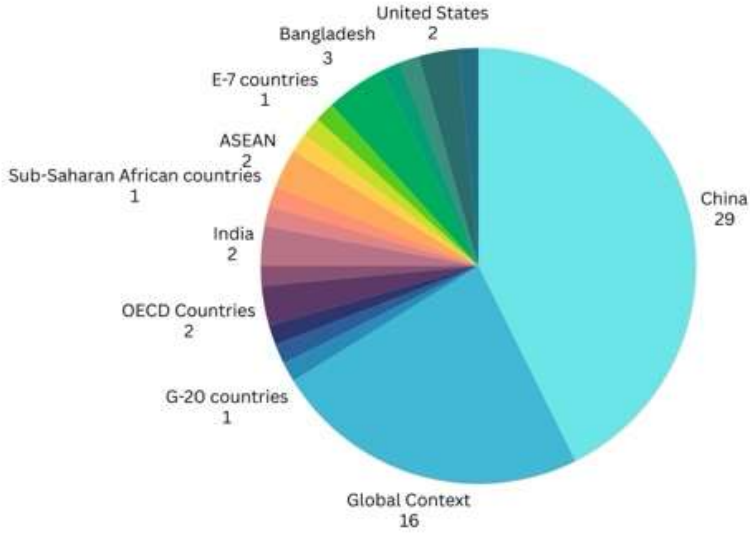


Figure 2. Overview of reviewed papers

Keyword Analysis

In VOSviewer, the minimum threshold for co-occurrence relationships between terms is set to two (Al Husaeni & Nandiyanto, 2022; Al Husaeni & Nandiyanto, 2023; Sarirah et al., 2019). Each cluster in the analysis is assigned a distinct color to represent its category, and the size of each circle within the cluster corresponds to the frequency with which the associated term appears in the dataset. The larger the circle, the more frequently the term is used (Al Husaeni & Nandiyanto, 2023; Naqvi et al., 2023). Items that frequently appear together in the dataset are grouped into the same cluster, which reflects thematic or topical relationships within the data.

The proximity of terms within the same cluster, as well as the strength of their links, indicates how closely they are related. Terms that appear within the same cluster exhibit a strong co-occurrence or co-citation relationship (Van Eck & Waltman, 2010; Kudo et al., 2018). As a result, the size of the circle increases with the frequency of the term's usage, while less frequent terms are represented by smaller circles (Al Husaeni et al., 2023; Singkhamfu et al., 2018).

The analysis revealed three distinct clusters, which are as follows:

1. Cluster 1 (Red) includes the terms: green economy, China, finance, environmental economics.

2. Cluster 2 (Green) contains the terms: fintech, green finance, natural resources, green growth, and economic growth.

3. Cluster 3 (Blue) encompasses the terms: sustainable development, sustainability, alternative energy, investments, and carbon emissions.

No.	Keywords	Freq.
1	fintech	13
2	sustainable development	10
3	economic growth	10
4	green economy	10
5	green growths	7
6	sustainability	7
7	carbon emission	6
8	environmental economics	5
9	green finance	7
10	investments	6
11	alternative energy	7
12	natural resource	5
13	china	7
14	economic development	5
15	finance	5

Table 1. Most frequently occurring keywords in papers on fintech and green finance

These clusters illustrate the key themes and interrelated topics within the literature on fintech and green finance.

The results reveal the most frequently used keywords in the publications, as detailed in Table 1. In addition to "fintech"and "sustainable development", the two most prominent keywords in terms of co-occurrence are "economic growth" and "green economy" (Table 2). As noted by Hasan et al. (2024), developed nations tend to focus more on the environmental impacts of fintech rather than on issues such as financial inclusion, poverty alleviation, income inequality reduction, and economic expansion. Consequently, much of the research is now centered on fintech's contribution to sustainable development in developing nations. The findings also indicate that China leads in terms of the number of publications addressing fintech research themes, which aligns with the study by Hasan et al. (2024).

Visualization of the Fintech and Green Finance Field of Study Using VOSviewer

VOSviewer offers several visualization methods, including network visualization (Figure 3), overlay visualization (Figure 4), and density visualization (Figure 5) (Al Husaeni & Nandiyanto, 2022). In network visualization, the relationships between terms are depicted as a network, where lines connect two terms, representing the strength and frequency of their association (Nandiyanto & Al Husaeni, 2021; Al Husaeni & Nandiyanto, 2022; Al Husaeni & Nandiyanto, 2023; Montejo et al., 2018).

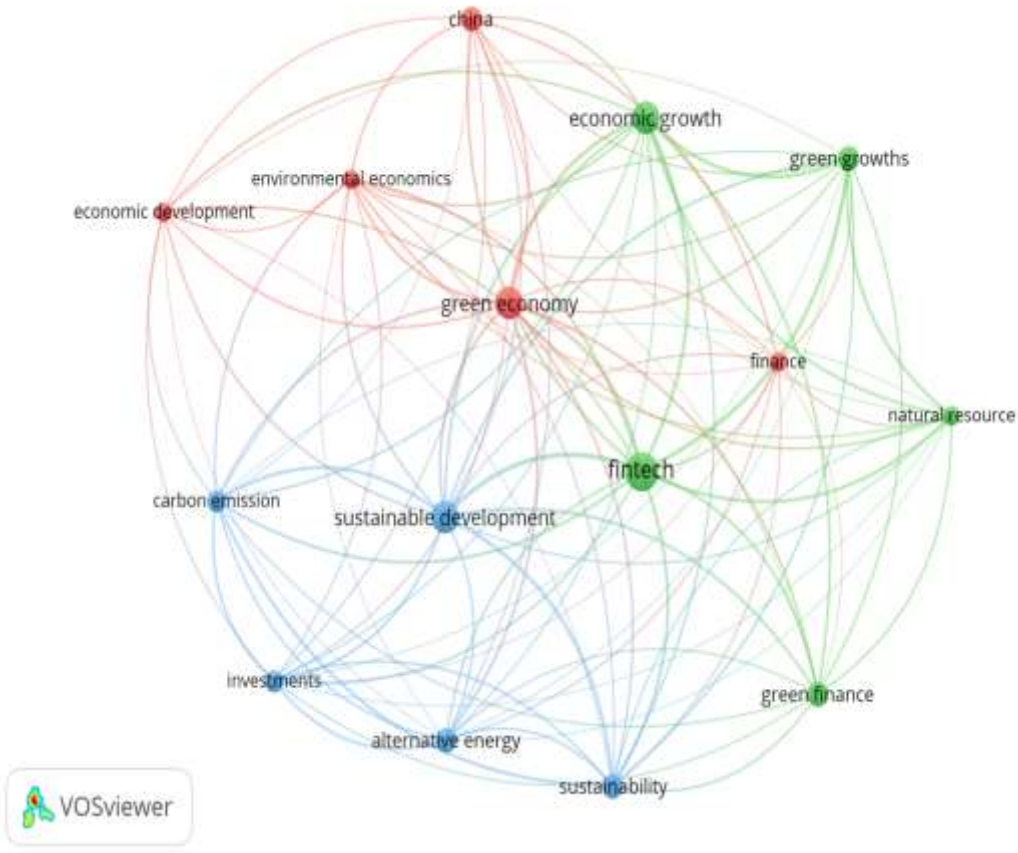


Figure 3. Network Visualization of Fintech and Green Finance

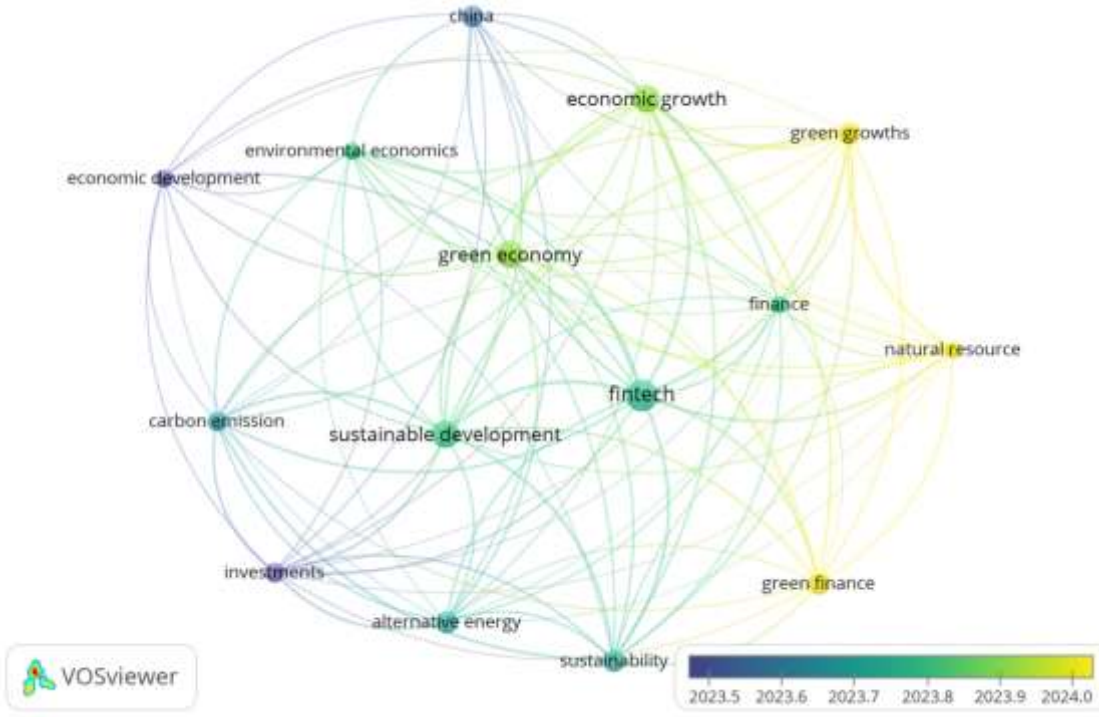


Figure 4. Overlay Visualization of Fintech and Green Finance Keyword.

Figure 5 illustrates the density visualization method. This method provides insight into the frequency with which terms appear in the research. The hue of each term is used to represent its frequency: the deeper the hue, the more frequently the term is used (Al Husaeni et al., 2023; Kongmanus, 2016).

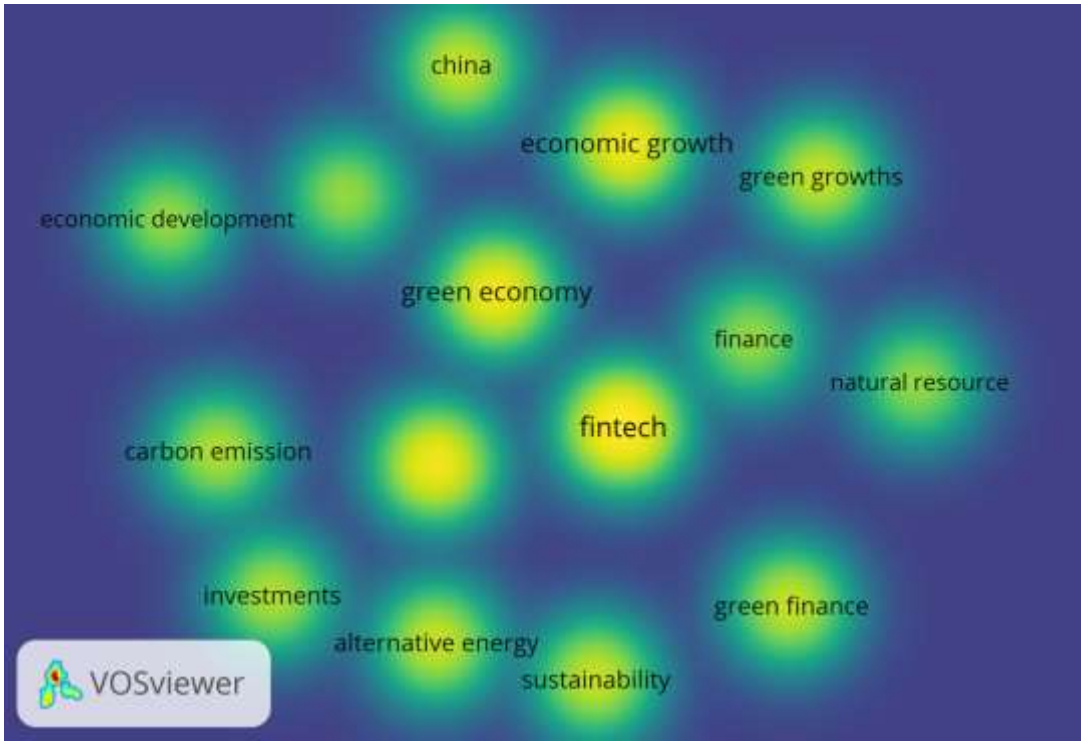


Figure 5. Density Visualization of Fintech and Green Finance Keyword.

This study utilizes 68 reviewed papers retrieved from Web of Science (WOS) and Scopus databases, with VOSviewer employed to analyze the datasets. The search string ("fintech" OR "financial technology") AND ("green finance" OR "sustainable finance") AND ("ASEAN") was used to filter the relevant information.

It is important to note that the results of this analysis may vary depending on the specific papers reviewed. The bibliometric analysis could be influenced by the absence of certain keywords in some of the literature. Additionally, limitations may arise during the data search process. Nonetheless, the analysis presented in this paper provides valuable insights into the trends in fintech and green finance, highlighting potential research gaps and offering directions for future studies on the topic.

Review of recent literature on factors influencing relationship between Fintech and Green Finance

The factors affecting the relationship between fintech and green finance based on PRISMA methods and taken from 2020 to 2025 is further explained in Table 2 in the Appendix.

In retrospect, it is evident that green finance is not often used as a dependent variable in recent studies. Instead, green finance performs the role of an explanatory variable, mediator or moderator depending on the purpose and objectives of a study. For instance, Jahanger et al. (2024) used green finance as an independent variable to in explaining its influence on sustainability issues in ASEAN countries. Similarly, Li and Chen (2024) used a fixed-effects regression model to explain the impact of green finance on bank performance. Furthermore, Nevaneth and Mishra (2023), Sun et al. (2025) and Xie

et al. (2024) employed green finance to explain its effect on country's sustainability using regression models.

From the point of view of ASEAN countries, limited number papers have sought to explain the impact of fintech on green finance in recent years. Jahanger et al. (2024) is one of the few studies which focuses on the impact of green finance on environmental sustainability in ASEAN countries.

A review of the recent literature also indicates that green finance has been utilized as a moderator (Li and Chen, 2024; Nenaveth, 2023; Hu et al., 2025; Hashim et al., 2017) as well as a mediator (Ali et al., 2024; Guang-Wen and Siddik, 2022). However, in this context, green finance was utilized in a variety of ways to address firm level issues and national based on issues relating to sustainable economic growth and the environment.

Fintech on the other hand has been used in numerous occasions as a regressor. For instance, Awais et al. (2023) used the principal component analysis (PCA) method to study the impact of fintech on green growth. Chen et al. (2024) sought to understand the relationship between fintech and green growth by using cointegration methods.

Nevertheless, Li and Chen (2024) used fintech as a moderator in understanding the impact of green credit on banks and found that fintech does play an important role in amplifying the effect on bank performance. IT and data capabilities of Chinese companies were however used as a mediator to explain the impact of fintech on corporate green investment (Tao and Chao, 2024; Djaparidze et al., 2018).

Recent literature has been useful in identifying moderator and mediator variables which could be used for purposes of analysing the relationship between fintech and green finance. For instance, Thottoli et al. (2024) identified various firm level moderating and mediating variables which influences innovation in SME's. Also, control variables which are used to study the relationship between fintech and green finance have improved from traditional variables such as foreign direct investment and capital formation (Huang, 2024) to variables more closely related to sustainability issues such as Financial development (FD), economic globalization (ECOGLB) and Human capital (HC) (Ali et al., 2024; Chen et al., 2024; Hanh et al., 2017).

Nevertheless, the review of recent literature implies that there is still a need to evaluate and re-examine the theoretical framework and variables affecting the relationship between fintech and green finance. Guided by Xu et al. (2024) and Wan, Lee and Sarma (2023), a base model and framework as well as variables were identified to explain this relationship. Nevertheless, Kwong et al. (2023) points to the vast potential which lies ahead when it comes to the impact of fintech on banking and lending activities and justifies the need for further studies in this area.

Findings

Crafting Factors Influencing the Effect of Fintech on Green Finance – Moderating, Mediating, and Control Variables

Figure 6 presents the proposed conceptual framework for the factors influencing the effect of fintech on green finance, specifically focusing on moderating, mediating, and control variables. As shown in Figure 6, this framework is structured around three key elements: mediating, moderating, and control variables. Building upon the foundational work of Xu et al. (2024), this framework is specifically designed to explore the role of fintech in green finance. This adaptation offers a comprehensive understanding of how fintech can significantly promote green finance through the

analysis of these variables. The framework highlights the direct relationships and interactions between fintech and green finance, aiming to leverage fintech's potential to advance green finance and contribute to achieving sustainable development goals.

Core Components of the Framework

The core components of the conceptual framework aim to provide an in-depth understanding of the relationship between financial technology (fintech) and green finance (GF). This framework incorporates various dependent, independent, moderating, mediating, and control variables, which have been carefully identified to provide a holistic view of the factors that shape fintech adoption and its role in advancing green finance.

Dependent Variable: Green Finance (GF)

Green finance is pivotal for fostering environmental sustainability, as it channels financial resources toward projects that tackle climate change and promote sustainable development. It is often viewed as a key dependent variable in sustainability research, as it reflects the degree to which the financial sector supports environmentally responsible initiatives. Green finance is typically assessed through various indicators such as green credit, green securities, green investments, and green insurance. These indicators collectively offer a comprehensive perspective on how the financial sector contributes to global environmental goals (Xu et al., 2024; Al-Saeedi et al., 2016). Furthermore, small and medium-sized enterprises (SMEs) also play an important role in green finance by integrating green practices into their business models, enhancing their financial performance, operational efficiency, and market competitiveness (Thottoli et al., 2024; Zali et al., 2016). Sustainable banking performance, which encompasses environmental performance, green finance adoption, and carbon neutrality goals, further underscores the financial sector's role in advancing green finance (Rahman et al., 2024; Ugwuanyi et al., 2016). The environmental performance (EP) of financial institutions is critical in understanding green finance, as it reflects their capacity to minimize environmental impacts like carbon emissions and energy consumption (Guang-Wen & Siddik, 2023). Additionally, the ecological footprint (EF), which measures sustainability, is key for evaluating the broader environmental impact of financial activities (Kashif et al., 2024; Haider et al., 2019). Collectively, these indicators offer valuable insights into how green finance contributes to achieving sustainability goals.

Independent Variable: Financial Technology (Fintech)

Fintech has become a transformative force in the financial sector, driving significant shifts in service delivery and enabling the advancement of green finance. The extent of fintech adoption is often measured through indices like the Digital Inclusive Finance Index and the number of fintech firms, which provide insights into the growth and reach of fintech solutions (Xu et al., 2024). Fintech's role in promoting green finance is increasingly recognized, with innovations such as digital payments, crowdfunding platforms, blockchain technology, and AI-driven financial solutions enhancing the transparency, accessibility, and efficiency of financial services. These technological advancements facilitate greater support for sustainable investments (Thottoli et al., 2024; Savkovic et al., 2017). Fintech innovations not only revolutionize financial services but also help institutions streamline operations and integrate sustainability goals more effectively (Rahman et al., 2024). Technologies such as blockchain, AI, and digital payments play a crucial role in promoting sustainability within banking operations by enhancing efficiency and driving innovation. Additionally, fintech plays a crucial role in climate finance by facilitating investments in green bonds, renewable energy projects, and eco-friendly technologies (Guang-Wen & Siddik, 2023).

Moderating Variables

Moderating variables are essential for understanding how external factors influence the relationship between fintech adoption and green finance outcomes. One key moderating factor is regional financial development, which significantly affects the impact of fintech tools on promoting green finance. Regions with more developed financial systems, infrastructure, and policies are more likely to see stronger fintech adoption, as they have the resources necessary to integrate these solutions into their financial systems (Xu et al., 2024). Regulatory frameworks also serve as important moderators, particularly with regard to their influence on fintech adoption among SMEs. Supportive regulations that promote digital finance can enhance fintech's effectiveness in advancing green finance, as businesses are more likely to adopt innovative financial technologies when the regulatory environment encourages such practices (Thottoli et al., 2024; Rahman et al., 2024). Furthermore, the availability of digital infrastructure is a key moderating factor. Regions with robust digital infrastructure are better equipped to leverage fintech for sustainable finance, as they provide the platforms necessary for fintech solutions to operate efficiently (Thottoli et al., 2024). Lastly, institutional quality, including strong governance, transparency, and accountability, is crucial for implementing green finance initiatives. High-quality institutions foster effective governance and resource allocation, ensuring that fintech solutions are used efficiently in advancing green finance (Kashif et al., 2024).

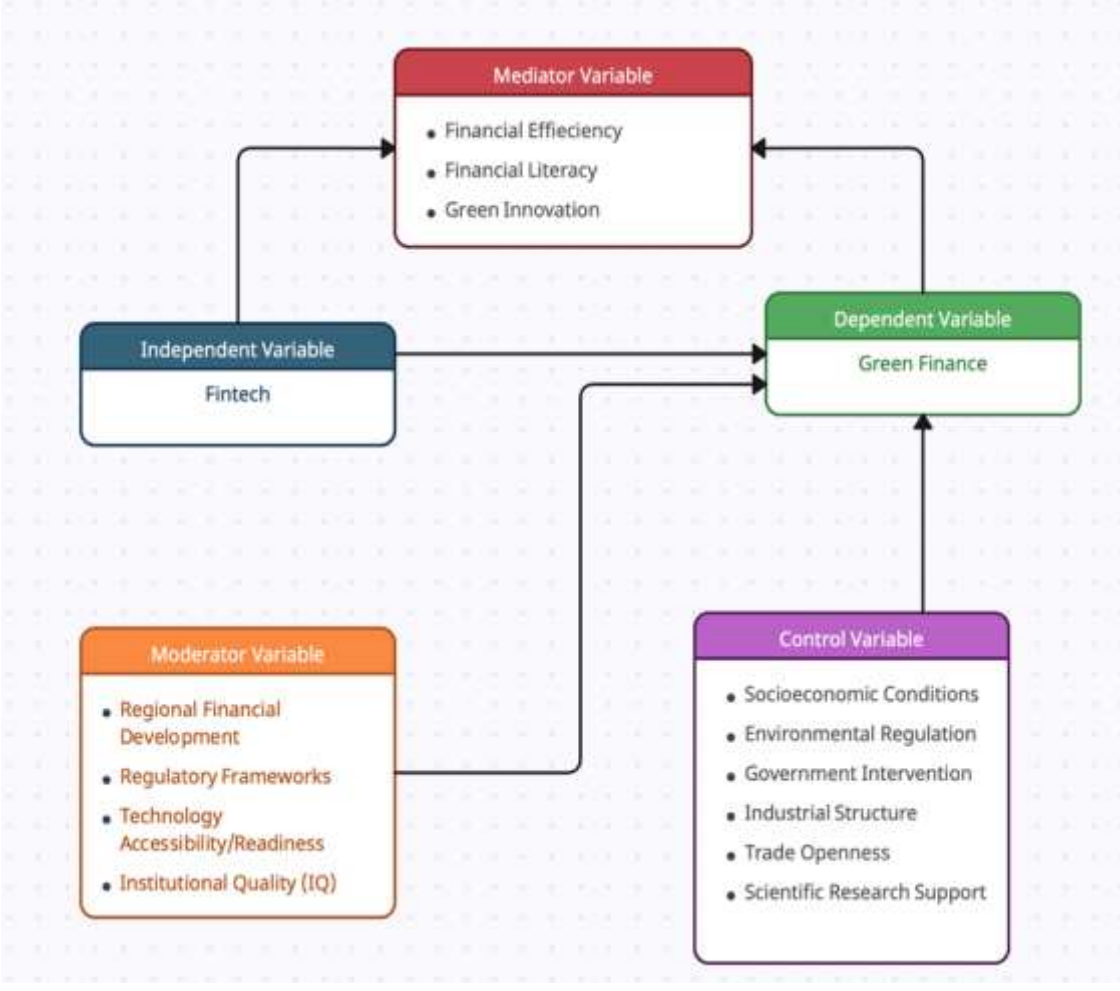
Mediating Variables

Mediating variables explain the mechanisms through which fintech adoption influences green finance outcomes. One such mediator is financial efficiency, as fintech solutions reduce transaction costs and improve the allocation of financial resources, making it easier to fund sustainable projects (Xu et al., 2024; Rahman et al., 2024). By enhancing the efficiency of financial operations, fintech reduces barriers to entry for green finance initiatives, facilitating greater investments in sustainability. Financial literacy also serves as a crucial mediator, particularly for SMEs. By improving financial literacy, fintech enables decision-makers to better understand and utilize digital tools for managing sustainable investments.] Another important mediator is green innovation, as fintech supports the development and scaling of eco-friendly technologies and business models. By facilitating businesses' transition to more sustainable operations, fintech plays a central role in driving green innovation across industries. The integration of fintech innovations plays a pivotal role in fostering sustainable practices, which in turn accelerates the expansion of green finance as highlighted by Xu et al. (2024), Thottoli et al. (2024), and Rahman et al. (2024).

Control Variables

Control variables are crucial for accounting for broader factors that may influence the relationship between fintech adoption and green finance. Socioeconomic conditions, such as education levels and income inequality, can significantly affect fintech adoption. Higher levels of education are linked to better financial literacy, which, in turn, supports the effective use of fintech for green finance (Kashif et al., 2024; Xu et al., 2024). Environmental regulations also play a critical role as control variables, as stringent environmental policies can drive both fintech adoption and the implementation of green finance practices. Strong environmental regulations incentivize businesses to adopt digital tools that promote sustainability (Xu et al., 2024). Government intervention, including fiscal policies and public spending on environmental initiatives, can also influence green finance and fintech adoption. Governments can create an enabling environment by providing supportive policies and funding for

green projects (Xu et al., 2024). Liu et al. (2023) stress that government support is crucial for accelerating the adoption of fintech in green finance. Economic structure, particularly the balance between the service and manufacturing sectors, also influences fintech adoption. Economies with a larger service sector are more likely to adopt digital financial solutions, affecting the implementation of green finance (Xu et al., 2024) . Additionally, trade openness can facilitate the adoption of green technologies by providing access to international markets and resources, enhancing the effectiveness of green finance solutions (Kashif et al., 2024). Lastly, government expenditure on research and



development is essential for driving innovation in green finance technologies. Investments in R&D help develop fintech solutions that promote environmental sustainability (Xu et al., 2024).

Figure 6: Proposed framework of Factor influencing the Effect of Fintech on Green Finance.

Rationale for the Proposed Framework

This research framework is designed to explore the complex relationship between financial technology (Fintech) and green finance, a subject that has gained increasing attention but remains underexplored in existing literature. The need for this framework arises from the growing recognition of Fintech's potential to transform the financial sector and facilitate the

achievement of global sustainability goals. While Fintech and green finance have been studied independently, their intersection remains largely unexplored. This framework aims to address this gap by offering a comprehensive model that links Fintech adoption to green finance outcomes, specifically through the lens of moderating, mediating, and control variables.

The importance of green finance as the dependent variable in this framework cannot be overstated. Green finance plays a crucial role in driving environmental sustainability by supporting investments in renewable energy, green bonds, and eco-friendly technologies. It reflects the extent to which the financial sector integrates environmental considerations into its operations, a key factor for meeting international climate goals (Xu et al., 2024). The framework also highlights the role of small and medium enterprises (SMEs) in promoting sustainable financing practices. SMEs can improve their financial performance and operational efficiency through the adoption of green finance models (Thottoli et al., 2024). By emphasizing the ecological footprint and environmental performance of financial institutions, the framework underscores the significant role of the financial sector in fostering green initiatives and addressing climate change.

Fintech, the independent variable in this framework, serves as the driving force behind the transformation of how financial services can support sustainability. Fintech innovations, such as blockchain, AI, and digital payments, enhance accessibility, transparency, and efficiency in financial transactions, which are essential for advancing green finance (Rahman et al., 2024). This framework emphasizes the role of Fintech in facilitating the adoption of green finance practices by enabling financial institutions to streamline operations, improve sustainability practices, and invest in green projects. Fintech can reduce transaction costs, improve the allocation of financial resources, and make green finance more accessible to both large institutions and SMEs (Xu et al., 2024).

This research framework fills a critical gap in the literature by exploring the relatively underexamined relationship between fintech adoption and green finance. While existing research has focused on the individual impacts of Fintech or green finance, a comprehensive model exploring how Fintech can specifically contribute to green finance goals has been lacking. By incorporating moderating variables such as regional financial development, regulatory frameworks, and institutional quality, the framework provides a nuanced understanding of how contextual factors shape the effectiveness of Fintech in promoting green finance. For instance, regions with more developed financial infrastructures and supportive policies are likely to experience stronger outcomes from Fintech adoption in green finance (Xu et al., 2024).

In addition to moderating variables, the framework introduces mediating variables that clarify the mechanisms through which Fintech drives green finance. Key mediators, such as financial efficiency, financial literacy, and green innovation, explain how Fintech adoption can lead to improved financial management, more sustainable business models, and increased investments in environmentally responsible projects (Thottoli et al., 2024). These mediators illustrate the transformative power of Fintech in fostering sustainable practices and enhancing the financial sector's ability to support green initiatives.

Lastly, control variables such as socioeconomic conditions, government policies, and environmental regulations are incorporated to account for the broader contextual factors that influence the adoption of Fintech and green finance. These control variables help isolate the specific impact of Fintech on green finance, while acknowledging external factors such as educational attainment, government interventions, and trade openness that may shape this

relationship (Kashif et al., 2024). Including these variables allows for a more comprehensive and accurate understanding of the factors that influence the adoption and effectiveness of Fintech in driving green finance.

In conclusion, this framework makes a valuable contribution to existing literature by offering a comprehensive analysis of the relationship between Fintech and green finance. It bridges the research gap by proposing a model that accounts for the moderating, mediating, and control variables shaping how Fintech can contribute to sustainable financial practices. As global sustainability goals become increasingly urgent, this framework provides critical insights into how financial technologies can support the transition to a more sustainable financial ecosystem, ultimately contributing to the achievement of global environmental objectives.

Conclusion

In conclusion, this research study, through its systematic literature review and the proposed conceptual framework, makes a meaningful contribution to deepening our understanding of the factors that shape the relationship between Fintech and green finance. By focusing on moderating, mediating, and control variables, the study uncovers key drivers that influence how Fintech adoption can enhance the outcomes of green finance initiatives. The inclusion of these variables in the framework provides a well-rounded and nuanced analysis, addressing important gaps in current research.

The methodology, utilizing PRISMA for the systematic review and VOSviewer for network visualization, offers a clear and transparent approach to identifying relevant studies. It helps illustrate how various factors interconnect within the Fintech and green finance landscape. This rigorous approach not only reviews existing literature but also proposes a fresh framework for understanding how Fintech can promote sustainable financial practices. By considering moderating factors like financial infrastructure, regulatory support, and institutional quality, alongside mediators such as financial efficiency, literacy, and innovation, the framework lays the groundwork for future research in this area.

Beyond advancing theoretical knowledge, this study also provides practical insights for financial institutions, policymakers, and other stakeholders. It shows how they can leverage Fintech to drive green finance initiatives effectively. As global sustainability goals become more pressing, the proposed framework offers a strategic direction for fostering a sustainable financial ecosystem, integrating green finance into mainstream financial services, and supporting the broader transition to a low-carbon economy.

Implications

The framework presents important implications for policymakers who aim to integrate Fintech into green finance strategies. By emphasizing moderating factors such as regulatory frameworks and institutional quality, the research suggests that well-designed policies and financial infrastructures can significantly enhance the effectiveness of Fintech in promoting green finance. Policymakers should consider fostering environments that support both technological innovation and sustainable financial practices to maximize the impact of these technologies on green finance.

The study also underscores the transformative role of Fintech in reshaping the financial sector. By improving financial management, operational efficiency, and transparency, Fintech offers significant potential for financial institutions to incorporate green finance practices. This could

not only reduce transaction costs but also lead to increased investments in environmentally responsible projects. Consequently, financial institutions—particularly banks and investors—are encouraged to adopt Fintech solutions that streamline operations and promote sustainable, green initiatives.

The framework further highlights the critical role of small and medium-sized enterprises (SMEs) in advancing sustainable financing practices. Fintech innovations have the potential to lower the barriers to green finance for SMEs, offering them better access to funding and enabling them to adopt more sustainable business models. This implies that tailored financial products and services powered by Fintech could support SMEs in transitioning to greener practices, fostering a more inclusive and sustainable financial ecosystem.

Moreover, by linking Fintech to green finance through mediating variables such as financial efficiency and green innovation, the framework outlines a clear path for promoting sustainable investments. For investors, this provides a clear strategy to increase their exposure to green projects. Fintech solutions can facilitate access to more transparent and cost-efficient financing opportunities in renewable energy, green bonds, and other sustainable sectors, further advancing green finance goals.

In addition, the framework sets the stage for future empirical studies exploring the intersection of Fintech and green finance. By examining the relationships between moderating, mediating, and control variables, future research can provide a deeper understanding of how Fintech adoption drives green finance outcomes. This opens the door to more data-driven insights that can guide policymakers and industry leaders in their efforts to promote sustainability.

The framework aligns with the growing urgency of achieving global sustainability goals. By investigating how Fintech can support green finance, the research offers a roadmap for integrating these technologies into mainstream financial services. This could have broad implications for the global economy, accelerating the transition to a low-carbon, sustainable financial ecosystem and contributing to the achievement of international climate objectives. This framework not only contributes to the theoretical understanding of the relationship between Fintech and green finance but also provides practical insights for those shaping the future of sustainable finance. As global demands for sustainability intensify, Fintech will increasingly play a pivotal role in advancing green finance and supporting the achievement of both environmental and economic objectives.

Finally, for researchers, this study provides a roadmap for further investigating the evolving relationship between fintech and green finance. The proposed framework and methodological approach, utilizing PRISMA and VOSviewer analysis, encourage deeper exploration of the moderating, mediating, and control variables that influence fintech's impact on sustainable finance. Future research can build on this study to refine existing theories, explore emerging technologies, and examine under-explored markets and sectors in the context of fintech-driven green finance.

Future Research

Future research should aim to propose a comprehensive framework that integrates both macro-level and micro-level factors, emphasizing the interconnections between moderating, mediating, and control variables. This study suggests the application of PRISMA for systematic literature review methodology and VOSviewer for bibliometric analysis. These tools will not only enhance the transparency of the review process but also enable the visualization of emerging trends and

knowledge gaps in the field.

A robust framework will offer a holistic understanding of how fintech can drive green finance, taking into account various regulatory, technological, and cultural contexts. Furthermore, future studies should investigate regional disparities in fintech's impact on green finance, especially in emerging economies and under-researched sectors such as renewable energy and climate tech finance.

The proposed framework, grounded in both theoretical insights and empirical findings, will provide valuable guidance for policymakers, financial institutions, and investors. By incorporating advanced bibliometric analysis, future research can bridge existing knowledge gaps, contributing to the development of effective, fintech-driven green financial strategies.

Acknowledgment

This work was supported by the AmBank Financial Service Chair Special Research Grant (Project No. PV054-2024) as well as the Joint Research Program between University Brawijaya and University of Malaya entitled "Improving Life Skills and Education on Personal Financial Management for Indonesian Migrant Workers in Kuala Lumpur, Malaysia" (Project No.: IF025-2024).

Appendix

No.	Author	Year	Title	Methodology	Variables
1	Ali et al.	2024	Exploring the impact of green finance and technological innovation on green economic growth: Evidence from emerging market economies.	Cross-Sectional CS-ARDL, AMG, CCEMG tests	**DV**: Green economic growth (GEG) **IV**: Green finance (GF), Technological innovation (TI) **CV**: Financial development (FD), economic globalization (ECOGLB), Human capital (HC)
2	Awais et al.	2023	Is fintech the new path to sustainable resource utilisation and economic development?	Principal Component Analysis (PCA)	**DV**: Green growth (GG) **IV**: Fintech, Population Growth, Unemployment, Tourism, ICT Exports, Carbon Emissions.
3	Chang & Wu	2024	Influence of fiscal decentralization, fintech, and mineral resources on green productivity of G5 countries Theory: Economic Growth Theory	Cross-sectional Augmented Distributed Lag (CS-ARDL) , Augmented Mean Group (AMG). Common Correlated Effect Mean	**DV**: Green Product**IV**ity **IV**: Revenue Decentralization, Expenditure Decentralization, Mineral Resources, Fintech

				Group (CCEMG)	
4	Chen, Ma, Li and Zhou	2024	Revolutionizing sustainable economic growth in China: Harnessing natural resources, green development, and fintech for a greener future.	Quantile ARDL	**DV**: Sustainable economic growth **IV**: Industrial waste per unit GDP, Sulphur dioxide emissions per unit GDP, CO2 emissions per unit GDP, Forest area (% of land area), Coverage ratio of green space index
5	Chen, Murshed, Sinha, Alam, & Khudoykulov	2024	Revisiting the resource curse hypothesis from the viewpoint of green growth: The role of Fintech as the de-cursing agent.	Cross-sectional Dependency (CDE) and Slope Heterogeneity (SHE), Cointegration methods.	**DV**: Green growth **IV**: Total natural resource rents, Fintech start-up financing, Labour force population, Gross fixed capital formation growth rate, Institutional quality. **CV**: Financial development (FD), economic globalization (ECOGLB), Human capital (HC)
6	Guang-Wen, & Siddik	2023	The effect of Fintech adoption on green finance and environmental performance of banking institutions during the COVID-19 pandemic: the role of green innovation.	PLS-SEM	**DV**: Environmental performance **IV**: Green finance (GF), Fintech Adoption (FA) **MED**: Green Innovation (GI)
No.	**Author**	**Year**	**Title**	**Methodology**	**Variables**
7	Huang	2024	Fintech inclusion in natural resource utilization, trade openness, resource productivity, recycling and minimizing waste generation: Does technology really drive economies toward green growth?.	Quantile ARDL	**DV**: Natural resource utilization, Waste management and recycling, Trade openness, Resource product**IV**ity. **IV**: Fintech **CV**: Economic growth, Trade openness, Foreign direct investment, Population growth, Capital formation, Environmental taxes, Population density
8	Hu, Jia & Yang	2025	Exploring FinTech, green finance, and ESG performance across corporate life-cycles	Fixed-effects Model	**DV**: ESG Performance **IV**: Fintech **MOD**: Green Finance, Market openness, Upgrading of industrial structure, Environmental regulation, Enterprise size, Gearing.

					CV: Net income growth rate, The shareholding ratio of the largest shareholder. Enterprise market value, Financing constraints.
9	Jahanger et al.	2024	Going away or going green in ASEAN countries: Testing the impact of green financing and energy on environmental sustainability	Non-linear autoregressive distributed lag (NARDL), Cross-sectional Augmented Distributed Lag (CS-ARDL) , Dumitrescu Hurlin panel causality tests	**DV**: Carbon dioxide **IV**: Green Finance, Economic Growth, Foreign Direct Investment, Clean Energy Consumption,
10	Kumar et al.	2024	Exploring the role of finance in driving circular economy and sustainable business practices.	Systematic literature review (SLR)	**DV**: Circular Economy **IV**: Fintech, Specialized financing solution
11	Kwong, Kwok & Wong.	2023	Green FinTech innovation as a future research direction: a bibliometric analysis on green finance and FinTech.	Systematic literature review (SLR)	N/A
No.	**Author**	**Year**	**Title**	**Methodology**	**Variables**
12	Li & Chen	2024	Sustainable Finance Meets FinTech: Amplifying Green Credit's Benefits for Banks	Fixed-effects regression	**DV**: Bank performance (ROA, ROE, Net Profit Margin) **IV**: Green credit (Scale of Green Credit, Green Credit Ratio)

					MOD: Fintech (Fintech News, Fintech Digital Transformation Index, Fintech Patent) **CV**: Bank Variables (Bank Size, Capital-to-asset ratio, Interest Generating Asset Ratio, Total Asset Turnover, Loan Concentration.), Macroeconomic Variables (Real GDP Growth Rate, CPI), Other Variables (Cost-to-Income Ratio, Admin Cost, Fee Income, Non-Performing Loan ratio, Overdue Loan Raio, Risk-Weighted Asses Ratio)
13	Merello et al.	2023	Analysing the determinant factors of the sustainability profile of Fintech and Insurtech companies	Panel Corrected Standard Errors (PCSE), Dynamic Systematic GMM	**DV**: CO2 emissions, Green certificates, Sustainability Rankings **IV**: Fintech Company **CV**: Size, ROA, Leverage, Age of Company, CSR, Board Size, Employee Voluntary Workers, Waste Reduction.
14	Nenavath & Mishra	2023	Impact of green finance and fintech on sustainable economic growth: Empirical evidence from India	Two-step generalized method of moments (GMM)	**DV**: Environmental Quality, Economic Effect**iv**eness, Economic System. **IV**: Carbon finance, Green insurance, Green credit, Green securities , Green investment. **MOD**: Financial Technology **CV**: Energy consummation. GDP per capita, Education, Fiscal expenditure.
15	Qin et al.	2024	Empirical evidence of fintech and green environment: Using the green finance as a Mediating variable.	STIRPAT model	**DV**: Green environmental index (GEI) **IV**: Fintech innovation (Fintech), provincial population, Industrial output, Environmental technology. **MED**: Green credit, green investment
16	Sun et al.	2025	Balancing acts: Assessing the roles of renewable energy, economic complexity, Fintech, green finance, green growth, and economic performance in G-20	MMQR	**DV**: Ecological Footprint **IV**: Fintech, Natural Resources, Renewable Energy, GDP, Economic complexity index, Institutional Quality, Green finance, Green growth.

			countries amidst sustainability efforts		
17	Tang, Sun & Xu	2024	Exploring the role of Fintech, Green Finance and Natural Resources towards Environmental Sustainability: A study on ASEAN economies	Cross Section ARDL.	**DV**: Environmental Sustainability (CO2 Emissions) **IV**: Fintech (FNT), Green Finance (GFN), Natural Resources (NTR), Economic Growth (ECG)
No.	**Author**	**Year**	**Title**	**Methodology**	**Variables**
18	Tao & Chao	2024	Investing in green, sustaining the planet: The role of fintech in promoting corporate green investment in the Chinese energy industry.	Structural equation modelling (SEM)	**DV**: Corporate Green Investment (CGI) **IV**: Fintech **MED**: Data-driven Decision-making Capability (DDC), Information Transparency (IT), Sustainable Development Strategy (SDS).
19	Thottoli et al.	2024	Exploring Mediating and moderating factors of FinTech adoption for innovations in SMEs	Systematic literature review	**DV**: Innovation in SME's **IV**: Factors contributing towards Fintech Adoption **MOD**: Financial mismatch, Institutional quality, Audit risk, Function of IT, Blockchain Technology, Financial sustainability, IT and Communication technology, Urbanization, Financial constraints, Industry 4.0 technologies, Financial technology, Disruptive technology, Knowledge of characteristics of SME's, Technology market, SME's competitive environment. **MED**: Big data analytics, Organizational culture, Supply chain practice, Financial literacy, Financial reporting aspects, Access to financial services, Financial education, IT quality, Business correspondent model, Financial transactions, Financial information.

20	Wan, Lee & Sarma	2023	Is Fintech good for green finance? Empirical evidence from listed banks in China	Fixed-effects regression.	**DV**: Green credit **IV**: Fintech development level **MED**: Capital adequacy ratio (CAR), Net profit ratio (NPR). **CV**: Bank size, Leverage level, Business d**iv**ersification, Customer concentration, equity multiplier, non-interest income rate, concentration ratio of loans. Customer concentration ratio
21	Xie et al.	2024	The Impact of Green Finance and Financial Technology on Regional Green Energy Technological Innovation Based on the Dual Machine Learning and Spatial Econometric Models	Fixed-effects regression.	**DV**: Green technological innovation **IV**: Green finance, financial technology **CV**: Financial Development Index, Environmental Development Index, Technological Investment Index, Industrial Structure Index.
22	Xu et al.	2024	Does Fintech Foster the Development of Green Finance?	Panel regression	**DV**: Green finance **IV**: Fintech **CV**: Environmental regulation (Env), Government intervention (Gov), Industrial structure (Ind), Level of education (Edu), Scientific research support (Sup).

Table 2: Review of relevant recent literature

Note: The following terms have been abbreviated: Dependent variable **(DV),** Independent Variable **(IV),** Control Variable **(CV),** Moderator **(MOD),** Mediator **(MED).**

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