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REVIEW

Green finance in banking industry: a systematic literature review

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Abstract

This study reviews the literature on green finance and highlights the emerging themes. This review is undertaken in the context of the growing global concern for environmental protection, action on climate change, and the pursuit of sustainable development goals. Employing a systematic review approach, this research critically examines and summarizes findings from 50 relevant studies. For this review, 50 papers published across 35 journals were selected with a particular focus on the most recent contributions that prioritize the subject of green finance. The literature review spans the period from 1980 to 2021. The aim of this study is to provide an overview of perspectives on green finance in the banking industry, and highlight key themes relating to green finance, including, but not limited to, environmental protection, climate change risk mitigation, technology and innovation, bank credit policies, and interest rates. The research question is: what do previous and current studies discuss under the topic of green finance? Through a comprehensive systemic review, this investigation reveals 22 distinct factors that significantly influence the adoption of green finance within banks. The ensuing discussion delves into the global imperatives, banking regulations, ethics, internal practices, risk and interest considerations, as well as the role of technology and innovation in enhancing awareness and understanding of green finance within the banking industry.

Keywords Green finance · Banking industry · Systematic review

JEL Classification G2 · G21 · G29

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Introduction

In recent times, environmental concerns have attracted increased attention and there is widespread agreement about the need for measures to protect our environment (Amidjaya and Widagdo 2020; Dörry and Schulz 2018). These concerns are also evident in the context of finance and various terms such as green investments, climate finance, environmental finance, and sustainable finance have emerged in discussions of green finance. These terms suggest the complexity of the field of green finance and the growing research interest in its characteristics and implementation.

Despite these significant advances, challenges persist, ranging from the absence of universally recognized legislative standards to the inherent risks and limitations of green finance endeavors (Barua and Barua 2020). There is room for further research to critically examine the initiatives undertaken by banks in relation to green finance. Green banking is a rapidly developing field that gives private sector banks a competitive edge (Shah and Khan 2020) creates new business prospects, and broadens the supervisors' and central banks' authority to safeguard the financial system and control the risks associated with specific financial institutions (Padoa-Schioppa 2003).

To meet Environmental, Social, and Governance (ESG) standards, financial resources should align with green financing, and extend their reach across various economic sectors for sustainability (Li et al. 2023; Ng 2021), including those dedicated to climate change mitigation, green construction, and renewable energy. As a response to a changing world marked by societal upheavals, business scandals, climate change impacts, and global financial events, the traditional banking paradigm is changing and evolving in different ways. However, previous studies have not adequately defined the role of banks in mobilizing investments in the energy transition with customers (Polzin and Sanders 2020). Financial institutions are increasingly focusing on providing environmentally friendly products and services (Weber and Feltmate 2016). Central banks and major players in the banking industry are committed to promoting environmentally sustainable financial solutions. The World Bank pays attention to the environment and collaboratively works with various entities to reduce carbon emissions (World Bank 2022). Several banks have realigned their strategic business objectives to support eco-friendly goods and services.

Despite the burgeoning interest in green finance, there is still uncertainty and a lack of clarity in many areas. The green finance landscape remains dynamic and multiple challenges and opportunities are influencing its trajectory. Previous and current studies have contributed significantly to an understanding of green finance within the banking industry; studies have explored topics ranging from the impact of green lending on financial performance to the effectiveness of regulatory frameworks in promoting sustainable finance practices (Zheng et al. 2021). By synthesizing the findings of these studies, this literature review aims to provide a comprehensive overview of the evolving landscape of green finance in the banking industry, and shed light on key themes that characterize this dynamic

field. Through a systematic examination of the existing literature, this review aims to identify gaps in knowledge and avenues for future research, thereby contributing to the ongoing discourse on green finance and its role in fostering environmental sustainability within the banking sector. In the course of this review this study aims to answer this—research question: *What do previous and current studies discuss within the realm of "green finance" in the banking industry?* It is anticipated that identifying the key themes will enable scholars to identify gaps in current research and determine directions for future empirical analysis. Furthermore, this research aims to address the scarcity of detailed empirical analysis on this subject and seeks to clarify the determinants.

Research methodology

To ensure a systematic review method, this study follows the guidelines of Harris et al. (2014), the review techniques of Akomea-Frimpong et al. (2022) and Carolina Rezende de Carvalho Ferreira et al. (2016). A systematic review of the literature was undertaken to identify key themes, note any gaps in previous studies and highlight areas which merit further investigation. Additionally, the review aimed to evaluate the validity and credibility of the methods, samples, and findings of prior research.

This study initially focused on examining the determinants of green finance within the banking industry. The data collected is from ABI/INFORM Complete, Emerald, Science Direct (Elsevier), Scopus, ProQuest Management. Google Scholar, and JSTOR were used to search for relevant articles, including dissertations, theses, and conference papers relating to the focus of this study. As this research focusses on green finance, green finance was used as a keyword during the search. A variety of combination keywords relating to green finance was used to search for relevant studies. The searching technique focused on two mains parts. Firstly, "AND" was used to search articles relating to green finance. Secondly, "AND" was used to search articles relating to banking industry and its relevant products and processes.

Regarding the inclusion criteria, common determinants of green finance, such as green finance, green investments, green bonds, green loans, sustainable investments, green insurance, green products, bank, and banking industry emerged as recurring themes in the existing research. The exclusion criteria are related to the terminology of green finance in non-bank sectors. Keywords were systematically employed, resulting in the identification of 180 publications, including reviews, books, articles, and conference proceedings. The study's timeframe encompassed publications from 1980 to 2021, with an emphasis on content published in English. This refined search approach yielded a selection of 80 relevant journal articles.

Out of the initial pool of 80 journal publications on green finance, a refined selection process led to the identification of 50 articles that were deemed relevant for in-depth analysis and discussion. These selected articles specifically addressed the study's research objectives, ensuring a focus on green banking within the banking sector. It is noteworthy that in the first round of screening, all 80 articles on green finance were considered, but none of them met the criteria for inclusion as they did not sufficiently investigate the key issues pertaining to green banking. To facilitate

Table 1 Top cited article analysis, with authors, article titles on green finance

Authors	Titles of article
Wang and Zhi (2016)	The role of green finance in environmental protection: two aspects of market mechanism and policies
Dietrich and Wanzenried (2011)	Determinants of bank profitability before and during the crisis: evidence from Switzerland
Dörry and Schulz (2018)	Green financing, interrupted. Potential directions for sustainable finance in Luxembourg
Li et al. (2018)	Green loan and subsidy for promoting clean production innovation
Cui et al. (2018a, b)	The impact of green lending on credit risk in China
Chen et al. (2019)	Lending interest rate, loaning scale, and government subsidy scale in green innovation
Kılıç and Kuzey (2019)	Determinants of climate change disclosures in the banking industry
Julia and Kassim (2020)	Exploring green banking performance of Islamic banks vs conventional banks in Bangladesh based on Maqasid Shariah framework
Julia et al. (2020)	Islamic social finance and green finance to achieve SDGs through minimizing post harvesting losses in Bangladesh

further analysis, data from all the studies included in this investigation were meticulously compiled into a Microsoft Excel spreadsheet, laying the groundwork for comprehensive graphical analysis (Table 1).

Background analysis of relevant articles

The quantity of publications over the sample period is illustrated in Fig. 1. The study's timeframe, from 1980 to 2021, was chosen because this period aligns with the availability of published papers on green financing and the international recognition of the concept. The results, presented in Fig. 1, demonstrate a consistent upward

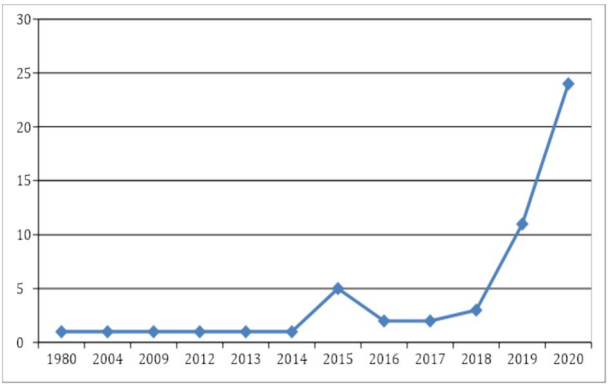

Fig. 1 Trend of green finance publications

trend in the number of publications related to banks' green financing from 2014 to 2020. This upward trajectory indicates a sustained and growing scholarly focus on the subject, reflecting its increasing importance in the financial field. Notably, the significant surge in publications from 2 in 2019 to 24 in 2020 highlights the surge in scholarly attention and suggests that global economic dynamics are a driving force behind this growth.

Support from organizations like the international finance corporation, along with the availability of resources, solutions, and tools for sustainability, has further contributed to the burgeoning interest in green finance. It's important to highlight that this trend of increasing research into green finance by banks is expected to continue, as the topic remains highly relevant to the banking industry across various jurisdictions. Factors such as support from environmental activists and improved access to information for identifying and capitalizing on social and environmental opportunities have likely played a role in driving this growing interest.

Among the 50 research papers included in this analysis, 35 different journals were identified as sources of these papers. However, our selection criteria focused on journals that had published a minimum of two relevant publications, enabling us to pinpoint the periodicals that consistently featured scholarly work in the field of green finance.

According to the Fig. 2, the top publications that met this criterion include the Journal of Sustainable Finance and Investment, Emerging Markets, Internet Finance, Technological Forecasting and Social Change, Sustainability, Humanomics, Finance, and Trade. While these journals collectively accounted for 20 of the 50 relevant papers reviewed in this study, it is noteworthy that a significant portion of the research in green finance encompasses both theoretical and practical aspects, as explored within the pages of these journals. Figure 3 illustrates that China is the most frequent case study for papers relating to green finance.

The analysis of relevant publications revealed that existing studies on green finance predominantly employed five distinct research approaches. Figure 4

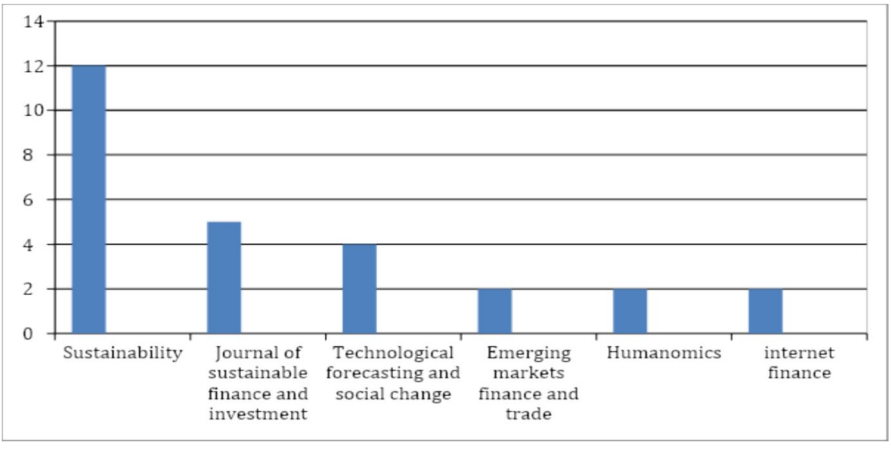

Fig. 2 Top journals publishing green finance papers

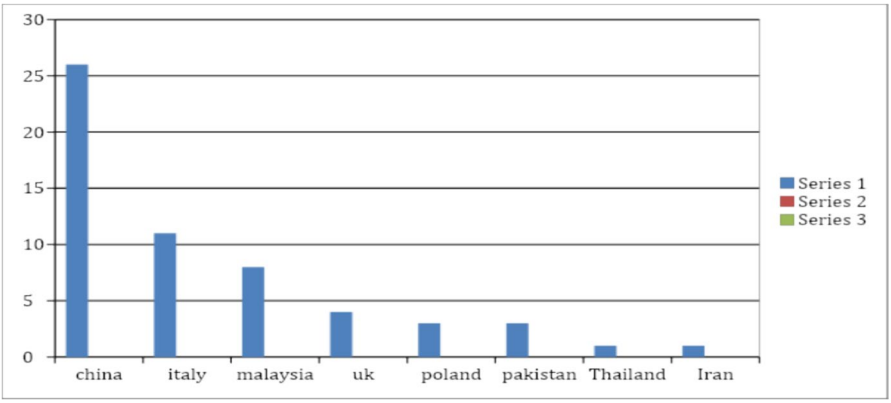

Fig. 3 Countries that appear to be the most popular for green finance papers

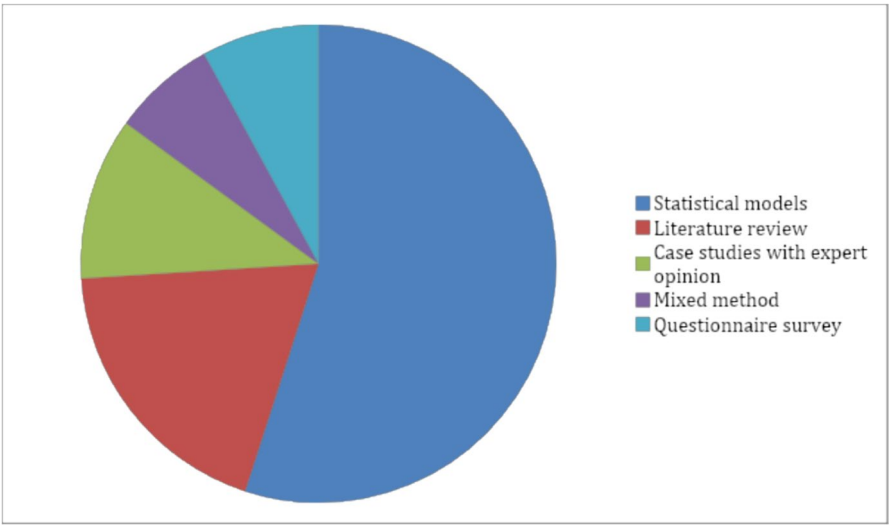

Fig. 4 Type of study for green finance papers

shows the types of previous studies. These methodologies are statistical models, literature reviews, case studies, mixed methods, and questionnaire surveys. Among these research methodologies, statistical models were the most prevalent, with 55% of the surveyed publications utilizing this approach to investigate green finance within financial institutions. Following closely, the review of policy documents, categorized under literature review, represented the second most frequently employed research strategy, and was employed in 19% of the surveyed papers included in this study. The third most commonly adopted research approach involved case studies that incorporated interviews as data collection tools. This method was employed in 11% of the surveyed studies. In contrast,

mixed methods and questionnaire surveys were the least utilized research methodologies in the context of green finance, each garnering 8% and 7% of the total publications respectively.

Overview of green finance products

Green credit investment, green long-term investment accounts, climate finance banking, and insurance goods are the categories of financial services and products that come under the umbrella term of green finance. Debt and equity are the main financial vehicles used in green financing, each characterized by unique branding, terms, and conditions. Within the financial sector, a diverse array of green finance solutions is emerging, each characterized by its unique branding, terms, and conditions. Banks strategically explore and promote relevant green financing products, positioning themselves as market leaders who are ahead of their competitors. The 50 papers which were selected for this study were used to identify the most common green finance products offered by banks. Table2 summarizes the green finance products identified in relevant papers. Each one of these products will be discussed in the subsequent sections of this study.

Table 2 Summary of green finance products

Green finance products	References
Green credit	Ahmad et al. (2018), Andreeva et al. (2018), Benijts (2014), Berensmann et al. (2017), Bieliński and Mosionek-Schweda (2018), Buchner et al. (2014), Chan and Liano (2009), Clark (2015), Contreras et al. (2019)
Green long-term investment	Ahmad et al. (2018), Andreeva et al. (2018), Bal et al. (2013), Barbu and Boitan (2019), Benijts (2014), Buchner et al. (2014), Campiglio et al. (2018), Celik and Ogus Binatli (2018), Clark (2015)
Carbon finance	Ahmad et al. (2018), Amidjaya and Widagdo (2020), Andreeva et al. (2018), Barbu and Boitan (2019), Benijts (2014), Campiglio et al (2018), Carolina Rezende de Carvalho Ferreira et al. (2016), Celik and Ogus Binatli (2018), Chen et al (2019), Díaz-García et al (2015)
Climate finance	Benijts (2014), Berensmann et al (2017), Buchner et al (2014), Campiglio et al (2018), Clark (2015), Contreras et al (2019), D'Orazio and Valente (2019), Dietrich, and Wanzenried (2011)
Green traded stocks and green bonds	Ahmad et al (2018), Andreeva et al (2018), Babihuga and Spaltro (2014), Benijts (2014), Carolina Rezende de Carvalho Ferreira et al. (2016), Chan and Liano (2009), D'Orazio and Valente (2019)
Green bancassurance	Ahmad et al (2018), Barbu and Boitan (2019), Berensmann et al (2017), Buchner et al (2014)
Green infrastructural	Buchner et al (2014)

Green credit

The first product for discussion is green credit. Based on the literature, green development can enhance the financial benefits of green credit issued by banks. Higher green economic growth and greater support through government environmental policies imply a higher positive impact of green credit on the financial performance of banks (Lian et al 2022). The results demonstrate that green credit improves commercial banks' financial performance, and this improvement is primarily derived from the positive effect of green credit on the rate of return on banks' interest-bearing assets (Mirza et al 2023). Overall, the research suggests that to encourage the coordinated growth of green finance and a green economy, commercial banks should aggressively expand their green credit operations, and the government should reinforce its green credit incentive programs.

It is evident from the literature that banks offer a specialized form of financing known as green loans or green credit, specifically designed to provide short- to medium-term loans to a range of beneficiaries, including new enterprises, small firms, and international organizations. The primary objective of these green loans is to facilitate research and the development of new products with environmental benefits (Zi 2023). Green loans serve as a catalyst for green innovation startups, positioning them competitively, especially within the realm of high-tech enterprises (Cooke 2011). These loans also play a pivotal role in fortifying the capital structures of small businesses, coupled with the advantage of low-interest rates, which can provide crucial financial resilience (Berger and Demirgüç-Kunt 2021).

Furthermore, studies show that banks adhere to agreements such as the equator principles when extending green loans to small businesses. These principles prioritize initiatives that contribute to environmental well-being. Under the equator principles, banks are mandated to increase the volume of loans disbursed, lower interest rates, and extend the repayment terms (Conley and Williams 2011). These measures are aimed at incentivizing businesses to embark on projects and initiatives that have a positive impact on the environment, and thereby foster a greater interest in environmentally responsible endeavors (Deb et al 2024).

Green long-term investment accounts

Another topic in the research is green long-term investment accounts, also known as sustainable investment accounts. These investment accounts are a banking service designed to empower customers to accumulate funds for long-term investments in environmentally beneficial sectors, including agriculture and renewable energy (Weber and Feltmate 2016). Recent trends indicate a growing interest in investments in renewable energy with banks playing a crucial role by facilitating the financing of such projects (Sen and Ganguly 2017). In addition to promoting environmentally responsible investments, banks also support programs aimed at fostering social integration, enhancing corporate governance practices, and improving labor relations (Scholtens 2006). These

initiatives require adequate funding to address economic challenges faced by minority groups and issues related to an aging workforce. One priority in this respect is pension schemes. Assuring that participants get a sufficient income upon retirement is a basic objective of every pension scheme. While an increasing number of defined contribution plans builds up an amount of assets that may be converted into a pension income upon retirement, defined benefit pension plans outline how pension income will be established in advance and then work to achieve this (Exley et al 1997). However, there is no set amount for this retirement income. Often, there is a focus on swiftly accumulating pension assets in the short term rather than prioritizing the ultimate goal of securing adequate retirement income. This trend is observed among regulators, most pension providers, and even members of pension plans themselves. However, there is a growing recognition of the importance of adopting benchmarks that encourage pension funds to invest with the long-term objective of ensuring retirees' financial well-being (Brüggen et al 2017). Leading pension funds, which have embraced outcome-based standards geared towards long-term sustainability, serve as prime examples of this shift in approach.

Carbon finance

Publications also focus on the topic of carbon finance. The scholarship shows that carbon financing has gained substantial interest recently as an economic strategy to combat climate change, because it can encourage low-cost emission reductions. Carbon financing plays a significant role in creating a stable carbon trading system, notably in China, as the largest developing nation with abundant resources for carbon emissions (Chen et al 2022). Previous papers provide a comprehensive analysis of the state of research and development as well as the obstacles facing the carbon market and carbon financing. Those studies focus on the evolution of the carbon market and the role of financial institutions in carbon financing, and include a brief introduction of relevant ideas and history (Zhou and Li 2019). Studies particularly focus on the new policies and the carbon trading pilots that were implemented (Munnings et al 2016). Overall, the studies present the policy implications for the growth of the carbon market and carbon financing in the future, which will be crucial for creating a single global carbon market (Michaelowa et al 2019).

It is apparent from the research studies that the banking industry actively finances a wide range of projects, including the construction of tunnels and zigzag kilns (Azim 2017). Additionally, as part of their long-term commitment to environmental investments, banks also ensure that the programs they support receive sufficient funding. This funding is crucial for addressing economic challenges encountered by minority groups and those related to an aging workforce, such as pension-related issues (Clements et al 2014). These efforts serve to promote social integration, enhance cohesion within communities, establish robust corporate governance practices, and foster improved labor relations (Barrett 2002).

Climate finance

Studies show that banks are actively engaged in addressing the climate crisis, which encompasses the reduction of greenhouse gas emissions resulting from industrial activities and all human endeavors (Light and Skinner 2021). Their primary objective is to mobilize funds that contribute to strengthening climate resilience and enhancing overall human well-being (Lamb and Steinberger 2017). Furthermore, these financial institutions support various initiatives, organizations, and advocacy groups dedicated to mitigating the impacts of adverse weather fluctuations (Winn et al 2011). The provision of climate finance by banks is a multifaceted and intricate endeavor, involving diverse approaches. Previous research has developed a composite score for assessing, measuring, and comparing global engagement based on data that demonstrates different nations' levels of commitment to climate-related financial policymaking over the past few decades (D'Orazio and Thole 2022). Researchers and policymakers may assess international commitment to climate-related financial policymaking using the established climate-related financial policy index by using a standardized measure. While earlier studies indicate the highest levels of group diversity, it is noteworthy that emerging economies show the most engagement in green financial policymaking (Claessens and Yurtoglu 2013). At this point, it would appear that there is not a single prescribed method or strategy for transitioning the financial sector towards sustainability.

Green bonds and stocks

The selected publications also identify the phenomenon of green stocks and bonds. Green securities are financial instruments offered by banks, with the primary purpose of funding initiatives in the green sector. These instruments encompass a range of options, including exchange-traded green funds and green indexes. The emergence of green stocks and bonds plays a pivotal role in optimizing resource allocation within the capital market, thereby contributing to the growth of the real economy (Geiger et al 2013). Chinese banks and Asian stock markets have emerged as leaders in the promotion and marketing of green securities, actively supporting the development and expansion of publicly traded enterprises (Force 2015). Within this context, the creation of green bonds, the advancement of green index products, and ongoing improvements are among the top priorities for stock markets. This global collaboration in green finance demonstrates a shared commitment to addressing environmental challenges and promoting sustainability. Businesses may commit to climate-friendly initiatives via green bonds. Previous empirical research studies show that managers employ green bond commitments to convey the profitability of their environmental initiatives (Deschryver and De Mariz 2020). Earlier studies demonstrate a signaling effect whereby companies adopt green initiatives driven by management incentives and carbon fines, anticipating that that the latter will amplify the former's impact (Marquis et al 2011).

Sustainable bancassurance

Risk is an inherent part of life, and one effective method for managing these risks is through insurance, another topic evident in the selected publications. In green banking, bancassurance plays a significant role by offering carbon–neutral underwriting protection for environmentally friendly assets and liabilities such as vehicles and buildings (Akomea-Frimpong et al 2022). This innovative product not only benefits the environment, but also extends its advantages to both people and animals. Customers, including homeowners and automobile owners, can leverage eco-friendly insurance policies, which come with enticing alternatives (Mai 2021). These policies offer premium discounts for various environmentally responsible choices, such as carbon–neutral vehicles and certified green residences or buildings. The collaboration between banks and insurers is instrumental in promoting sustainable practices within the financial sector, thereby contributing to the broader goals of green banking (Park and Kim 2020). Green banking, as a concept, actively fosters green innovation and provides an effective means to mitigate risks that are insurable, ultimately creating a more sustainable and environmentally conscious financial landscape. Financial institutions have long struggled with declining interest margins due to increased competition, technological advancements, financial sector liberalization, and globalization. Bancassurance is the best option in the light of the recent surge in financial innovation (Schultz and Weingast 2003). Bancassurance is defined as the insurance business's sales through bank channels. Bancassurance helps banks retain customers while giving them the chance to generate new revenue sources Previous studies show that annual interest on loan advances and bancassurance have a high positive correlation with the financial success of commercial banks; however, the annual inflation rate has a negative correlation (Waweru 2014; Chen et al 2009). Due to the strong correlation between bancassurance and the financial success of commercial banks, senior management could benefit from supporting the adoption and implementation of bancassurance. A report by Deutsche Bank suggests reviewing the banking act in order to develop regulations that would improve understanding and identification of this channel for selling insurance through banks (Hoehle et al 2012).

Green infrastructural finance

Green infrastructure financing is another topic in the surveyed literature. Green infrastructure financing is a forward-looking approach to funding that actively supports and advances the development of an ecologically balanced environment [China Council for International Cooperation on Environment and Development (CCICED) Secretariat 2023]. This innovative financing strategy leverages sustainable finance principles to facilitate the construction of large-scale infrastructure projects. Many countries have made achieving low-carbon, climate-resilient development a policy aim, yet a major challenge lies in funding infrastructure projects in the energy, transportation, water, and construction sectors. Given the expanding infrastructure

demands and budgetary restrictions, large-scale private sector involvement will be necessary for such transformative change. However, there is insufficient expertise in integrating environmental policy goals, including climate change objectives, into investment policy frameworks and infrastructure development (Corfee-Morlot et al 2012). Prior research indicates that additional elements are crucial for achieving the transition to a low-carbon, climate-resilient economy (Corfee-Morlot et al 2012), despite the existence of many studies which focus on the importance of environmental and climate change policies in supporting this transition (Feola and Nunes 2014). Establishing a foundation for green investment policies that consider climate change adaptation and mitigation, with infrastructure investment as a starting point, draws attention to the numerous possibilities and difficulties faced by both established and developing nations during the transition to development through investments in both new and rebuilt infrastructure. This implies that investments in green finance infrastructure have the potential to produce a variety of advantages for local development. To concurrently address climate change and local development goals, a comprehensive policy framework is required to guide domestic changes that can manage the use of scarce public money while also enabling and encouraging private investment to support a transition across pertinent infrastructure sectors (Worker and Palmer 2020).

One key feature of green infrastructure financing is its long-term nature, providing borrowers with a range of repayment options tailored to their needs. Banks play a pivotal role in this process by acting as private partners in public–private partnerships with the public sector. This collaborative approach not only attracts private investors but also creates specialized avenues for securing financing for essential infrastructure projects (Abdel Aziz 2007). The tangible outcomes of investments in green infrastructure are evident in the development of environmentally friendly infrastructure on a global scale. These investments not only contribute to a sustainable economy but also foster a more stable global climate (D'Orazio and Popoyan 2019). In conclusion, funding green infrastructure projects holds significant potential for mitigating the environmental impacts associated with public structures and encourages further investments in green initiatives (Naumann et al 2011).

A brief overview: main themes relating to green finance

From previous studies it is evident that there are various determinants relating to green finance. Table 3 illustrates the main themes identified in previous studies about green finance. Studies show that developing and implementing green finance policies has become imperative on a global scale, with central banks worldwide mandating various green initiatives. These initiatives include requiring banks to obtain green certifications, adhere to green credit ratings, foster environmental innovation, and promote social inclusion. As a result, the banking sector is undergoing a significant transformation with banks that embrace green finance rules becoming more competitive. In many countries, the adoption of green roofs has gained popularity as part of sustainable practices. However, the total number of banks operating within a nation can be influenced by entry barriers in the banking sector. These regulations,

Table 3 Key themes in green finance research

Key themes	References
Global effort on environmental protection and climate change	Amidjaya and Widagdo (2020), Benijts (2014), Berensmann et al (2017), Celik and Ogus Binatli (2018), Chan and Liano (2009), Contreras et al (2019), Cui et al (2018a, b), D'Orazio and Popoyan (2019), D'Orazio, and Valente (2019), Dörry and Schulz (2018), Durrani et al (2020), Elliott and Zhang (2019), Falagas et al (2008), Flaherty et al. (2016), Forcadell et al (2019), Fu and Ng (2020)
Banking industry rules	Benijts (2014), Berensmann et al (2017), Campiglio et al (2018), Celik and Ogus Binatli (2018), Chan and Liano (2009), Chen et al (2019), Clark (2015), Contreras et al (2019), D'Orazio and Valente (2019), Gallagher and Yuan (2017), Hassan (2009)
Internal practices and ethics of banks	Ahmad et al (2018), Benijts (2014), Campiglio et al (2018), Celik and Ogus Binatli (2018), Chan and Liano (2009), Chen et al (2019), Clark (2015), D'Orazio and Valente (2019), Hassan (2009)
Bank risks	Benijts (2014), Berensmann et al (2017), Buchner et al (2014), Campiglio et al (2018), Celik and Ogus Binatli (2018), Chan and Liano (2009), Chen et al (2019), Contreras et al (2019), Flaherty et al. (2017), Fu and Ng (2020)
Social justice and social inclusion	Ahmad et al (2018), Amidjaya and Widagdo (2020), Benijts (2014), Berensmann et al (2017), Chan and Liano (2009), Falagas et al (2008), Ganda (2018), Hassan (2009), Hu et al (2021)
Interest rates	Andreeva et al (2018), Berensmann et al (2017), Celik and Ogus Binatli (2018), Chan and Liano (2009), Contreras et al (2019), Forcadell et al (2019), Fu and Ng (2020), Gallagher and Yuan (2017)
Technology and innovation	Andreeva et al (2018), Berensmann et al (2017), Bieliński and Mosionek-Schweda (2018), Buchner et al (2014), Contreras et al (2019), Cui et al (2018a, b)
Consumer awareness Financial literacy	Azhgaliyeva and Liddle (2020), Contreras et al (2019), Falcone and Sica (2019), Flaherty et al. (2017)
Ethical corporate governance and disclosures	Benijts (2014), Contreras et al (2019), Cui et al (2018a, b), Hu et al (2021)
GDP growth rate	Campiglio et al (2018), Celik and Ogus Binatli (2018), D'Orazio and Valente (2019)
Verified information about green finance	Ahmad et al (2018), Azhgaliyeva and Liddle (2020), Benijts (2014), Chan and Liano (2009)
Returns on investment for green finance	Ahmad et al (2018), Chan and Liano (2009), Gianfrate and Peri (2019)
Bank credit policies	Falcone and Sica (2019), Fu and Ng (2020)
Level of consumer demand and expectation	Ahmad et al (2018), Benijts (2014), Gallagher and Yuan (2017)
Bank age	Ahmad et al (2018), Chan and Liano (2009)
Leverage	Ahmad et al (2018), Clark (2015)

Table 3 (continued)

Key themes	References
Financial access	Benijts (2014), Falcone and Sica (2019)
Global financial crisis and unpredictable events	Benijts (2014), Diaz-García et al. (2015)
Employee awareness training	Contreras et al (2019), Flaherty et al. (2017)
Taxes	Celik and Ogus Binatli (2018), Dörry and Schulz (2018)
Inflation	D'Orazio and Valente (2019),Dikau and Volz (2021)
sustainability	Babihuga and Spaltro (2014), Carolina Rezende de Carvalho Ferreira et al. (2016)

designed to ensure ethical and legal operations, play a pivotal role in shaping the level and nature of competition within the financial sector (Boon 2010). For banks to effectively transform into responsible environmental stewards, top management will need to champion internal green banking practices as an integral part of their everyday operations. This commitment could permeate from the highest levels of leadership down to every staff member within the organization. Senior management can spearhead the development and integration of green initiatives into the bank's core operations (Tan et al 2017). Simultaneously, banks should remain attuned to the needs of their clients and work diligently to maintain social legitimacy, both of which significantly influence green banking practices. Furthermore, the bank's hazard identification and risk control procedures have a direct impact on the decisions made regarding green financing (Dikau and Volz 2021). Credit managers responsible for offering green finance must possess a comprehensive understanding of the various risks involved, along with a sound knowledge of how to apply green credit risk models effectively.

It is apparent that in the twenty-first century, the dynamics between banks and communities have significantly evolved, influenced by the principles of social integration and equality. The manner in which banks address social issues, including racial discrimination, diversity, human rights, minority rights, and consumer protection, has increasingly become a determinant of their standing and popularity within the community (Taibi 1993). Green financing typically offers lower interest rates, fostering increased green investments and reducing the scarcity of green credit (D'Orazio and Popoyan 2019). These interest rates are intrinsically tied to the capital intensity of the green finance sector. Notably, interest rates on green infrastructure bonds tend to be higher compared to the interest rates on green credit provided to smaller enterprises (Taghizadeh-Hesary et al 2021). Additionally, technology has played a pivotal role in advancing understanding and awareness of green finance, introducing innovative methods for creating green financing products, simplifying data acquisition, and monitoring green loans. Technology contributes to the development of human capital, as exemplified by the case of farmers who are provided with alternative low-interest financing options (Balassa 1980). Such initiatives not only motivate farmers to explore green finance, but also stimulate increased productivity. Technological advancements have significantly influenced business models,

particularly in the financial services sector. An essential consideration is whether these new technologies can accelerate the growth of green finance while simultaneously enhancing bank profitability by optimizing various functional aspects of banking organizations.

Discussion

Green finance and the global imperative

Global action on environmental protection and climate change is a pressing contemporary concern that extends its influence into the banking sector, touching upon ethical considerations and the associated risks (Richardson 2009). In this context, social justice, social inclusion, and interest rates emerge as pivotal determinants of green finance, as elucidated in the existing literature (Nizam et al 2019). Green finance involves actionable steps toward environmental protection and addressing climate change by facilitating investment in projects that offer environmental benefits (Buchner et al 2014). Green finance effectively addresses global environmental concerns and aligns with global progress toward sustainable development goals (Biermann et al 2017). Recognized for its significance on a global scale, green finance has attracted substantial attention as it emphasizes the urgent necessity for sustainable and environmentally friendly financial practices. This growing awareness stresses the importance of socially responsible projects with positive global impacts, which can contribute significantly to sustainable development.

The impetus for banks to embrace sustainable practices is often driven by the willingness of companies to align with global and regional environmental and climate change policies and agreements (Wright and Nyberg 2017). External pressures and demands play a significant role in compelling banks to act responsibly in response to these global imperatives (Esposito et al 2019). Particularly, the imperative to abstain from or reconsider financing fossil fuels has become important due to the prevailing climate and environmental challenges, with international and regional organizations exerting influence in this regard (Morin et al 2020). Banks are, in turn, applying pressure on their business partners to integrate green finance principles into their financial frameworks. The influence of worldwide environmentalists and climate change activists has also been instrumental in prompting banks worldwide to embrace environmental reforms (Dikau and Volz 2021). However, it is essential to note that the concept of environmental protection lacks a single, universally accepted definition and encompasses diverse facets (Lehtonen 2004). The complexity of environmental issues highlights the challenge of translating the concept into legislation and adjudication.

Green finance, as a financial service supporting environmental protection, climate change mitigation, and energy efficiency, is gaining prominence. China stands out as an economic powerhouse with the potential to establish robust green finance policy frameworks (Volz 2018). According to Durrani et al (2020), the central government in China has already taken significant steps in this direction, exemplified by the release of the "guidelines on developing a green financial system". From

this perspective, green finance assumes a critical role in incentivizing businesses to make environmentally responsible investments, assisting nations in reducing emissions, decarbonizing their economies, and preparing for the consequences of global warming. Green finance encompasses financial products and services aimed at a wide range of environmental goals, including reducing industrial pollution and promoting sustainable practices in water, sanitation, and biodiversity (Van Zanten and van Tulder 2021). Furthermore, green finance considers the financial costs associated with managing green investments, an aspect which is often overlooked but which involves substantial financing challenges (Hailiang et al 2023). In addressing environmental challenges, especially those linked to the growing frequency of catastrophic events due to climate change, immediate attention must be given to physical risks. An effective strategy to mitigate such risks involves insurance. Climate change, a highly intricate and far-reaching issue, touches every corner of the globe (Orr 2009). Its influence is intertwined with population growth, economic development, social transformation, and the availability of essential resources for humanity. Consequently, addressing the impacts of climate change becomes paramount, particularly for future generations (Alm and Sievänen 2013).

Banking sector regulations

Many countries' central banks and national banking regulators have acknowledged the necessity of creating and enforcing green financing rules. Green finance in the banking sector means minimizing environmental effects in its financing (Zhang et al 2022). The sector actively funds green businesses and technologies, creates new green financial products, and expands the market for low-carbon economic growth (Huang 2022). Banks are now required to obtain green certification, and demonstrate green credit scores, environmental innovation, and social inclusion, according to central banks. Banks who comply with these green financing rules are competitively rewarded by the central banks with tax breaks and other benefits (Xing et al 2021). Green financing is expanding as a consequence of banks being under tremendous internal pressure in the banking sector. This is because there is fierce rivalry among banks to outperform one another. Previous studies demonstrate the development of green finance policies and its key determinants in the banking sector (Mendez and Houghton 2020). It is found that green finance is becoming more important in the banking industry because of efforts to protect banks and society at large against unforeseen future economic issues (Ziolo et al 2019). Globally significant stakeholders in the banking industry, including central banks, have committed to supporting the promotion of environmentally friendly financial products. Researchers have shown that low-carbon awareness is a consideration in the banking industry (Akhter et al 2023; Dahlmann et al 2019). Several banks have announced a shift in their business strategies to include more environmentally friendly goods. Regulations have been devised and put into effect by central banks to direct green financing transactions in the banking industry (Park and Kim 2020). Interestingly, many banks throughout the world have not shown that they are prepared to offer financial products on green financing, despite the significance of these pledges. Among the many

problems green financing faces worldwide are a lack of globally standardized standards, clarity about significant dangers, and restricted scope and dimensions.

The term green finance describes the range of financial services and goods that financial institutions offer for sustainable development. Within the banking industry, green finance refers to a broad range of market-based lending and investing activities that take social and environmental responsibility into account (Gilchrist et al 2021). These activities include retail banking, project financing, asset management, and investment finance. It is found that banking regulation has a positive impact on green finance (Xu et al 2022). Specifically, our results indicate that laws governing the oversight of newcomers to the financial industry, external reporting and audits, and deposit insurance all effectively lead to a rise in green finance (Strandberg 2005). Furthermore, banking rules support a region's efforts to increase economic growth and attract foreign direct investment (Nasir et al 2019). For nations to reach their maximum potential for economic expansion, laws that safeguard financial service providers while simultaneously facilitating convenient and inexpensive access to capital are required (Pazarbasioglu et al 2020).

Internal practices and ethics of banks

In the endeavor to transform banks into responsible environmental participants, a crucial initial step involves the seamless integration of green banking principles within their top management strategies, as highlighted by Forcadell et al (2019). This integration, however, goes beyond the mere commitment of top management; it necessitates active engagement from employees in fostering environmentally friendly daily operations, thereby embedding green banking practices into the culture of the bank (Lian et al 2022).

For sustainable progress in the adoption of green programs within banking operations, it is imperative that senior management focusses on their development and internalization. Notably, the alignment of customer expectations and the pursuit of social legitimacy emerges as a compelling motivation for the adoption of green banking practices (Lian et al 2022). Indeed, a comprehensive study delving into ethical behaviors within banks revealed the presence of 17 distinct forms of ethical conduct, all intimately linked to internal behaviors (Anand et al 2004). Intriguingly, research findings suggest that younger employees exhibit a heightened awareness of ethical issues compared to their more experienced counterparts. Furthermore, employees with longer tenure within a company may tend to prioritize job security, potentially leading to the inadvertent oversight or rationalization of unethical behavior (Anand et al 2004).

In this context, previous research highlights the critical importance of attending to internal behaviors, and recognizing their profound influence on external conduct (Reis et al 2000). Business ethics are shown to be a shared moral responsibility in commercial interactions, as well as the personal responsibility of all the individuals involved. Moreover, previous studies accentuate the pivotal role played by a code of ethics. The four key elements crucial for the analysis of ethical banking practices are

argued to be banking ethics, professional conduct, moral behavior, and ethical lending (Anand et al 2004).

Significantly, banks that prioritize addressing customer concerns with goodwill and a genuine focus on the client's best interests tend to experience fewer complaints (Lian et al 2022). Furthermore, the research demonstrates a direct correlation between lower levels of staff loyalty and satisfaction and a reduced customer acceptance rate for promoting the bank's products within the banking industry (Lian et al 2022). These diminished levels of loyalty and enjoyment also exhibit a parallel relationship with overall consumer satisfaction. Consequently, previous studies emphasize the indispensable role of commercial banks in recognizing and integrating ethical principles into their banking procedures, fostering an ethically responsible banking environment (Yeung 2011).

Yeung's study found no substantial ethical disparities between banks in the public and private sectors, particularly in the domains of the bank code, professional banking, and ethical lending (Yeung 2011). Nevertheless, notable distinctions were discerned in the ethical behavior exhibited by managers in the two sectors, particularly within specific contexts related to ethical banking. According to Yeung (2011), prior studies did not define the detail of internal practices and ethics of banks around green finance. It is important to determine whether ethical banking can be as profitable as conventional banking despite only investing in projects based on social values. For sustainable progress in the adoption of green programs within banking operations, it is imperative that senior management focusses on their development and internalization (Lashitew 2021). Notably, the alignment of customer expectations and the pursuit of social legitimacy emerges as a compelling impetus for the adoption of green banking practices.

Bank risk

Banks' risk management practices affect the decisions which are made about green financing. Credit managers need to understand the risks related to green finance as well as the fundamentals of using green credit risk models in issuing green finance (Krosinsky and Purdom 2016). Conventional finance risk techniques such as Credit Exposure Analysis may be used to assess green financing through consideration of the benchmarks used to measure economic capital with the help of Basel II for banks and borrowers as national regulatory requirements (Lian et al 2022). Green loans frequently come with less demanding collateral, whose value changes over time and in accordance with the amount borrowed (Huang et al 2019). Credit derivatives and credit insurance might be used to manage bank green credits and reduce risk. (Elliott and Zhang 2019). Creating and controlling new markets, lowering costs related to services purchased and taking out legal protection insurance are ways to lower risks (Lashitew 2021). Investors may utilize their financial expertise and resources due to the potential harm that events linked with this risk may create, and employ other resources to try and mitigate social and environmental risks in the companies in which they buy shares (Lashitew 2021). By developing technology that permits the integration of environmental risk, for instance, innovation might increase financing for green activities from the standpoint

of the environmental component evaluations into credit choices. Green finance instruments share the common trait of making lending and investing decisions in accordance with the demands of environmental sustainability, conducting environmental screening and risk analysis (Monti 2009). Physical risks and direct losses in the value of financial assets are the other two categories of climate risks as a result of climate- and weather-related occurrences and potential repercussions if parties who have suffered losses or damages seek recompense (Monti 2009). The vulnerability of the financial system to these risks has been highlighted in a number of recent studies. For example, Dietz et al (2016) examined how three stylized yet substantial macro prudential and credit policy designs connect to climate change, and consequently impact banks' balance sheets, financial stability, and ultimately their long-term growth.

Interest rates

Green financing typically offers lower interest rates, fostering increased green investments and reducing the scarcity of green credit, as highlighted by Wang and Zhi (2016). These interest rates are intrinsically tied to the capital intensity of green finance. Notably, interest rates on green infrastructure bonds tend to be higher compared to the interest rates on green credit provided to smaller finance entities, as observed by Julia and Kassim (2019) and Yusof et al. (2016). Moreover, in the context of a low-interest rate environment, central banks and sovereign wealth funds have amassed substantial savings. The primary macroeconomic determinants of long-term bond yields include interest rates, inflation rates, and production levels. High interest rates often incentivize the reduction of bond durations. It is worth noting that ecologically friendly sectors such as agriculture, renewable energy, environmental infrastructure, and circular economies offer loans with lower interest rates. This favorable lending landscape highlights a crucial relationship between credit spreads and corporate social responsibility (Cui et al 2018a, b).

Borrowers with poorer corporate social performance tend to face higher interest rates compared to their counterparts with better performance (Cui et al 2018a, b). Lenders factor the risks associated with their borrowers' corporate social responsibility into the interest rates they charge. Interestingly, superior environmental performance is associated with improved financial outcomes and reduced credit risks (Jo et al 2015). However, it is noteworthy that heightened environmental concerns may be correlated with higher debt costs, while proactive environmental initiatives are associated with lower debt costs (Jo et al 2015). State-owned banks, often funded by the government, extend more affordable financing rates to clients engaged in environmentally beneficial endeavors, such as retrofitting with green roofs (Jo et al 2015). The favorable interest rates offered on green loans depend on various factors, including the prevailing market conditions.

Technology and innovation

Sustainable economic transformation, the promotion of green innovation, and addressing climate change all hinge on the effective implementation of inclusive green finance.

The development of innovative tools designed for green financing products can streamline data acquisition and enhance the monitoring of green loan performance. Ongoing efforts are also focused on leveraging cutting-edge technologies for data collection and storage, particularly in the context of creating a climate change database. The existing body of literature primarily examines factors that facilitate green innovation, including environmental regulations, government funding for research and development, technology transfer mechanisms, tax incentives, and stakeholder responsibilities, as identified by Van Leeuwen and Mohnen (2017). Additionally, technology-oriented enterprises often require secure and low-interest financing to fuel their expansion, as noted by Amidjaya and Widagdo (2020). Furthermore, the development of human capital can be enhanced through technology adoption. For instance, providing farmers with access to alternative, low-interest financing options can incentivize their engagement in green finance and boost productivity.

Technology has played a pivotal role in raising awareness and understanding of green finance, as evidenced in the work of Azhgaliyeva and Liddle (2020) and Chen et al (2019). The green environmental finance sector encompasses various aspects, including infrastructure investment, state financial support for green innovations, and the growth of green markets. Green economic development is intricately linked to green financing, offering a systematic approach to this connection, as discussed by Rubtsov (2016), Medvedeva et al (2022) and Thalassinos and Dafnos (2015). Financial institutions, particularly banks, hold a competitive advantage due to their operational autonomy and effectiveness in providing investment products and services. Companies that adopt energy-saving technologies may qualify for financial assistance through competitive processes conducted by development organizations (Du et al 2014). The pursuit of the world's best financing strategies for green breakthroughs fuels the demand for financial institutions committed to reallocating investments in green technologies. Through embracing ethical investment and funding standards, financial institutions can play a pivotal role in fostering the growth of the green economy.

To achieve green growth, it is imperative to attain higher investment growth rates and accelerate the pace of innovation transformation (Du et al 2014). A comprehensive study has contributed valuable insights into socio-technical innovation, which involves systematic, society-wide change. This research has closely examined various industries, ranging from urban systems to energy and water, to trace the history of technological disruption and develop prescriptive approaches for sectoral transitions (Du et al 2014). The methodology has led to the creation of numerous analytical tools, including the multi-level viewpoint and the framework for transition management, both of which are particularly relevant for investigating social innovation and governance. This framework outlines innovation-related activities and delineates four non-sequential governance stages.

Conclusion and future direction

The primary objective of this study was to conduct a comprehensive analysis of the existing body of knowledge pertaining to green finance, with a specific focus on identifying key factors influencing the adoption of green finance practices

by banks. This study sheds light on the increasing global interest and attention directed toward environmental preservation, climate change mitigation, social inclusion, and sustainability, particularly within the banking industry. The methodology employed in this study was a systematic review of 50 relevant papers that investigated green financing in the banking sector. The findings of this investigation reveal a total of 22 distinct factors that exert influence on green finance adoption within banks. These factors encompass a wide spectrum, ranging from climate change, environmental preservation, and sustainable development to internal procedures, bank ethics, and various risk considerations.

In addition to these factors, innovation and technology, environmental performance, sustainable economic growth, energy conservation, and green financial regulation have all emerged as significant variables that are commonly explored in research within the banking industry. Furthermore, regulations and policies, risk mitigation, the limited number of factors, performance and disclosures, sustainable economic growth, data and modeling, as well as research and policy gaps, constitute areas within the banking sector related to green financing that warrant attention from researchers and policymakers alike. There exists a disparity between a nation's compliance with domestic green finance regulations and its engagement in international agreements pertaining to environmental conservation and climate change. These disparities necessitate alignment with and integration into the regulatory framework of banks. Given the absence of standardized green financing regulations, various banking industries worldwide adopt different strategies. Future research on regulations and policies should encompass the incorporation and implementation of these measures within the banking sector. Green financing can involve inherent risks, which may lead to potential losses. Given the unpredictable nature of the extent of these uncertainties, banks should proactively consider the substantial risks associated with green finance products, both in the short and long term.

Policies aimed at managing risks and facilitating discussions about green financing should be integrated into regulations governing both internal and external bank credit risk. Future research on risk mitigation models should also emphasize promoting ethical financial behavior from societal and environmental perspectives. While various efforts, such as the implementation of green credit key success indicators, have been undertaken to assess the effectiveness of green financing, these initiatives have their limitations, as they are primarily focused on some countries and may not be universally applicable. Therefore, further research is imperative to explore performance metrics, disclosures, and their broader implications.

Addressing the gap in sustainable economic growth between countries necessitates comprehensive research aimed at thoroughly understanding and evaluating the role of green finance. This research is essential for promoting sustainable economic growth in both developed and developing nations. Nevertheless, the absence of a comprehensive green finance database presents challenges in accessing information related to banks' green funding activities. As a result, scholars in the field of green finance must endeavor to develop practical models and establish a reliable database.. These efforts are essential for unlocking new opportunities in the future.

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