

Unveiling the Evolution of Green Finance through Bibliometric and Content Analysis

Beatrice-Larisa Dumnici, Monica Violeta Achim, Cristina Bota-Avram

Abstract

This study examines the literature on green finance and associated concepts, including sustainable finance, environmental finance, and carbon finance. It analyses contributions, constraints, and evolutionary trends throughout time and thematic categories. A central objective is to assess how the development of green finance shapes economic and corporate competitiveness in the context of the global transition toward a low-carbon and resilient economic system. The paper employs bibliometric analysis on 1,712 articles indexed in the Web of Science database for the period 2005–2025. Using Biblioshiny in RStudio, the study investigates publication dynamics, influential journals and authors, and the intellectual structure of the field. Complementing this, a content analysis of 30 highly relevant articles provides qualitative insights into methodological patterns and theoretical approaches. The findings reveal a significant expansion of research on green finance, driven by regulatory pressures, sustainability-oriented investment strategies, and the increasing urgency of climate policy goals. The analysis highlights that green finance can enhance competitiveness by fostering eco-innovation, improving risk management, and attracting long-term responsible capital. Nevertheless, the literature also points to persistent challenges, including conceptual ambiguities, regulatory inconsistencies, and uneven global adoption, which may limit competitiveness outcomes. This study identifies major research clusters and emerging themes, reflecting both consolidation and fragmentation within the field. Overall, this research offers an integrated evidence-based perspective, clarifies the link between green finance and competitiveness, and outlines promising avenues for future research aligned with the focus of the journal on competitiveness and sustainable economic performance.

Keywords: green finance, sustainable finance, environmental finance, carbon finance, ESG, bibliometric analysis

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1. INTRODUCTION

The transition toward a green economy increasingly depends on the financial system's capacity to direct capital flows toward activities that support climate goals and sustainable development. Global commitments such as the Paris Agreement and the European Union's Green Taxonomy have reinforced the role of finance in addressing environmental challenges, while also creating expectations for greater transparency and accountability in capital allocation. As a result, green finance has emerged as both a policy priority and an area of growing academic inquiry, reflecting the recognition that financial markets can either accelerate or hinder the shift to a low-carbon economy (Campiglio, 2016).

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In recent decades, green finance has become a prominent topic in both economic and environmental literature, with the explicit aim of coordinating economic development, resource use, and environmental protection. Despite extensive research, the concept still lacks a universally accepted definition. It is often used interchangeably with sustainable finance, environmental finance, or carbon finance, each emphasising different facets of the nexus between economy and environment. Green finance, broadly defined, refers to instruments and practices that integrate ecological considerations into decision-making, ranging from green bonds and ESG-linked investments to regulatory frameworks that incentivise low-carbon activities (Wang & Zhi, 2016; Nenavath & Mishra, 2023).

The broader framework of sustainable finance provides essential context. Traditional finance has historically been associated with linear production and consumption cycles and limited attention to environmental impacts (Schoenmaker, 2017). In contrast, sustainable finance aims to protect long-term economic and ecological well-being by embedding sustainability across all financial flows (Ziolo et al., 2019). Within this framework, green finance is one component, closely linked to carbon finance, which addresses the health and climate consequences of carbon dioxide emissions and facilitates decarbonization (Simon et al., 2012).

Other related categories include development finance, focused on public funding to support growth in developing countries (Tierney et al., 2011); microfinance, which combats social exclusion by providing financial services to low-income populations (Hazudin et al., 2022; Adda et al., 2021); and responsible finance, which accounts for both environmental and social outcomes of investment (Scholtens et al., 2008). In this sense, sustainable finance represents an overarching framework encompassing all these forms, with the integration of more tools into the financial system increasing its ability to address negative externalities and contribute to the Sustainable Development Goals (Schoenmaker, 2017; Ziolo et al., 2019).

At the same time, the historical trajectory of green finance research reveals a series of distinct phases. The pioneering years of the 2000s were dominated by discussions of climate finance and the role of international organizations. The issuance of the first green bonds by the European Investment Bank and the World Bank in the late 2000s marked an important turning point, although academic interest remained relatively modest during the subsequent years. The adoption of the Paris Agreement in 2015 triggered an exponential rise in publications between 2016 and 2020, with themes such as ESG investing and the financial implications of sustainable development gaining prominence, alongside early critiques of greenwashing and fragmented standards. Since 2021, the field has entered a stage of rapid maturation and standardization, dominated by debates on the EU taxonomy, global reporting frameworks, and the integration of fintech and digital innovations, while also grappling with the challenges of compliance costs, unequal access, and more sophisticated forms of greenwashing.

Nevertheless, academic literature in this area remains fragmented, with research scattered across diverse topics such as carbon markets, green bonds, ESG disclosure, and policy design, using heterogeneous methodologies and data sources. This dispersion has generated a body of work that is rich but uneven, lacking a unified perspective.

Despite the growing interest in green finance, existing review studies remain fragmented in scope, often focusing on specific instruments (e.g., green bonds), particular geographical regions, or narrowly defined sustainability dimensions. Furthermore, many of these reviews rely primarily on bibliometric mapping techniques, with limited integration of qualitative evidence that contextualises theoretical developments, regulatory milestones, and market evolution. As a result, the literature lacks an integrated perspective that simultaneously captures

the long-term evolution of the field, its intellectual structure, and the theoretical and methodological patterns emerging from highly influential studies.

Against this backdrop, the present paper combines bibliometric analysis of 1,712 articles indexed in the Web of Science with a content analysis of 30 highly relevant papers. Together, these approaches aim to map the evolution of green finance research across four time intervals, structure it within the broader green finance framework, and highlight both its achievements and persistent gaps that warrant further investigation.

This paper aims to contribute to the ongoing debates in the specialised literature on the role of green finance in supporting the transition to a sustainable economy. It provides an extended overview of past and current developments in this field. It emphasises both the opportunities and limitations of green finance as a mechanism for addressing climate change and environmental degradation. Although several review studies have been conducted in this area, many focus on specific instruments, such as green bonds (Flammer, 2021) or ESG investing (Friede et al., 2015), while others are limited to particular regions or sectors. In this paper, we adopt a comprehensive understanding of green finance that encompasses green bonds, sustainable banking, carbon finance, and ESG-related practices, as outlined by Wang and Zhi (2016) and Ziolo et al. (2019).

We argue that this study makes several contributions. This study encompasses a broad period from 2005 to 2025 and utilises the Web of Science (WOS) database to create an initial sample of 4,604 articles. After applying specific filter criteria, the final sample analysed consists of 1,712 articles. Secondly, it applies a combination of bibliometric analysis and content analysis. This dual approach allows, on the one hand, an extensive bibliometric examination of publication dynamics, influential journals, leading authors, and interconnections among countries, keywords, and research outlets, and on the other hand, a qualitative review of 30 highly relevant articles, selected based on their thematic significance and scholarly impact.

Through this content analysis, the study identifies the main theoretical perspectives employed, the dominant research methodologies adopted, and the most salient findings related to the evolution of green finance. It also highlights key challenges, such as fragmented reporting frameworks, greenwashing, and unequal access to green capital. Finally, the paper outlines several research gaps and provides guidelines for future studies to deepen our understanding of the nexus between finance, sustainability, and climate policy.

To guide the analysis, this study addresses the following research questions:

RQ1: How has the literature on green finance evolved between 2005 and 2025?

RQ2: What are the main themes and methods used in studies on green finance, sustainable finance, environmental finance and carbon finance?

RQ3: What gaps and challenges remain in this field, and what directions can future research take?

Aligned with these research questions, the study defines the following objectives:

RO1: To analyse the evolution of the green finance literature between 2005 and 2025 by examining publication trends and the dynamics of scientific output.

RO2: To identify and categorize the main themes, theoretical perspectives, and methodological approaches used in studies on green finance and associated concepts through a combined bibliometric and content analysis.

RO3: To detect existing gaps, limitations, and conceptual challenges within the field and to propose future research directions that can advance the understanding of green finance and its links to sustainability and competitiveness.

The paper is organised as follows. Section 2 outlines theoretical background. Section 3 presents the research objectives, the data used, and the research methodology. Section 4 reports the results of the content analysis and provides the basis for the discussions. Finally, Section 5 concludes the study and outlines its limitations.

2. THEORETICAL BACKGROUND

The concept of green finance has developed at the confluence of economics, environmental science, and financial regulation, embodying the expanding awareness that environmental risks and climate externalities increasingly influence financial stability and long-term economic outcomes. As delineated in the literature, green finance does not have a universally acknowledged definition; however, it is generally understood as the collection of financial instruments, institutions, and policies that direct capital towards environmentally advantageous activities (Wang & Zhi, 2016). Within the comprehensive framework of sustainable finance, which integrates sustainability objectives into financial decision-making, green finance functions alongside environmental finance and carbon finance, with each highlighting specific aspects of the finance–environment relationship (Linnenluecke et al., 2016; Ziolo et al., 2019).

The evolution of green finance is grounded in several theoretical perspectives. First, the sustainability risk perspective highlights how environmental degradation, climate shocks, and biodiversity loss generate financially material risks (Wilson, 2010). This view argues that environmental factors should be integrated into investment decisions to mitigate systemic risks. Recent empirical work also reinforces this perspective. Shahrour et al. (2023) show that firms' exposure to climate-related risks has direct implications for financial performance and valuation. Their analysis demonstrates that climate vulnerability is transmitted into firm-level risk metrics, underscoring the financial materiality of environmental shocks and supporting the rationale for integrating climate risk into investment and regulatory decision-making.

Second, theories of market failure and environmental externalities explain the need for regulatory mechanisms such as carbon pricing, emission trading systems, and subsidies to correct distortions arising from unpriced pollution. Early studies on carbon market microstructure emphasise how policy-induced scarcity and price signals shape investment incentives (Bredin et al., 2014). Third, institutional and governance theories stress the importance of coherent reporting frameworks and standardisation. Fragmented ESG (Environmental, Social, and Governance) standards and weak disclosure rules create information asymmetries, inconsistencies, and greenwashing risks, underscoring the need for alignment across sustainability reporting systems (Park & Ravenel, 2015).

Complementary evidence is provided by Kuzey et al. (2023), who find that disparities in ESG performance across firms can lead to over-investment and resource misallocation. Their results highlight how unequal or inconsistent ESG practices generate informational frictions and governance challenges, reinforcing the need for standardised sustainability reporting to improve comparability and reduce market distortions.

Recent regulatory developments also reinforce the governance-oriented perspective. Montesinos-Sansaloni et al. (2025) show that Corporate Sustainability Reporting Directive (CSRD) strengthens transparency and comparability in sustainability disclosures, reducing information asymmetries that hinder effective financial decision-making. Their findings

indicate that improved reporting quality supports innovation capacity and contributes to long-term competitiveness within the social economy.

A complementary strand of theory emerges from the Environmental Kuznets Curve (EKC), which proposes an inverted U-shaped relationship between economic development and environmental degradation. Recent studies extend this framework to the finance-environment linkage, suggesting that green finance may follow a similar trajectory as financial systems mature (Su & Lee, 2025). Recent empirical research also strengthens this EKC-related view. Wang et al. (2024) show that green finance significantly promotes high-quality energy development in China, with a 1% increase in the green finance index associated with a 0.767% improvement in energy quality. These findings indicate that as financial systems evolve, the effectiveness of green finance intensifies, supporting the notion that environmental and financial development follow a non-linear trajectory.

Additionally, signalling theory is frequently used to explain why firms issue green bonds or adopt sustainability practices: credible environmental commitments can reduce information asymmetry, attract responsible investors, and enhance firm value, provided that these signals are supported by transparent reporting and measurable outcomes. Another foundational perspective relates to financial innovation theory, which posits that significant structural shifts, such as the transition to a low-carbon economy, stimulate the creation of new financial instruments, markets, and risk-management practices. The increasing demand for green investments, technological change, and regulatory reforms together drive innovation in financial products, ranging from green bonds to blended-finance structures (Allen & Yago, 2011).

Finally, an essential theoretical link for the present study concerns the relationship between green finance and competitiveness. Drawing on Porter's hypothesis, stringent environmental standards can enhance competitiveness by encouraging technological innovation, improving resource efficiency, and reducing long-term risk. Empirical research demonstrates that green finance can stimulate eco-innovation, raise total factor productivity, and support firms' competitive positioning, especially in economies undergoing rapid energy transition (Lee & Lee, 2022; Saeed Meo & Karim, 2022). Additional evidence supporting this relationship emerges from the literature on sustainable lending. Mirza et al. (2024) show that green and blue lending reshape the risk profile and long-term resilience of banking portfolios, suggesting that environmentally oriented credit allocation can simultaneously support decarbonisation objectives and improve financial stability. Their study indicates that sustainable credit structures influence risk-return dynamics, thereby reinforcing the strategic role of green finance in enhancing firm-level and sector-level competitiveness. Further evidence on the financial implications of climate exposure is provided by Umar et al. (2025), who analyse how climate-related risks affect credit portfolio quality and banking resilience in a developing economy. Their findings show that higher climate vulnerability is associated with increased credit risk and reduced portfolio stability, underscoring the importance of integrating climate considerations into lending practices and financial regulation. This perspective reinforces the broader view that green finance contributes not only to environmental objectives but also to the resilience and competitiveness of financial institutions. A related contribution is provided by Afzal et al. (2023), who examine depositor behaviour in response to bank-level risk signals. Their findings indicate that greater transparency and credible ESG-aligned practices strengthen market discipline by reducing information asymmetries and fostering trust in financial institutions. This mechanism supports the broader theoretical view that sustainable finance

enhances both environmental outcomes and systemic financial stability, which in turn contributes indirectly to competitiveness in the financial sector.

Green finance is increasingly recognised as a driver of economic competitiveness, as it directs capital towards low-carbon technologies, improves risk management, and stimulates eco-innovation, thereby strengthening firms' productivity and strategic positioning (Liu, 2024). Taken together, these theoretical perspectives provide a comprehensive foundation for understanding the evolution of green finance and clarifying how its development shapes environmental performance, financial resilience, and long-term economic competitiveness.

3. RESEARCH OBJECTIVES, METHODOLOGY AND DATA

The study employs a mixed-methods approach, integrating bibliometric analysis alongside a content analysis of a purposive sample consisting of 30 highly relevant publications. With respect to the bibliometric analysis, the methodology draws upon recent trends and frameworks established in contemporary literature (Wang et al., 2022; Anuar et al., 2022; Bota-Avram, 2023, 2024). This dual approach aims to provide a comprehensive understanding of the subject matter while leveraging the strengths of both quantitative and qualitative research methodologies.

Methodologically, the integration of large-scale bibliometric mapping and qualitative content analysis provides a more comprehensive and nuanced perspective than either method on its own. The bibliometric component captures the macro-level intellectual structure of the field, including its evolution, influential actors, and thematic trajectories. In contrast, the qualitative content analysis enables a micro-level examination of how theories, methodological approaches, and policy narratives have developed within key publications. By combining these complementary perspectives, the study strengthens the robustness of the findings and enhances explanatory power by linking structural patterns in the literature with deeper conceptual insights.

To enhance the bibliometric mapping of the 1,712 articles included in the final dataset, we selected a purposive sample of 30 highly relevant publications. These were chosen based on their thematic significance and scholarly impact across four time intervals: 2005–2010, 2011–2015, 2016–2020, and 2021–2025. This review allowed us to identify the main foundational theories used, the research methods applied, the central themes discussed, and the contributions made to both academic debate and policy design.

The data extraction and screening process was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol, updated by Page et al. (2021). Initially introduced in 2009 as a benchmark for ensuring transparency and rigour in systematic reviews, the protocol has been refined to reflect advances in identifying, selecting, evaluating, and synthesising studies (Bota-Avram, 2023, 2024). The detailed selection process is summarised in Figure 1 (PRISMA flowchart).

The dataset was retrieved from the Web of Science (WOS) Core Collection, a widely recognised database of high-quality academic journals frequently used in bibliometric research (Raghuram et al., 2019; Caputo et al., 2021; Echchakoui, 2020; Bota-Avram, 2023, 2024). A comprehensive search was conducted in September 2025 using the terms “*green finance*”, “*sustainable finance*”, “*environmental finance*”, and “*carbon finance*” across titles, abstracts, and keywords. This procedure resulted in an initial sample of 4,604 publications covering the period 2005–2025. During the screening phase, we considered only peer-reviewed journal articles, reviews, and early-access publications, excluding non-English works. Additionally, we limited the dataset to the core economic categories defined by the Web of Science (WOS), specifically

Economics, Business Finance, Business, and Management, as these areas are most relevant to our research. Consequently, 2,148 records were removed, leaving us with 2,456 publications for further assessment.

During the eligibility stage, the remaining papers' abstracts were carefully reviewed to assess their relevance to green finance and related concepts. Following this assessment, 744 items were excluded, leaving a final dataset of 1,712 articles. These publications were exported in plain text format and analysed using Biblioshiny (Bibliometrix R package) (Aria & Cuccurullo, 2017). This enabled comprehensive mapping of publication dynamics, citation structures, leading authors and journals, and thematic trends and international collaborations.

To complement the quantitative bibliometric analysis, a content analysis was also undertaken. A purposive sample of 30 highly relevant papers was selected. Article selection was grounded in thematic relevance and temporal synchronicity with the field's major milestones from 2005 to 2025. This qualitative step allowed for a deeper examination of the theoretical foundations, research methodologies, and policy contributions of the most influential works in the field.

The full process of identification, screening, eligibility, and inclusion is summarised in Figure 1 (PRISMA flowchart) below:

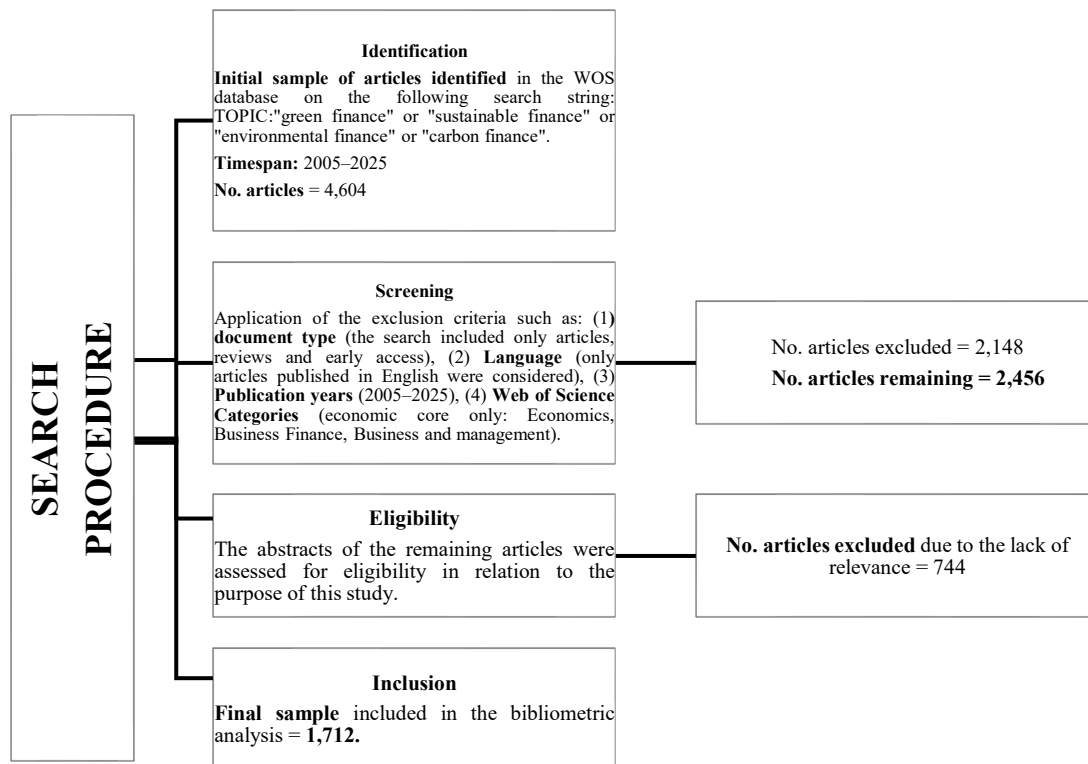


Fig. 1 - The PRISMA flowchart protocol for green finance. Source: Authors' own elaboration based on Page et al. (2021)

This section presents the main findings of a bibliometric analysis of a final sample of 1,712 articles on green finance and related concepts, including sustainable finance, environmental finance, and carbon finance. The results are organised in several ways, such as publication output, influential authors, key journals, and contributions from different countries. Additionally, the field's primary research themes are highlighted. The main objective of the

bibliometric analysis is to provide a comprehensive overview of the intellectual and thematic development of green finance research, as well as to illustrate its trends over time.

3.1 Characteristics of the selected sample

In our bibliometric analysis, we scrutinised a total of 1,712 scholarly articles that investigated the evolution of green finance and its associated concepts from 2005 to 2025. The analysis encompassed contributions from 3,619 authors. Among these authors, 218 played a role in the creation of 237 single-authored documents, while the majority participated in collaborative multi-authored papers. To evaluate the extent of collaboration within this body of work, we employed the Collaboration Index as formulated by Aria and Cuccurullo (2017). This index quantifies the average number of co-authors per article, with results illustrated in Table 1. Our findings reveal a Collaboration Index of 3.07 for multi-authored documents, signifying a robust and increasingly prevalent trend towards collaborative research among scholars in the domain of green finance.

Tab. 1 - Selected sample characteristics. Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

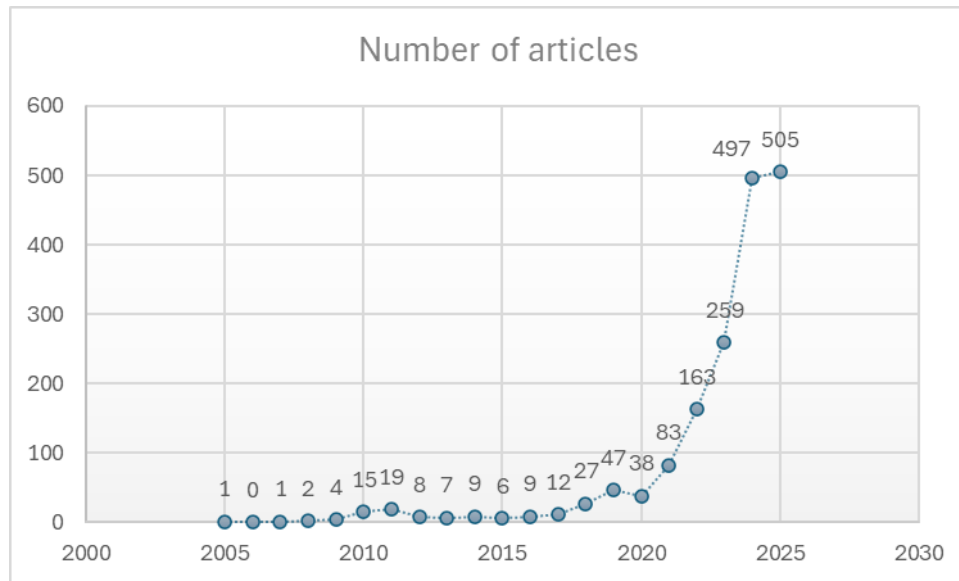
Main information about data	Results
Timespan	2005–2025
Sources	437
Documents	1712
Annual Growth Rate %	36.51
Document Average Age	2.13
Average citations per doc	21.88
References	64862
DOCUMENT CONTENTS	
Keywords Plus (ID)	1505
Author's Keywords (DE)	4189
AUTHORS	
Authors	3619
Authors of single-authored docs	218
AUTHORS COLLABORATION	
Single-authored docs	237
Co-Authors per Doc	3.07
International co-authorships %	32.94
DOCUMENT TYPES	
article	1426
article; early access	279
review	7

3.2 Publication dynamics

The evolution of green finance literature from 2005 to 2025 demonstrates a gradual growth that has recently surged exponentially, as illustrated in Figure 2. In the initial phase (2005–2010), the output was quite limited, with only 1 to 4 publications annually, primarily consisting of conceptual papers on environmental finance and climate finance. The second phase (2011–2015) showed modest consolidation, with the number of articles increasing to 7 to 19 per year, reflecting early discussions on green bonds and corporate social responsibility (CSR). A significant turning point occurred following the Paris Agreement in 2015, when the number of

studies

sharply



increased from around 27 in 2018 to 83 in 2020, coinciding with the mainstream adoption of ESG investing and a rise in critiques of greenwashing.

The period from 2021 to 2025 is characterised by an accelerated maturation of the field of green finance, as evidenced by a significant increase in scholarly publications. Specifically, the volume of published works surged from 163 in 2022 to 497 in 2024, reaching 505 publications in 2025 as of the data extraction date. This remarkable growth can be attributed to the implementation of more stringent regulatory frameworks, such as the European Union Taxonomy and International Sustainability Standards Board (ISSB) standards, alongside the integration of fintech and blockchain technologies into contemporary green finance discourse. Collectively, these trends indicate a transition from previously isolated conceptual contributions to a more cohesive and diversified body of research that firmly situates green finance at the nexus of sustainability studies and climate transition scholarship.

Fig. 2 - The dynamics of publications. Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

3.3 Most influential journals

Upon conducting a comprehensive analysis of our curated dataset comprising 1,712 scholarly articles focused on green finance and associated concepts, it was observed that these articles were disseminated across 437 distinct academic journals. Table 2 illustrates the top 10 most influential journals, ranked according to the cumulative number of citations accrued.

Energy Economics occupies a leading position in the scholarly discourse surrounding the intersection of finance and the energy transition, with a total of 112 published articles and 6,014 citations to date. Within the analysed sample, the journal's most-cited article, authored by Alharbi et al. (2022), has garnered 171 citations and explores the relationship between green financing and renewable energy production, measured in kilowatt-hours (kWh). This study disaggregates renewable energy output into bioenergy and non-bioenergy components and analyses data from 44 countries spanning the period from 2007 to 2020. The findings indicate

a positive and statistically significant association between green finance and renewable energy production in both short and long-term contexts. Notably, the impact of green financing is more pronounced in nations exhibiting higher capacities for innovation, elevated emission intensities, greater exposure to climate-related risks, and well-developed credit markets. This research underscores the critical role of financial mechanisms in facilitating the transition to sustainable energy systems.

Finance Research Letters emerges as the most prolific journal in the domain of sustainable finance, publishing 131 articles that have garnered a total of 3,396 citations. This significant citation count reflects the rapid incorporation of sustainability-related research within mainstream finance. In third place, Energy Policy contributes 31 articles and achieves 3,069 citations, underscoring the critical policy implications associated with sustainable finance initiatives.

Conversely, Ecological Economics, with 18 articles and 1,945 citations, offers essential theoretical and ecological foundations for this burgeoning field. Furthermore, Technological Forecasting & Social Change ranks fifth, presenting 29 articles that collectively receive 1,919 citations, thereby highlighting the pivotal role of innovation and long-term strategic perspectives in advancing green finance. This synthesis of contributions illustrates the multifaceted nature of sustainable finance, integrating empirical research, policy analysis, theoretical frameworks, and technological foresight.

These results confirm that green finance has become a truly interdisciplinary field, with leading outlets spanning finance, economics, and sustainability. The strong presence of journals such as Energy Economics and Finance Research Letters indicates that the topic has gained legitimacy in both mainstream finance and specialised sustainability publications.

Tab. 2 - Top 10 influential journals. Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

Rank	Source Title	Total citations	Number of publications	The year of the first publication	Publisher
1	Energy Economics	6014	112	2018	Elsevier
2	Finance Research Letters	3396	131	2019	Academic Press Inc Elsevier Science
3	Energy Policy	3069	31	2009	Elsevier Sci Ltd
4	Ecological Economics	1945	18	2009	Elsevier
5	Technological Forecasting & Social Change	1919	29	2018	Elsevier Science Inc
6	International Review of Financial Analysis	1561	59	2014	Elsevier Science Inc
7	Economic Analysis and Policy	1439	49	2021	Elsevier

8	Business Strategy and the Environment	1137	42	2015	Wiley
9	Journal of Sustainable Finance & Investment	1072	49	2018	Routledge Journals, Taylor & Francis Ltd
10	Journal of Financial Economics	986	4	2021	Elsevier Science SA

3.4 Most influential publications

This section undertakes a comprehensive analysis of the most influential publications by examining their global and local citation metrics, using contemporary methodologies prevalent in bibliometric research (Kumar et al., 2021; Baker et al., 2020). Global citations (as disclosed in Table 3) refer to the aggregate number of citations a publication receives across a diverse array of studies, regardless of disciplinary boundaries or research fields (Kumar et al., 2021; Baker et al., 2020). This approach not only highlights the overall impact of the publications but also facilitates a deeper understanding of their significance within the broader academic discourse.

The most frequently cited articles within our corpus underscore the central themes and methodological diversity that characterise the field of green finance research. A prominent study is "Corporate Green Bonds", authored by Flammer (2021), which has accumulated 935 citations, averaging 187 citations per year. This work highlights the increasing significance of innovative financial instruments in facilitating the sustainability transition. Flammer's article explores the concept of corporate green bonds, examining their issuance by companies and the subsequent effects on stock market performance, environmental outcomes, and investor demographics. The study engages with three theoretical frameworks: signalling theory, which addresses the credibility of environmental commitments; the phenomenon of greenwashing; and the implications for the cost of capital. Flammer (2021) concludes that the issuance of corporate green bonds serves as a credible signal of a firm's environmental commitment. The analysis reveals that the market responds favourably to such signals, leading firms to not only enhance their environmental performance indicators but also to attract investors aligned with sustainable practices, often without any discernible cost advantage over conventional bonds. This research thus contributes to a nuanced understanding of the interplay between financial instruments and environmental sustainability.

Similarly, Lee and Lee (2022) explored the relationship between green finance and total factor productivity in their study, "How Does Green Finance Affect Green Total Factor Productivity? Evidence from China," which has garnered 819 citations (205 per year). This indicates a rapid increase in empirical studies connecting green finance to productivity and economic growth. Other influential works include Yu et al. (2021), with 789 citations, and Zhang et al. (2021), with 558 citations. These studies emphasise how green finance can alleviate financing constraints and promote green growth, especially in emerging economies. In contrast, Irfan et al. (2022), with 545 citations, highlight the significance of regional policies in supporting innovation. Additionally, Taghizadeh-Hesary and Yoshino (2019), with 474 citations, underscore the role of private sector participation as a driver of sustainable investment.

Tab. 3 - Top 10 cited articles ranked by their global citations. Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

Rank	Authors	Year	Article title	Total Citations	Total Citations per Year
1	Flammer, C.	2021	Corporate green bonds	935	187.00
2	Lee, C.C. & Lee, C.-C.	2022	How does green finance affect green total factor productivity? Evidence from China	819	204.75
3	Yu, C.-H., Wu, X., Zhang, D., Chen, S. & Zhao, J.	2021	Demand for green finance: Resolving financing constraints on green innovation in China	789	157.80
4	Zhang, D., Mohsin, M., Rasheed, A.K., Chang, Y. & Taghizadeh-Hesary, F.	2021	Public spending and green economic growth in BRI region: Mediating role of green finance	558	111.60
5	Irfan, M., Razzaq, A., Sharif, A. & Yang, X.	2022	Influence mechanism between green finance and green innovation: Exploring regional policy intervention effects in China	545	136.25
6	Taghizadeh-Hesary, F. & Yoshino, N.	2019	The way to induce private participation in green finance and investment	474	67.71
7	Wang, J., Ma, M., Dong, T. & Zhang, Z.	2023	Do ESG ratings promote corporate green innovation? A quasi-natural experiment based on SynTao Green Finance's ESG ratings	432	144.00
8	Campiglio, E.	2016	Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy	413	41.30
9	Saeed Meo, M., & Karim, M. Z. A.	2022	The role of green finance in reducing CO2 emissions: An empirical analysis	396	99.00
10	Zhou, G., Liu, L. & Luo, S.	2022	Sustainable development, ESG performance and company market value: Mediating effect of financial performance	395	98.75

Local citations refer to the citations gathered from studies and articles included in the review corpus. In our study, local citations (as disclosed in Table 4) refer to the number of contextual citations received by an article within a sample of 1,712 articles on green finance and its associated concepts, selected from the WOS database (Kumar et al., 2021; Baker et al., 2020; Bota-Avram, 2024).

When comparing rankings based on global citations to those based on local citations, several important patterns emerge. Three papers, “Corporate Green Bonds” (Flammer, 2021), “The Way to Induce Private Participation in Green Finance and Investment” (Taghizadeh-Hesary & Yoshino, 2019), and “Beyond carbon pricing: The role of banking and monetary policy in

financing the transition to a low-carbon economy” (Campiglio, 2016) appear on both lists, highlighting their dual influence. These papers are widely recognised across various disciplines while also being highly relevant within the specialised field of green finance.

It is important to note that Taghizadeh-Hesary and Yoshino (2019) directly address the key challenge of green financing: mobilising private capital at scale. They do this not only through general recommendations but also by presenting operational mechanisms and a theoretical model that demonstrates when investors are attracted to green projects. The authors propose two practical instruments based on project size: the Distributed Ledger Technology - Hometown Investment Trust (DLT-HIT), which supports local funds for small projects, and the Green Credit Guarantee Scheme (GCGS) combined with a spillover tax, which is designed for larger projects.

On the other hand, the local citation ranking brings forward papers that are less visible globally but central to ongoing scholarly conversations in this domain. For example, Saeed Meo and Karim (2022) and Khan et al. (2022) receive a comparatively modest number of global citations but perform strongly locally, reflecting their resonance within green finance debates.

The citation analysis reveals that, while a small number of authors dominate productivity, the intellectual influence within the field is more widespread. A few key works serve as the main theoretical and empirical foundations of green finance research. This situation illustrates both the maturity and the fragmentation of the field.

Tab. 4 - Top 10 cited articles ranked by their local citations. Source: Authors’ own elaboration based on Web of Science data using Biblioshiny in RStudio

Rank	Authors	Article title	Year	Local Citations	Global Citations	LC/GC Ratio (%)
1	Flammer, C.	Corporate green bonds	2021	178	935	19.04
2	Taghizadeh-Hesary, F. & Yoshino, N.	The way to induce private participation in green finance and investment	2019	90	474	18.99
3	Saeed Meo, M., & Karim, M. Z. A.	The role of green finance in reducing CO2 emissions: An empirical analysis	2022	74	396	18.69
4	Dikau, S. & Volz, U.	Central bank mandates, sustainability objectives and the promotion of green finance	2021	53	270	19.63
5	Khan, M. A., Riaz, H., Ahmed, M. & Saeed, A.	Does green finance really deliver what is expected? An empirical perspective	2022	49	211	23.22
6	Al Mamun, M. A., Boubaker, S. & Nguyen, D.K.	Green finance and decarbonization: Evidence from around the world	2022	44	211	20.85

7	Wang, K.-H., Zhao, Y.-X., Jiang, C.-F. & Li, Z.-Z.	Does green finance inspire sustainable development? Evidence from a global perspective	2022	44	176	25.00
8	Liu, C. & Xiong, M.	Green finance reform and corporate innovation: Evidence from China	2022	35	126	27.78
9	Campiglio, E.	Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy	2016	32	413	7.75
10	Agliardi, E. & Agliardi, R.	Financing environmentally- sustainable projects with green bonds	2019	27	121	22.31

3.5 Most productive authors

In bibliometric studies, the most productive authors (disclosed in Table 5) are defined as those who have published the highest number of papers in a specific research field, regardless of their citation impact (Gupta, 2024). Interest in green finance among researchers has grown rapidly, with most of the highly productive authors beginning to publish after 2020. Notably, Li Y. and Wang Y. stand out as the most prolific authors, each contributing a total of 35 publications. Li Y.'s research, particularly from 2022 (which garnered 399 citations) and 2023 (with 205 citations), emphasises the role of green finance in promoting innovation and productivity. Conversely, Wang Y.'s more recent contributions, especially in 2023 (which received 336 citations), focus on environmental, social, and governance (ESG) factors and sustainable development on a global scale.

Additionally, in 2024, Wang Y. published an intriguing article on greenwashing. This study investigates whether greenwashing improves access to finance, revealing an ambivalent response: in the short term, it increases bank loans, but it also exacerbates over-indebtedness, leading to more inefficient funding. The analysis is based on listed Chinese firms from 2007 to 2022 and measures greenwashing using a text-based index derived from a Naive Bayes classification of environmental reports. The findings were estimated using Heckman models and robustness tests.

Tab. 5 - Most productive authors. Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

Rank	Author	No. of publications	Frequency	Total Citations	Total citations per year
1	LI Y	35	2022 – 2 articles	399	99.75
			2023 – 6 articles	205	68.33
			2024 – 12 articles	106	53
			2025 – 11 articles	16	16
			2023 – 4 articles	64	21.33
2	WANG Y	35	2023 – 7 articles	336	112

<https://doi.org/10.7441/joc.2026.SI.12>

			2024 – 8 articles	60	30
			2025 – 15 articles	52	52
			2019 – 1 article	377	53.85
			2021 – 2 articles	1347	269.40
			2022 – 2 articles	452	113
3	ZHANG Y	26	2023 – 3 articles	71	23.67
			2024 – 10 articles	119	59.50
			2025 – 13 articles	19	19
4	LI X	28	2022 – 2 articles	61	15.25
			2023 – 5 articles	27	8.99
			2024 – 7 articles	50	25
			2025 – 10 articles	42	42
			2009 – 1 article	0	0
			2010 – 1 article	0	0
			2021 – 2 articles	142	28.40
5	TAGHIZADEH-HESARY F	21	2022 – 4 articles	417	104.25
			2023 – 4 articles	150	50
			2024 – 1 article	11	5.50
			2025 – 1 article	2	2
			2022 – 1 article	187	46.75
6	WANG J	21	2023 – 6 articles	758	252.66
			2024 – 9 articles	147	73.5
			2025 – 5 articles	28	28
			2020 – 1 article	215	35.83
			2022 – 2 articles	35	8.75
7	LIU X	16	2024 – 4 articles	80	40
			2025 – 9 articles	16	16
			2019 – 2 articles	579	82.71
			2020 – 1 article	384	64
			2021 – 8 articles	972	194.40
8	LEE CC	15	2024 – 4 articles	143	71.50
			2025 – 3 articles	26	26
			2017 – 1 article	0	0
			2020 – 1 article	1	0.16
			2021 – 2 articles	131	26.20
9	WANG X	15	2023 – 2 articles	126	42
			2024 – 7 articles	115	57.50
			2025 – 3 articles	9	9
			2021 – 1 article	150	30
			2022 – 4 articles	243	60.75
10	ZHANG D	15	2023 – 3 articles	274	91.33
			2024 – 6 articles	152	76
			2025 – 1 article	1	1
			2020 – 1 article	2	0.33
			2022 – 2 articles	272	68

3.6. Cluster map based on document coupling

Figure 3 illustrates the clusters generated through document coupling, highlighting the positioning of different research themes within green finance based on their impact and centrality. On the right side, the cluster encompassing green bonds (78%), green finance (16.7%), and sustainable finance (64%) is prominent, as it is both central and influential. This reflects its status as the mainstream of the field and its strong connections to other research areas.

In contrast, the cluster located in the lower-left quadrant, which includes green finance (83.3%), China (90.5%), and green innovation (90%), exhibits high internal coherence but lower centrality and impact. This suggests a more specialised body of literature. While the study of green bonds and sustainable finance has become well-established at the core of academic discourse, research focusing on China and green innovation, although cohesive and rapidly growing, occupies a more peripheral position in the global scholarly landscape.

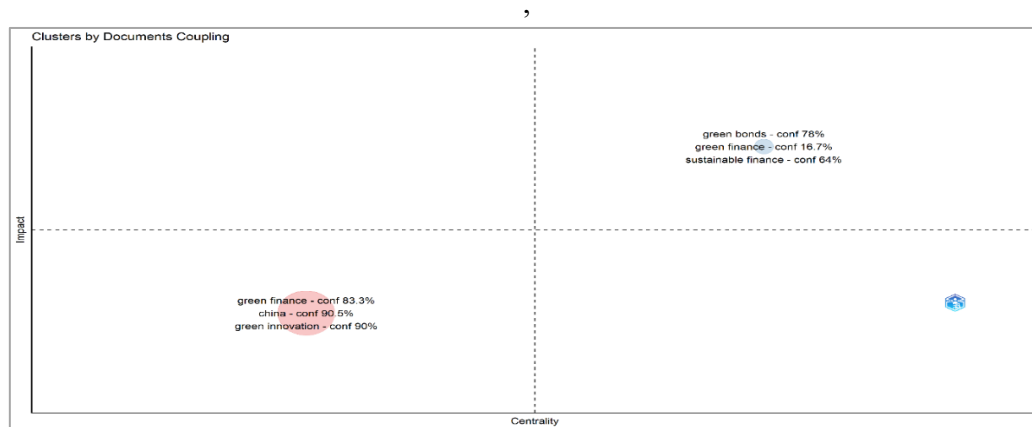


Fig. 3 - Map of clusters by document coupling. Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

3.7. Three-field plot: interrelationships among countries, keywords and journals

The Biblioshiny package for RStudio incorporates a Sankey diagram-based three-field plot, which serves as a valuable tool for visualising the interrelationships among keywords, countries, and academic journals. This methodology has been articulated in previous works (Abhishek & Srivastava, 2021; Riehmann et al., 2005). As depicted in Figure 4, the three-field plot elucidates the interconnectedness of keywords (on the left), countries (in the centre), and publication outlets (on the right) within the domain of green finance literature. The analysis demonstrates that China significantly dominates this research area, contributing the most extensive body of literature. Chinese publications predominantly focus on themes such as green finance, innovation, sustainable development, as well as performance and impact assessment. The findings indicate that prominent journals in which these studies are published include Finance Research Letters, Energy Economics, and the International Review of Financial Analysis.

Countries such as India and Italy are increasingly recognised for their significant contributions to the realm of sustainable finance, investment, and Environmental, Social, and Governance (ESG) criteria. The United Kingdom and France emerge as pivotal players in this field, frequently engaging with scholarly journals such as "Business Strategy and the Environment" and the "Journal of Sustainable Finance & Investment." In North America, the United States, alongside Germany, Australia, and Spain, actively engages in research pertaining to sustainability and corporate social responsibility. These contributions are often disseminated through publications such as "Economic Analysis and Policy" and "Corporate Social Responsibility and Environmental Management."

Overall, this analysis reveals a geographically diverse research landscape. China is identified as a leader in terms of productivity and a thematic focus on green finance and green innovation. In contrast, European nations tend to emphasise corporate governance and policy dimensions. The United States, on the other hand, exhibits a closer alignment with sustainability-driven approaches, highlighting the varying regional priorities and areas of expertise within the global discourse on sustainability.

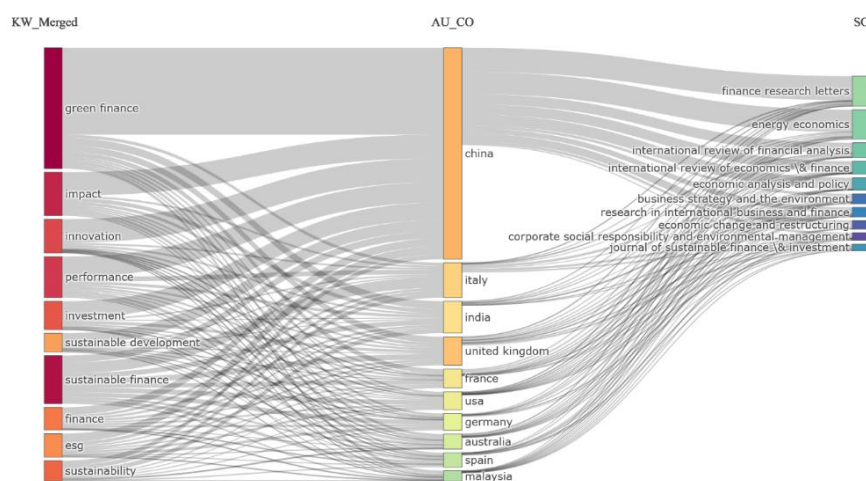


Fig. 4 - Three-field plot (countries-keywords-journals). Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

3.8 Trend topics analysis

The examination of trend topics is a pivotal component of bibliometric research, as it elucidates the temporal evolution of salient themes within a particular discipline. This analytical framework enables researchers to discern the emergence, growth, and decline of specific concepts, thereby facilitating the identification of both established domains and nascent directions for scholarly inquiry. Within the realm of green finance, such analyses not only capture academic advancements but also reflect the impact of global events and policy frameworks, notably the Paris Agreement and the COVID-19 pandemic.

Figure 5 presents an overview of the trend topics within green finance research, illustrating the emergence and frequency of relevant keywords over time. The formative contributions from 2010 to 2014 primarily concentrated on concepts such as carbon trading, the clean development mechanism (CDM), and the low-carbon economy, indicative of the initial emphasis on carbon finance and mechanisms associated with the Kyoto Protocol. In the subsequent period from 2015 to 2020, the literature exhibited diversification, incorporating themes related to financial innovation, responsible investment, and environmental finance. This evolution signals a broader conceptualisation of the field, reflecting an increasing recognition of the multifaceted nature of green finance.

Following the adoption of the Paris Agreement in 2015, a notable escalation in research intensity has been observed, particularly from 2020 onward. This period has seen an emergence of key concepts such as green bonds, corporate social responsibility, sustainable finance, and the green economy within scholarly discourse. More recently, from 2021 to 2025, the focus has evolved towards more advanced themes, including environmental, social, and governance

(ESG) performance, financial technology (fintech), and the pivotal role of central banks. This shift underscores the transformative impact of regulatory frameworks and digital technologies on performance metrics and their subsequent influence on the contemporary debate surrounding sustainability. Additionally, the inclusion of terms such as COVID-19 indicates that the pandemic has catalysed an academic interest in resilience and strategies for green recovery, further enriching the discourse.

The COVID-19 pandemic has led to a significant reduction in pollution from industrial production, as many manufacturing capacities that were previously underused have been effectively phased out. Concurrently, the diminished support for green products presents an opportunity for government entities to redirect resources toward green research and development initiatives in times of declining production yields. This strategic shift can facilitate the establishment of augmented green production capacities while minimising policy-associated costs. It is important to note that finance serves as the foundational pillar of the modern economy, playing a critical role in sustaining and driving the unit economics of various sectors (Hu et al., 2021).

Overall, Figure 5 illustrates a clear thematic evolution: starting with carbon-centred mechanisms in the early years, transitioning to mainstream sustainable finance and innovation after 2015, and finally moving towards technology-driven and regulatory dimensions in the post-2020 period.

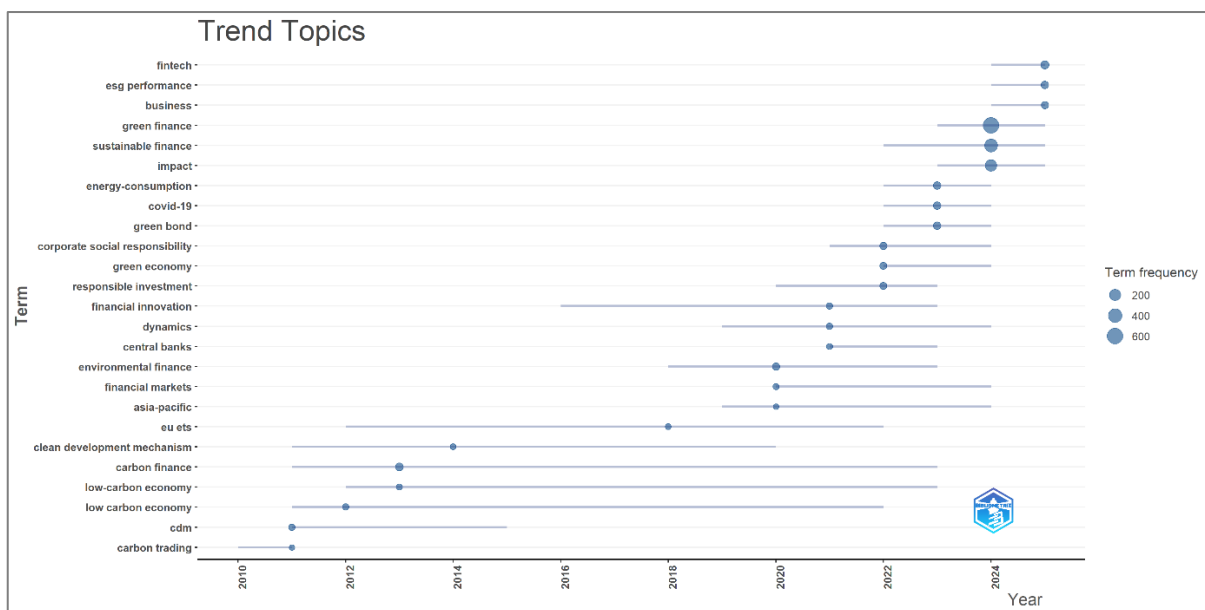


Fig. 5 - The analysis of trend topics. Source: Authors' own elaboration based on Web of Science data using Biblioshiny in RStudio

4. RESULTS AND DISCUSSION

This section presents a content analysis of the most significant articles within the field under investigation. Whereas the theoretical background presents the main concepts and frameworks associated with green finance, the following section examines how these elements are reflected in the literature through the thematic patterns identified in the content analysis. The selection of articles was grounded in thematic relevance and temporal synchronicity with key milestones in the field, spanning from 2005 to 2025. We included only studies published subsequent to each milestone: the Kyoto Protocol, the introduction of the first green bond, the Paris

Agreement, the European Green Deal, the COVID-19 pandemic, the EU Taxonomy, the ISSB standards, and the commencement of the 2025 implementation. Furthermore, the selected articles explicitly engage with the implications of these pivotal events. This criterion ensures that the evidence reflects the contemporary policy and market conditions, while prioritising contributions that enhance understanding in the aftermath of each regulatory or market shift. For a more comprehensive understanding of these events, please refer to Figure 6, which emphasises their chronological unfolding.

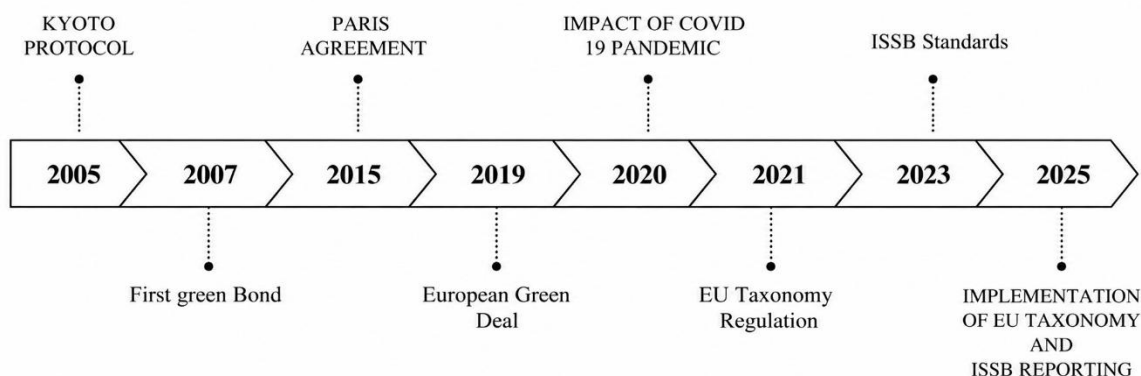


Fig. 6 - Key milestones in green finance, 2005–2025. Source: Authors' own elaboration

Content analysis serves as a vital methodological approach predominantly employed within the social sciences to conduct in-depth examinations of literature within specific domains. This analytical framework facilitates the identification of significant gaps in the existing body of literature, thereby contributing to a more nuanced understanding of the research landscape.

Building on the milestones presented above and illustrated in Figure 6, the evolution of green finance was delineated into four distinct temporal periods. Each interval reflects a phase marked by major regulatory, policy, or market developments that influenced the thematic orientation of the literature. Anchoring the content analysis in these institutional milestones improves the transparency of the methodological approach and strengthens the coherence of the analysis by situating emerging research themes within their broader policy and market context.

4.1 Evolution of the concept over time

In light of the significant developments in green finance throughout time, this section will systematically present scholarly articles categorised by the temporal context of these pivotal events.

❖ 2005–2010: Foundations - from environmental risk to early carbon finance

The formative phase of green finance is anchored in two complementary theoretical strands. The first is the sustainability risk lens, which posits that sustainable finance becomes increasingly salient as environmental degradation and the externalities of pollution are

recognised as financially material factors. This recognition compels investors and policymakers to seek demonstrable sustainability credentials (Wilson, 2010). Concurrently, environmental risk is positioned as a fundamental component of financial decision-making, establishing a critical link between environmental conditions and the economic and social viability of investments (Hoti et al., 2007). This conceptual framework encompasses various dimensions of risk, including systemic sustainability risks, pesticide-related risks, and catastrophic risks.

First, early carbon finance mechanisms demonstrate how policy can create investment flows. At the multilateral level, REDD (Reducing Emissions from Deforestation and Forest Degradation) was proposed as a compensation scheme for avoided deforestation, allowing tropical countries to access carbon revenues linked to verified emission reductions (Combes Motel et al., 2009). Operationally, the Kyoto Protocol and the establishment of China's Designated National Authority in 2004 catalysed a rapid pipeline of Clean Development Mechanism (CDM) projects after 2005. Meanwhile, India expanded solar home systems for remote electrification—both examples highlight how climate mechanisms transform policy into fundable green projects (Chaurey & Kandpal, 2009). Between 2008 and 2010, China's expansion of renewable energy sources, including wind, small hydro, and biomass, illustrated how early carbon financing interacts with domestic energy policy to build low-carbon capacity (Lewis, 2010).

The period from 2005 to 2010 marked a significant evolution in the conceptual and institutional frameworks underpinning green finance. During these years, environmental risks began to be recognised as financially pertinent, leading to the development of mechanisms such as the Clean Development Mechanism (CDM) and Reducing Emissions from Deforestation and Forest Degradation (REDD). These mechanisms created revenue models that facilitated the financing of green projects, thus rendering them bankable. Furthermore, the initial deployments of renewable energy technologies illustrated the critical interplay between policy implementation, financial investment, and the consequent transformation of assets. This era laid the groundwork for the subsequent growth and sophistication of green finance initiatives.

❖ 2011–2015: Carbon market microstructure and turn to ESG

In this phase, the European Union Emissions Trading System (EU ETS) solidified its status as Europe's preeminent climate policy instrument. Nonetheless, the efficacy of the price signal intended to facilitate green finance towards low-carbon projects was significantly undermined, as the prices of EU Allowances (EUA) remained persistently low and volatile. This volatility hindered consistent incentives for investment in abatement technologies (Abadie & Chamorro, 2008; Dietz & Fankhauser, 2010; Bowen, 2011; Bredin et al., 2014). The primary focus of carbon market microstructure studies has centred on aspects such as liquidity, volatility clustering, and price discovery from the perspective of market quality. Despite advancements in trading infrastructure, firms faced considerable challenges in transitioning from the procurement of emissions permits to capital expenditure in clean technologies. This was largely attributable to an insufficient perception of anticipated scarcity, which represents a crucial mechanism through which policy-imposed prices are translated into green investments.

The complexities surrounding information asymmetry have been elucidated through the lens of the "lemon problem," which highlights the detrimental effects of unequal access to information on market dynamics. As articulated by Ghosal and Sokol (2013) and Stiglitz (2000), the phenomenon known as "adverse selection" arises when buyers and sellers possess different levels of knowledge about product quality. This information disparity leads to a diminished demand for high-quality goods, as potential buyers are unable to accurately assess the value of

the assets being offered. Stiglitz identifies two primary types of information in which asymmetry is particularly consequential: information about quality and information about purpose. The significance of quality cannot be overstated, as many subpar goods disproportionately benefit from adverse selection; consumers often lack the ability to distinguish between high-quality and low-quality products. Consequently, buyers adopt a cautious approach and are only willing to pay a price that reflects the average quality. In such a scenario, sellers, indifferent to the quality of their offerings, are incentivised to market primarily low-quality items. This imbalance in the marketplace results in a pervasive shift toward low-quality goods, culminating in what is frequently termed a "lemon market" (Ghosal & Sokol, 2013).

Investors faced inconsistent and conflicting sustainability disclosures, leading to a shift towards developing ESG data infrastructure. Park and Ravenel (2015) recommended aligning the standards of SASB, GRI, CDP, UN Global Compact, and IIRC, rather than seeking complete harmonisation. This approach aims to reduce reporting fatigue, improve comparability, and support the mainstream integration of ESG factors into valuation and risk models. In summary, when the signal from carbon pricing weakened, markets began seeking reliable ESG indicators and verification to evaluate environmental performance and direct capital toward more sustainable issuers.

Between 2011 and 2015, carbon markets underwent operational development; however, they largely failed to deliver a robust investment signal. A critical challenge during this period was the insufficiency of high-quality information, which prompted a re-evaluation of priorities towards the establishment of ESG standards. Consequently, green finance evolved from a model primarily centred on policy-price intermediation to one that emphasises data-driven assessments and pricing of sustainability initiatives.

❖ **2016–2020: Approaches after implementation of the Paris Agreement: market take-off, ESG mainstreaming, and the policy mix**

Following the adoption of the Paris Agreement, green finance emerged as a crucial mechanism for facilitating a low-carbon transition. Green economy frameworks position public-private investment as a pivotal driver of both income and employment growth, while concurrently aiming to reduce emissions and pollution, improve resource efficiency, and safeguard biodiversity. This conceptual framework explicitly links the financial system to environmental outcomes and economic development, outlining a comprehensive toolkit of financial instruments—such as green mortgages, project finance, eco-funds, carbon finance, and insurance—through which capital can be effectively channelled towards renewable energy initiatives, cleaner production processes, and sustainable infrastructure development (Soundarrajan & Vivek, 2016).

The expansion of emissions trading schemes (ETS) and carbon taxation frameworks, such as those implemented in China's pilot programs and the subsequent announcement of a national ETS, established a comprehensive carbon pricing mechanism aimed at reallocating corporate capital expenditures (CAPEX) towards the advancement of clean technologies (Bailis et al., 2015; Gallego-Álvarez et al., 2015). Nevertheless, a considerable body of literature has raised concerns regarding the efficacy of these market instruments in instilling a sense of scarcity that aligns with planetary boundaries. This raises questions about their compatibility with biophysical limits, as articulated by Linnenluecke et al. (2016).

The integration of Environmental, Social, and Governance (ESG) factors into investment practices increasingly transitioned into the mainstream arena. As evidenced by the significant

growth in assets governed by the United Nations Principles for Responsible Investment (PRI), the incorporation of ESG considerations has become a standard practice in both risk management and capital allocation (Ding et al., 2020). Within public markets, the evolution of green bonds from a niche financial instrument to a widely accepted investment vehicle has been propelled by issuances from sovereign entities, corporations, and financial institutions. The establishment of disclosure regimes, such as the Task Force on Climate-related Financial Disclosures (TCFD), coupled with the expanding availability of ESG research provided by financial institutions, has further amplified the demand for transparency and comparability in ESG reporting (Wardle et al., 2018). Moreover, empirical evidence emerging from developing markets has begun to elucidate disparities in yields and liquidity between green bonds and conventional bonds. Observations indicate that positive stock market reactions often accompany green bond announcements, suggesting that the green designation may play a role in reducing the cost of capital and enhancing issuer visibility (Hachenberg & Schiereck, 2018; Tang & Zhang, 2018; Tu et al., 2020). This body of literature underscores the implications of ESG integration not only for investment performance but also for broader market dynamics, indicating an evolving landscape in the capital markets where sustainability-oriented investments are becoming increasingly relevant.

In the realm of governance and standardisation, China has effectively integrated expedited approval processes with external pre-issuance evaluations and post-issuance reporting concerning the use of proceeds and the environmental benefits associated with financial instruments. This dual approach not only enhances the credibility of such instruments but also raises the competency requirements for issuers (Dou & Qi, 2019). In the context of infrastructure, particularly within low-carbon climate-resilient (LCCR) investments, there has been a notable increase in participation from long-term investors, such as European insurers, who are channeling funds into assets that provide predictable cash flows, exemplified by investments in wind and solar energy. This trend reflects a significant alignment between their investment responsibilities and support for sustainable projects (Mielke, 2019). Furthermore, in energy markets, while short-term demand fluctuations and scale limitations may contribute to elevated costs, the ongoing diffusion of renewable technologies and the associated learning curve indicate potential for cost reductions and stabilization in the medium term (Sun et al., 2019).

After the Paris Agreement, green finance shifted from a “promising niche” to a core component of the financial infrastructure supporting the transition: carbon price, mainstream ESG and green tools created scalable capital channels towards clean energy and sustainable infrastructure. In parallel, governance and standardisation have raised market credibility and long-term investors have anchored assets with stable flows.

❖ 2021–2025: Governance & standardisation

Governance and standardisation became the most important parts of green finance from 2021 to 2025. The combination of climate vulnerability, especially in Asia's rapidly emerging economies, and rising energy demand highlighted the need for rule-based, scalable finance for low-carbon power and resilience (Tolliver et al., 2021). At the same time, ongoing evidence of rising climate threats strengthened the argument for reliable disclosure and supervisory frameworks to turn sustainability goals into investment opportunities.

One of the most significant developments during this period was the rise of regulatory standard-setting and its effects beyond national borders, often referred to as the "Brussels effect". As companies and investors sought access to EU markets, European rules on sustainability

disclosure and taxonomy exerted an increasing influence on global practices. Multinational companies extended these rules across jurisdictions to avoid complying with multiple regulatory frameworks (Redondo Alamillos & De Mariz, 2022). This regulatory pull, combined with supervisory efforts by central banks and other prudential authorities, contributed to the integration of climate risk into financial monitoring. This increased the importance of transition plans, scenario analysis, and decision-useful ESG data for capital markets.

The literature empirically associates green finance, clean energy, and green economy practices with corporate sustainability outcomes within the Sustainable Development Goals (SDGs) framework, while also highlighting that growth-first strategies may compromise environmental quality in the absence of robust governance (Lee & Lee, 2022; Ye et al., 2022; Pyka & Nocon, 2021).

China is a prime example of how policy design and standardization are translated into scale. By 2022, the country had expanded green loans and green bonds to globally significant volumes, combining labelled-bond requirements (external review, detailed use-of-proceeds, and annual environmental reporting) with broader “double-carbon” targets (peaking emissions by 2030 and achieving carbon neutrality by 2060) (Dou & Qi, 2019; Su & Lee, 2025). An important design lesson for governance frameworks is provided by studies on green-finance pilot policies, which demonstrate measurable improvements in energy efficiency, provided that complementary environmental regulation and region-specific implementation are in place (Ren et al., 2025). The interaction between globalization and eco-productivity is the subject of parallel research, which emphasizes that institutional quality and standard alignment determine whether openness advances or undermines green development. This interaction is mediated through scale, structural, and technological channels (Ulucak et al., 2020; Jiang & Chang, 2022; Wang et al., 2021; Tufail et al., 2024).

Between 2021 and 2025, a significant transformation in governance occurred, transitioning from an optional framework to one predicated on established regulatory standards. This evolution in governance fundamentally influenced motivational dynamics and the quality of data dissemination. Notably, the Brussels Effect facilitated the proliferation of European Union-generated regulations on a global scale, thereby enhancing the accessibility of information for consumers and investors. Empirical evidence from pilot projects in nations such as China demonstrates that the efficacy of green finance regulations is maximized when synergistically aligned with complementary environmental regulations. Consequently, it can be asserted that the trajectory of green finance in emerging Asian economies is contingent upon the alignment of capital market standards with the overarching requirements of a large-scale energy transition.

4.2 Research methods

Researchers from our sample employed a variety of methodologies, encompassing both qualitative and quantitative approaches, to investigate the historical progression of green finance. A thorough analysis of the existing literature indicates that most studies adopt an empirical-quantitative methodology grounded in econometric techniques. This trend highlights the reliance on quantitative data to elucidate the dynamics of green finance development over time.

In the realm of quantitative research methodologies, Segura Querol (2015) has explored the impact of surplus allowances on corporate profitability within the European Union Emissions Trading System (EU ETS). Emission Allowances (EUAs) are conceptualised as essential inputs in the production processes of firms, significantly influencing their cost structures and,

consequently, their overall profitability. Companies participating in the EU ETS are obliged to acquire EUAs to fulfil their emissions reduction targets. In this context, scholars such as Sadorsky (2006) and Henriques and Sadorsky (2010) emphasise the necessity of managing the risks associated with potential increases in energy prices, given that energy considerations and climate change policies are anticipated to gain increasing relevance in the foreseeable future. The findings presented by Sadorsky (2006) and Henriques and Sadorsky (2010) demonstrate that during the period from 2005 to 2010, and particularly in the aftermath of the financial crisis in 2008, the price of EUAs was insufficiently high to incentivise Spanish firms to diminish their carbon dioxide emissions. This lack of incentive can be attributed to the absence of a clear cost advantage from reductions in emissions during this time frame.

In their study, Su and Lee (2025) examine the Environmental Kuznets Curve (EKC) theory, which posits that during the initial phases of economic development, environmental quality tends to deteriorate as income levels increase. However, as economic development progresses and income reaches a certain threshold, an inverted U-shaped relationship emerges between environmental quality and income. This analysis is based on data collected from 31 provinces in China over a period spanning from 2006 to 2021, encompassing a total of 496 observations. The paper further investigates the interplay between green finance and environmental quality, recognizing that financial development is a crucial component of economic growth and plays a significant role in promoting sustainable development. The authors posit that, akin to the established inverted U-shaped relationship between economic development and environmental quality, a similar correlation may exist between green finance and environmental quality. This hypothesis suggests that while green finance may initially contribute to environmental degradation due to increased economic activity, its benefits potentially manifest as income rises, ultimately leading to improved environmental outcomes.

Another interesting approach is presented by Bredin et al. (2014), who offer a noteworthy examination of the initial stages of the European Union (EU) Emission Trading Scheme (ETS), which was formally launched in January 2005. Their analysis is framed within the context of market microstructure, focusing on the operational dynamics and implications of the ETS. This scheme was implemented as part of the EU's commitment to reducing global carbon dioxide (CO₂) emissions. Specifically, the ETS allocates a finite number of emission allowances to firms annually, thereby limiting total emissions. Furthermore, it facilitates a market for trading these permits, enabling firms to buy and sell their allocated allowances, which can influence overall emissions-reduction strategies and market behaviour.

In parallel, a substantial body of conceptual and theoretical contributions elucidates various constructs and proposes integrative frameworks. Soundarrajan and Vivek (2016) assert that green finance serves as a cornerstone for sustainable growth in India, positing a connection among the financial sector, environmental enhancement, and economic development through the implementation of policy instruments and institutional reforms. Using a descriptive, literature-based methodology complemented by secondary sources, the authors underscore several challenges that impede progress, including constrained capital availability, insufficient awareness, the mispricing of environmental risks, regulatory deficiencies, and the enduring prevalence of fossil-fuel subsidies.

Similarly, Linnenluecke et al. (2016) present a conceptual review that integrates perspectives from finance, economics, environmental sciences, and strategic management to formulate a foundational framework for the emerging discipline of environmental finance. The authors characterise environmental finance as a burgeoning field specifically designed to tackle the challenges posed by climate change and sustainability risks. They contextualise this discipline

within the historical continuum from industrialisation to contemporary global risk management, positing that the 2015 Paris Agreement, along with advancements in clean technology, heralds a significant economic opportunity reminiscent of previous industrial revolutions. Through their synthesis of interdisciplinary insights, the authors advocate for a robust research agenda to advance understanding of environmental finance and its implications for future economic landscapes.

Conversely, many works in the field are conceptual and theoretical. They focus on defining and refining key constructs, developing analytical frameworks, and making assumptions, without gathering new data. These contributions help clarify the field's foundational aspects and outline potential research directions.

Park and Ravenel (2015) conduct a conceptual policy analysis focused on Bloomberg LP's role as a financial intermediary and its partnerships with NGOs. They explore the tensions among various sustainability reporting frameworks, including SASB, GRI, CDP, UN Global Compact, and IIRC. Their main argument is that increasing coherence among these frameworks can reduce inconsistencies, improve comparability, and lessen reporting fatigue. This, in turn, would facilitate the integration of ESG data into traditional investment decision-making.

A relevant example comes from Bloomberg's "BGREEN" initiative, which was launched in 2007 by Chairman Peter Grauer. BGREEN aimed to create short-term value through operational efficiencies and waste reduction while integrating sustainability into the corporate culture. To coordinate these efforts, Grauer established a Sustainability Group that reported directly to him. The initiative yielded quick returns and was projected to generate cumulative net savings of over \$50 million by 2013 (Park & Ravenel, 2013). This underscores the effectiveness of organisational design and governance in turning conceptual goals into measurable results.

4.3. Future research directions

Following a comprehensive content analysis of the preeminent literature on green finance, several notable gaps have been identified. These shortcomings highlight the need for further examination and a more in-depth analysis in future research endeavours. Given the recent surge in scholarly attention towards this field, it is crucial to address these deficiencies to deepen our understanding of the evolution of green finance. Table 6 summarises the principal research trajectories with substantial potential for further exploration in this domain.

Tab. 6 - Future research directions. Source: Authors' own elaboration

Future research directions	Starting points (sources)
Enhancing the comparability of ESG data: defining a common core of indicators and alignment rules vs. harmonisation (mapping between standards), metrics of divergence between providers, the role of external assurance and the impact on the cost of capital.	Park & Ravenel (2015); Ding et al. (2020)
Enhancing the comparability of green bonds (greenium): operational criteria by issuer type, external review, use of	Hachenberg & Schiereck (2018); Tang & Zhang

proceeds, maturity and market; standard protocols for matching (green vs. non-green)	(2018); Tu et al. (2020); Flammer (2021)
Enhancing the comparability of “Brussels effect” estimates: causal specifications (multi-country DiD specifications) that delimit exposure to Taxonomy/CSRD for non-EU issuers; common indicators for green issuance volume, cost of capital and quality of disclosures; treatment of market selection.	Redondo Alamillos & De Mariz (2022)
Making a more detailed set for the comparability of the measurement of greenwashing and financial effects: a replicable Natural Language Processing (NLP) protocol for a greenwashing score, standardised outcomes (loans, spreads, debt overhang), and a set of moderators (media, disputes, ESG audit, competition) applicable across jurisdictions; fixed-effects, Heckman and panel models.	Park & Ravenel (2015)
Making a more detailed set for the operational definition of “green finance” → Developing a more detailed operational definition of “green finance”: minimum set of criteria for comparability - (1) instrument (bond/loan/fund), (2) use of funds aligned with the taxonomy.	Park & Ravenel (2015); Ding et al. (2020)

5. CONCLUSION

This research presents a comprehensive analysis of the evolution of green finance, tracing its development from a policy-related niche to an essential component of the financial infrastructure supporting the low-carbon transition. Utilizing a thematic content analysis of 30 significant scholarly articles alongside bibliometric mapping of 1,712 records from the Web of Science, this evaluation identifies four pivotal inflection points in the trajectory of green finance. The first phase, spanning from 2005 to 2010, establishes the conceptual and institutional foundations for green finance. This period is characterised by growing recognition of environmental risks and the formulation of investable pipelines, primarily facilitated by emerging carbon mechanisms. Subsequently, the period from 2011 to 2015 highlights communication frictions and underscores the inadequacies inherent in a weak carbon-price signal. This phase catalysed an increased demand for reliable Environmental, Social, and Governance (ESG) data and consistency in reporting practices. From 2016 to 2020, we observed a significant maturation of market mechanisms that categorise financial tools and advocate for the mainstream acceptance of ESG principles. Concurrently, legislative frameworks, including emissions trading systems (ETS), carbon taxes, and transparency regulations, played a crucial role in structuring pathways for reallocating capital to sustainable initiatives. Finally, the 2021–2025 period is characterised by efforts to strengthen governance structures and standardisation practices, thereby enhancing the credibility, comparability, and transnational dissemination of norms in green finance. This comprehensive analysis not only elucidates the historical trajectory of green finance but also underscores the critical importance of consistent governance and robust standards in facilitating the transition to a sustainable financial future.

The evidence base encompasses quantitative empirical studies, primarily econometric analyses of policy and market effects, as well as qualitative and conceptual-theoretical contributions that clarify concepts, frameworks, and institutional designs. All these elements support the notion that green finance can facilitate the reallocation of funds from high-carbon to low-carbon investments. The findings also indicate that to achieve large-scale effectiveness, three key components are necessary: accessible data for informed decision-making and external verification to mitigate information frictions; rule-based governance to maintain stable expectations and reduce the risk of greenwashing; and policy complementarities, such as pricing and standards.

The integration of bibliometric mapping and thematic content analysis indicates that green finance may serve as an effective mechanism for capital reallocation, contingent on assurances of both informational quality and institutional legitimacy. Furthermore, the pivotal role of policy complementarities is underscored: carbon pricing, which effectively signals scarcity, achieves optimal efficacy when coupled with explicit stipulations on revenue allocation, transparent impact reporting for designated financial instruments, and regulatory oversight that incorporates climate-related risks into the framework of financial regulation. Collectively, these elements form a comprehensive market framework that converts market signals into consistent corporate investments, thereby driving measurable environmental outcomes.

This study acknowledges several limitations that warrant consideration. First, the analysis is limited to records indexed in the Web of Science (WOS) and to articles, reviews, and early-access publications written in English and classified within selected economic categories. Consequently, relevant contributions available in other databases, document types, languages, or disciplinary fields may have been excluded. To address this limitation, future research should consider a broader range of databases and publication types to provide a more comprehensive understanding of the topic. Additionally, the analysis was conducted based on significant events that influenced the evolution of the term "green finance." Consequently, certain articles that could have contributed meaningfully to the discourse may have been overlooked. While an alternative approach could involve analysing publications based on citation metrics, this research aimed to offer a distinctive perspective, which is why a more personalised analytical framework was employed.

Future research should build on the gaps identified in this study by expanding the range of scientific databases used. It should improve methodological standardisation, especially in areas such as ESG data comparability and the evaluation of green financial instruments. Further work is needed to examine the effectiveness of emerging regulatory and sustainability frameworks across different economic and institutional contexts.

References

1. Abadie, L. M., & Chamorro, J. M. (2008). European CO₂ prices and carbon capture investments. *Energy Economics*, 30, 2992–3015. <https://doi.org/10.1016/j.eneco.2008.04.001>
2. Abhishek, & Srivastava, M. (2021). Mapping the influence of influencer marketing: a bibliometric analysis. *Marketing Intelligence & Planning*, 39(7), 979–1003. <https://doi.org/10.1108/MIP-03-2021-0085>
3. Adda, G., Dokor, G. A. B., Azigwe, J. B., & Odai, N. A. (2021). Management commitment and corporate sustainability integration into small and medium-scale

<https://doi.org/10.7441/joc.2026.SI.12>

- enterprises: A mediation effect of strategic decision-making. *Economics, Management and Sustainability*, 6(2), 6–20. <https://doi.org/10.14254/jems.2021.6-2.1>
4. Afzal, A., Mirza, N., & Firdousi, S. (2023). Do depositors discipline the banking sector? Evidence from an emerging economy. *Review of Accounting and Finance*, 22(2), 194–205. <https://doi.org/10.1108/RAF-09-2022-0271>
5. Agliardi, E., & Agliardi, R. (2019). Financing environmentally-sustainable projects with green bonds. *Environment and Development Economics*, 24(6), 608–623. <https://doi.org/10.1017/S1355770X19000020>
6. Al Mamun, M., Boubaker, S., & Nguyen, D. K. (2022). Green finance and decarbonization: Evidence from around the world. *Finance Research Letters*, 46, 102807. <https://doi.org/10.1016/j.frl.2022.102807>
7. Alharbi, S., Al Mamun, M., Sabri, B., & Rizvi, S. R. (2022). Green finance and renewable energy: A worldwide evidence. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4315725>
8. Allen, F., & Yago, G. (2011). Environmental finance: Innovating to save the planet*. *Journal of Applied Corporate Finance*, 23(3), 99–111. <https://doi.org/10.1111/j.1745-6622.2011.00347.x>
9. Anuar, A., Marwan, N. F., Smith, J., Siriyanun, S., & Sharif, A. (2022). Bibliometric analysis of immigration and environmental degradation: evidence from past decades. *Environmental Science and Pollution Research International*, 29(9), 13729–13741. <https://doi.org/10.1007/s11356-021-16470-1>
10. Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
11. Bailis, R., Drigo, R., Ghilardi, A., & Masera, O. (2015). The carbon footprint of traditional woodfuels. *Nature Climate Change*, 5(3), 266–272. <https://doi.org/10.1038/nclimate2491>
12. Baker, H.K., Pandey, N., Kumar, S. & Haldar, A. (2020). A bibliometric analysis of board diversity: current status, development, and future research directions. *Journal of Business Research*, 108, 232–246. <https://doi.org/10.1016/j.jbusres.2019.11.025>
13. Bota-Avram, C. (2023). Bibliometric analysis of sustainable business performance: Where are we going? A science map of the field. *Economic Research-Ekonomska Istraživanja*, 36(1), 2137–2176. <https://doi.org/10.1080/1331677X.2022.2096094>
14. Bota-Avram, C. (2024). Examining the white and dark sides of digitalisation effects on corruption: Unveiling research patterns and insights for future research. *The Journal of Risk Finance*, 25(2), 181–223. <https://doi.org/10.1108/JRF-10-2023-0256>
15. Bowen, A. (2011). The case for carbon pricing. Grantham Research Institute, LSE. http://www2.lse.ac.uk/GranthamInstitute/publications/Policy/docs/PB_casecarbonpricing_Bowen.pdf
16. Bredin, D., Hyde, S., & Muckley, C. (2014). A microstructure analysis of the carbon finance market. *International Review of Financial Analysis*, 34, 222–234. <https://doi.org/10.1016/j.irfa.2014.03.003>

17. Campiglio, E. (2016). Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy. *Ecological Economics*, 121, 220–230. <https://doi.org/10.1016/j.ecolecon.2015.03.020>
18. Caputo, A., Pizzi, S., Pellegrini, M., & Dabić, M. (2021). Digitalization and business models: Where are we going? A science map of the field. *Journal of Business Research*, 123, 489–501. <https://doi.org/10.1016/j.jbusres.2020.09.053>
19. Chaurey, A., & Kandpal, T. C. (2009). Carbon abatement potential of solar home systems in India and their cost reduction due to carbon finance. *Energy Policy*, 37(1), 115–125. <https://doi.org/10.1016/j.enpol.2008.07.038>
20. Combes Motel, P., Pirard, R., & Combes, J.-L. (2009). A methodology to estimate impacts of domestic policies on deforestation: Compensated Successful Efforts for “avoided deforestation” (REDD). *Ecological Economics*, 68(3), 680–691. <https://doi.org/10.1016/j.ecolecon.2008.06.001>
21. Dietz, S., & Fankhauser, S. (2010). Environmental prices, uncertainty, and learning. *Oxford Review of Economic Policy*, 26(2), 270–284. <https://doi.org/10.1093/oxrep/grq005>
22. Dikau, S., & Volz, U. (2021). Central bank mandates, sustainability objectives and the promotion of green finance. *Ecological Economics*, 184, 107022. <https://doi.org/10.1016/j.ecolecon.2021.107022>
23. Ding, A., Daugaard, D., & Linnenluecke, M. K. (2020). The future trajectory for environmental finance: Planetary boundaries and ESG analysis. *Accounting & Finance*, 60(1), 3–14. <https://doi.org/10.1111/acfi.12599>
24. Dou, X., & Qi, S. (2019). The choice of green bond financing instruments. *Cogent Business & Management*, 6(1), 1652227. <https://doi.org/10.1080/23311975.2019.1652227>
25. Echchakoui, S. (2020). Why and how to merge Scopus and Web of Science during bibliometric analysis: The case of sales force literature from 1912 to 2019. *Journal of Marketing Analytics*, 8(3), 165–184. <https://doi.org/10.1057/s41270-020-00081-9>
26. Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, 142(2), 499–516. <https://doi.org/10.1016/j.jfineco.2021.01.010>
27. Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, 5(4), 210–233. <https://doi.org/10.1080/20430795.2015.1118917>
28. Gallego-Álvarez, I., Segura, L., & Martínez-Ferrero, J. (2015). Carbon emission reduction: The impact on the financial and operational performance of international companies. *Journal of Cleaner Production*, 103, 149–159. <https://doi.org/10.1016/j.jclepro.2014.08.047>
29. Ghosal, V., & Sokol, D. D. (2013). Compliance, detection, and mergers and acquisitions. *Managerial and Decision Economics*, 34(7–8), 514–528. <https://doi.org/10.1002/mde.2626>

30. Gupta, K. (2024). Conceptual analysis of DESIDOC Journal of Library and Information Technology: A bibliometric study. SSRN. <https://doi.org/10.2139/ssrn.493225>
31. Hachenberg, B., & Schiereck, D. (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management*, 19(6), 371–383. <https://doi.org/10.1057/s41260-018-0088-5>
32. Hailiang, Z., Iqbal, W., Chau, K. Y., Raza Shah, S. A., Ahmad, W., & Hua, H. (2023). Green finance, renewable energy investment, and environmental protection: Empirical evidence from BRICS countries. *Economic Research-Ekonomska Istraživanja*, 36(2), 2125032. <https://doi.org/10.1080/1331677X.2022.2125032>
33. Hazudin, S. F., Sabri, M. F., Kader, M. A. R. A., Saripin, M. S., & Ridzuan, M. R. (2022). Social capital, entrepreneurial skills, and business performance among rural micro-enterprises in times of crisis. *Knowledge and Performance Management*, 6(1), 75–86. [https://doi.org/10.21511/kpm.06\(1\).2022.07](https://doi.org/10.21511/kpm.06(1).2022.07)
34. Henriques, I., & Sadorsky, P. (2010). Can environmental sustainability be used to manage energy price risk? *Energy Economics*, 32(5), 1131–1138. <https://doi.org/10.1016/j.eneco.2010.01.006>
35. Hoti, S., McAleer, M., & Pauwels, L. L. (2007). Measuring risk in environmental finance. *Journal of Economic Surveys*, 21(5), 970–998. <https://doi.org/10.1111/j.1467-6419.2007.00526.x>
36. Hu, J., Li, J., Li, X., Liu, Y., Wang, W., & Zheng, L. (2021). Will green finance contribute to a green recovery? Evidence from Green Financial Pilot Zone in China. *Frontiers in Public Health*, 9, 794195. <https://doi.org/10.3389/fpubh.2021.794195>
37. Irfan, M., Razzaq, A., Sharif, A., & Yang, X. (2022). Influence mechanism between green finance and green innovation: Exploring regional policy intervention effects in China. *Technological Forecasting and Social Change*, 182, 121882. <https://doi.org/10.1016/j.techfore.2022.121882>
38. Jiang, C., & Chang, Y. (2022). Clean energy projects in Asian economies: Does FDI and stock market matter for sustainable development? *Economic Research-Ekonomska Istraživanja*, 35(1), 5843–5857. <https://doi.org/10.1080/1331677X.2022.2038650>
39. Khan, M. A., Riaz, H., Ahmed, M., & Saeed, A. (2022). Does green finance really deliver what is expected? An empirical perspective. *Borsa Istanbul Review*, 22(3), 586–593. <https://doi.org/10.1016/j.bir.2021.07.006>
40. Kumar, S., Pandey, N., Lim, W. M., Chatterjee, A. N., & Pandey, N. (2021). What do we know about transfer pricing? Insights from bibliometric analysis. *Journal of Business Research*, 134, 275–287. <https://doi.org/10.1016/j.jbusres.2021.05.041>
41. Kuzey, C., Uyar, A., & Karaman, A. S. (2023). Over-investment and ESG inequality. *Review of Accounting and Finance*, 22(3), 399–421. <https://doi.org/10.1108/RAF-10-2022-0279>
42. Lee, C. C., & Lee, C. -C. (2022). How does green finance affect green total factor productivity? Evidence from China. *Energy Economics*, 107, 105863. <https://doi.org/10.1016/j.eneco.2022.105863>

43. Lewis, J. I. (2010). The evolving role of carbon finance in promoting renewable energy development in China. *Energy Policy*, 38(6), 2875–2886. <https://doi.org/10.1016/j.enpol.2010.01.020>
44. Linnenluecke, M. K., Smith, T., & McKnight, B. (2016). Environmental finance: A research agenda for interdisciplinary finance research. *Economic Modelling*, 59, 124–130. <https://doi.org/10.1016/j.econmod.2016.07.010>
45. Liu, C., & Xiong, M. (2022). Green finance reform and corporate innovation: Evidence from China. *Finance Research Letters*, 48, 102993. <https://doi.org/10.1016/j.frl.2022.102993>
46. Liu, Z. (2024). Assessing the role of green finance in enhancing rural economic resilience and environmental sustainability. *Frontiers in Management Science*, 3(1), 82–89. <https://doi.org/10.56397/FMS.2024.02.09>
47. Mielke, J. (2019). Signals for 2 °C: The influence of policies, market factors and civil society actions on investment decisions for green infrastructure. *Journal of Sustainable Finance & Investment*, 9(2), 87–115. <https://doi.org/10.1080/20430795.2018.1528809>
48. Mirza, N., Umar, M., Sbia, R., & Jasmina, M. (2024). The impact of blue and green lending on credit portfolios: A commercial banking perspective. *Review of Accounting and Finance*, 24(2), 238–253. <https://doi.org/10.1108/RAF-11-2023-0389>
49. Montesinos-Sansaloni, E. X., Ribeiro, D., & Botella-Carrubi, D. (2025). The role of the corporate sustainability reporting directive in public–private partnerships for research and development: Spotlight on the social economy. *The Journal of Risk Finance*. <https://doi.org/10.1108/JRF-02-2025-0071>
50. Nenavath, S., & Mishra, S. (2023). Impact of green finance and fintech on sustainable economic growth: Empirical evidence from India. *Heliyon*, 9(5), e16301. <https://doi.org/10.1016/j.heliyon.2023.e16301>
51. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., & Whiting, P. (2021). PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>
52. Park, A., & Ravenel, C. (2013). Integrating sustainability into capital markets: Bloomberg LP and ESG’s quantitative legitimacy. *Journal of Applied Corporate Finance*, 25(3), 62–67. <https://doi.org/10.1111/jacf.12030>
53. Park, A., & Ravenel, C. (2015). An alignment proposal: Boosting the momentum of sustainability reporting. *Journal of Applied Corporate Finance*, 27(2), 52–57. <https://doi.org/10.1111/jacf.12117>
54. Pyka, I., & Nocon, A. (2021). Banks’ capital requirements in terms of implementation of the concept of sustainable finance. *Sustainability*, 13(6), 3499. <https://doi.org/10.3390/su13063499>
55. Raghuram, S., Hill, N. S., Gibbs, J. L., & Maruping, L. M. (2019). Virtual work: Bridging research clusters. *Academy of Management Annals*, 13(1), 308–341. <https://doi.org/10.5465/annals.2017.0020>
56. Redondo Alamillos, R., & De Mariz, F. (2022). How can European regulation on ESG impact business globally? *Journal of Risk and Financial Management*, 15(7), 291. <https://doi.org/10.3390/jrfm15070291>

57. Ren, Z., Bo, Y., & Lei, Y. (2025). Green financial policy, environmental regulation, and energy use efficiency. *Finance Research Letters*, 74, 106711. <https://doi.org/10.1016/j.frl.2024.106711>
58. Riehmann, P., Hanfler, M., & Froehlich, B. (2005). Interactive Sankey diagrams. In *Information Visualization, 2005. INFOVIS 2005. IEEE Symposium on Information Visualization* (pp. 233–240). IEEE. <https://doi.org/10.1109/INFOVIS.2005.21>
59. Sadorsky, P. (2006). Modeling and forecasting petroleum futures volatility. *Energy Economics*, 28(4), 467–488. <https://doi.org/10.1016/j.eneco.2006.04.005>
60. Saeed Meo, M., & Karim, M. Z. A. (2022). The role of green finance in reducing CO2 emissions: An empirical analysis. *Borsa Istanbul Review*, 22(1), 169–178. <https://doi.org/10.1016/j.bir.2021.03.002>
61. Schoenmaker, D. (2017). Investing for the common good: A sustainable finance framework. Bruegel Essay and Lecture Series. https://www.bruegel.org/system/files/wp_attachments/From-traditional-to-sustainable-finance_ONLINE.pdf
62. Scholtens, B., Cerin, P., & Hassel, L. (2008). Sustainable development and socially responsible finance and investing. *Sustainable Development*, 16(3), 137–140. <https://doi.org/10.1002/sd.359>
63. Segura Querol, S. P. (2015). Economic performance of the EU ETS: Three points of view: Policy makers, companies and investors (Doctoral thesis, Universidad de Zaragoza). Repositorio Universidad de Zaragoza – Zeguan.
64. Shahrour, M. H., Arouri, M., & Lemand, R. (2023). On the foundations of firm climate risk exposure. *Review of Accounting and Finance*, 22(5), 620–635. <https://doi.org/10.1108/RAF-05-2023-0163>
65. Simon, G. L., Bumpus, A. G., & Mann, P. (2012). Win–win scenarios at the climate–development interface: Challenges and opportunities for stove replacement programs through carbon finance. *Global Environmental Change*, 22(1), 275–287. <https://doi.org/10.1016/j.gloenvcha.2011.08.007>
66. Soundarrajan, P., & Vivek, N. (2016). Green finance for sustainable green economic growth in India. *Agricultural Economics (Zemědělská ekonomika)*, 62(1), 35–44. <https://doi.org/10.17221/174/2014-AGRICECON>
67. Stiglitz, J. E. (2000). The contributions of the economics of information to twentieth century economics. *The Quarterly Journal of Economics*, 115(4), 1441–1478. <https://doi.org/10.1162/003355300555015>
68. Su, Y., & Lee, C. (2025). Green finance, environmental quality and technological innovation in China. *International Journal of Finance & Economics*, 30(1), 405–425. <https://doi.org/10.1002/ijfe.2924>
69. Sun, Y., Sun, M., & Tang, X. (2019). Macro analysis of renewable energy impacting on the electric power future market in the world. *Proceedings of the 2019 2nd International Conference on Computers in Management and Business*, 35–40. <https://doi.org/10.1145/3328886.3328898>

70. Taghizadeh-Hesary, F., & Yoshino, N. (2019). The way to induce private participation in green finance and investment. *Finance Research Letters*, 31, 98–103. <https://doi.org/10.1016/j.frl.2019.04.016>
71. Tang, D. Y., & Zhang, Y. (2018). Do shareholders benefit from green bonds? SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.3259555>
72. Tierney, M. J., Nielson, D. L., Hawkins, D. G., Roberts, J. T., Findley, M. G., Powers, R. M., Parks, B., Wilson, S. E., & Hicks, R. L. (2011). More dollars than sense: Refining our knowledge of development finance using Aiddata. *World Development*, 39(11), 1891–1906. <https://doi.org/10.1016/j.worlddev.2011.07.029>
73. Tolliver, C., Fujii, H., Keeley, A. R., & Managi, S. (2021). Green innovation and finance in Asia. *Asian Economic Policy Review*, 16(1), 67–87. <https://doi.org/10.1111/aepr.12320>
74. Tu, C. A., Rasoulinezhad, E., & Sarker, T. (2020). Investigating solutions for the development of a green bond market: Evidence from analytic hierarchy process. *Finance Research Letters*, 34, 101457. <https://doi.org/10.1016/j.frl.2020.101457>
75. Tufail, M., Song, L., & Khan, Z. (2024). Green finance and green growth nexus: Evaluating the role of globalization and human capital. *Journal of Applied Economics*, 27(1), 2309437. <https://doi.org/10.1080/15140326.2024.2309437>
76. Ulucak, Z. Ş., İlkay, S. Ç., Özcan, B., & Gedikli, A. (2020). Financial globalization and environmental degradation nexus: Evidence from emerging economies. *Resources Policy*, 67, 101698. <https://doi.org/10.1016/j.resourpol.2020.101698>
77. Umar, M., Mirza, N., Achim, M. V., & Ribeiro-Navarrete, S. (2025). The impact of climate change on credit portfolios and banking resilience: Preliminary evidence from a developing economy. *International Review of Financial Analysis*, 102, 104021. <https://doi.org/10.1016/j.irfa.2025.104021>
78. Wang, B., Dong, K., & Taghizadeh-Hesary, F. (2024). Can green finance promote high-quality energy development? The case of China. *The Journal of Risk Finance*, 25(1), 64–79. <https://doi.org/10.1108/JRF-08-2023-0194>
79. Wang, J., Ma, M., Dong, T., & Zhang, Z. (2023). Do ESG ratings promote corporate green innovation? A quasi-natural experiment based on SynTao Green Finance's ESG ratings. *International Review of Financial Analysis*, 87, 102623. <https://doi.org/10.1016/j.irfa.2023.102623>
80. Wang, K.-H., Zhao, Y.-X., Jiang, C.-F., & Li, Z.-Z. (2022). Does green finance inspire sustainable development? Evidence from a global perspective. *Economic Analysis and Policy*, 75, 412–426. <https://doi.org/10.1016/j.eap.2022.06.002>
81. Wang, L., Wang, H., Dong, Z., Wang, S., & Cao, Z. (2021). The air pollution effect of government economic growth expectations: Evidence from China's cities based on green technology. *Environmental Science and Pollution Research*, 28(22), 27639–27654. <https://doi.org/10.1007/s11356-021-12536-2>
82. Wang, X., Qin, Y., Xu, Z., & Skare, M. (2022). A look at the focus shift in innovation literature due to Covid-19 pandemic. *Journal of Business Research*, 145, 1–20. <https://doi.org/10.1016/j.jbusres.2022.02.067>

83. Wang, Y., & Zhi, Q. (2016). The role of green finance in environmental protection: Two aspects of market mechanism and policies. *Energy Procedia*, 104, 311–316. <https://doi.org/10.1016/j.egypro.2016.12.053>
84. Wardle, M., & Mills, S. (2018). Transparency and disclosure – do policy frameworks enhance financial centre reputation? *Journal of Sustainable Finance & Investment*, 8(4), 323–328. <https://doi.org/10.1080/20430795.2018.1485380>
85. Wilson, C. (2010). Why should sustainable finance be given priority? Lessons from pollution and biodiversity degradation. *Accounting Research Journal*, 23(3), 267–280. <https://doi.org/10.1108/10309611011092592>
86. Ye, J., Al-Fadly, A., Huy, P. Q., Ngo, T. Q., Hung, D. D. P., & Tien, N. H. (2022). The nexus among green financial development and renewable energy investment in the wake of the COVID-19 pandemic. *Economic Research-Ekonomska Istraživanja*, 35(1), 5650–5675. <https://doi.org/10.1080/1331677X.2022.2035241>
87. Yu, C.-H., Wu, X., Zhang, D., Chen, S., & Zhao, J. (2021). Demand for green finance: Resolving financing constraints on green innovation in China. *Energy Policy*, 153, 112255. <https://doi.org/10.1016/j.enpol.2021.112255>
88. Zhang, D., Mohsin, M., Rasheed, A. K., Chang, Y., & Taghizadeh-Hesary, F. (2021). Public spending and green economic growth in BRI region: Mediating role of green finance. *Energy Policy*, 153, 112256. <https://doi.org/10.1016/j.enpol.2021.112256>
89. Zhou, G., Liu, L., & Luo, S. (2022). Sustainable development, ESG performance and company market value: Mediating effect of financial performance. *Business Strategy and the Environment*, 31(7), 3371–3387. <https://doi.org/10.1002/bse.3089>
90. Ziolo, M., Filipiak, B. Z., Bak, I., Cheba, K., Tirca, D. M., & Novo-Corti, I. (2019). Finance, sustainability and negative externalities: An overview of the European context. *Sustainability*, 11(15), 4249. <https://doi.org/10.3390/su11154249>

Contact information

Beatrice-Larisa Dumnici, PhD Candidate

Babeş-Bolyai University
 Faculty of Economics and Business Administration
 Department of Finance
 Romania
 E-mail: beatrice.dumnici@econ.ubbcluj.ro
 ORCID: 0009-0001-2164-9947

***prof. Monica Violeta Achim, Ph.D. Habil. (Corresponding author)**

Babeş-Bolyai University
 Faculty of Economics and Business Administration
 Department of Finance
 Romania

<https://doi.org/10.7441/joc.2026.SI.12>

E-mail: monica.achim@econ.ubbcluj.ro

ORCID: 0000-0003-4701-041X

assoc. prof. Cristina Bota-Avram, Ph.D. Habil.

Babeş-Bolyai University

Faculty of Economics and Business Administration

Department of Accounting

Romania

E-mail: cristina.botaavr@econ.ubbcluj.ro

ORCID: 0000-0003-0485-1243

Appendix

Rank	Authors	Publication year	Total citations	Title	Country	Research method	The main purpose and key finding
Publications between 2005–2010							
1	Hoti, S., McAleer, M., & Pauwels, L. L.	2007	24	MEASURING RISK IN ENVIRONMENTAL FINANCE	Global analysis	Empirical analysis of the conditional volatility or time-varying risk associated with investing in leading sustainability-driven firms.	Conditional volatility observed on most series; presence of extreme variations; patterns appropriate to inference.
2	Combes Motel, P., Pirard, R., & Combes, J.-L.	2009	68	A methodology to estimate impacts of domestic policies on deforestation: Compensated Successful Efforts for “avoided deforestation” (REDD)	Asia, Latin America and Africa	Econometric model applied to a panel of participating countries over several periods (48 countries)	The authors propose a new approach called Compensated Successful Efforts (CSE) – for estimating the impact of internal policies on reducing avoided deforestation (REDD). The methodology is based on rewarding countries based on their efforts to reduce deforestation, unlike other models. The CSE method is presented as an important conceptual alternative to traditional mechanisms for setting compensated discounts (compensated reductions).
3	Wilson, C.	2010	17	Why should sustainable finance be given priority? Lessons from pollution and biodiversity degradation	Global analysis	Systematic literature review	The concept of sustainable finance is relevant and timely, but it is necessary to clarify and address many fundamental issues in order to be able to function effectively and credibly.

4	Lewis, J. I.	2010	154	The evolving role of carbon finance in promoting renewable energy development in China	China	Assessment of the impact of the Clean Development Mechanism (CDM) on the development of the renewable energy sector.	The CDM has played a significant role in supporting renewable energy development in China, suggesting the positive potential of global funding to mitigate emissions in developing countries. Future reforms of the CDM (and international engagement) could significantly influence the evolution of renewable energy in the coming years
5	Chaurey, A. & Kandpal, T.C.	2009	53	Carbon abatement potential of solar home systems in India and their cost reduction due to carbon finance	India	A quantitative analysis based on technical and economic calculations and scenarios	The article aims to estimate the potential to reduce CO ₂ emissions by using domestic solar systems (Solar Home Systems – SHS) in non-electrified rural areas of India and to evaluate how climate finance (carbon finance) could reduce costs for users.
Publications between 2011–2015							
6	Allen, F., & Yago, G.	2011	12	Environmental Finance: Innovating to Save the Planet	Global analysis	Theoretical analysis - evolution over time	Creating a sustainable economy will require massive investment to establish new means and methods of production, alternative energy, clean technologies, and new green industries. This kind of immense demand for capital is exactly the sort of trigger that sets financial innovation in motion.
7	Park, A. & Ravenel, C.	2013	58	Integrating Sustainability Into Capital Markets: Bloomberg LP And ESG's Quantitative Legitimacy	Global analysis	Theoretical analysis	BGREEN was an internal sustainability initiative that generated significant savings and created a foundation for Bloomberg to become a legitimate player in the ESG market, promoting sustainability as an integral part of business and investment.
8	Phillips, J. & Newell, P.	2013	85	The governance of clean energy in India: The clean development mechanism (CDM) and domestic energy politics	India	Theoretical analysis	This paper explores the ways in which clean energy is being governed in India.
9	Ghosal, V. & Sokol, D.	2013	24	Compliance, Detection, and Mergers and Acquisitions	Global analysis	The paper uses a theoretical framework based on the “Lemons” problem, analyzing three major regulatory areas: Environment, Finance and Accounting (including fraud and FCPA), Antitrust and cartels.	The study indicates that mechanisms such as expensive certifications, disclosures and stakeholder engagement can signal quality and mitigate uncertainty, but the degree of efficiency varies across domains.

10	Bredin, D., Hyde, S. & Muckley, C.	2014	82	A microstructure analysis of the carbon finance market	Europe	The study employs an empirical econometric approach using ultra-high frequency futures data from the European Union Emissions Trading Scheme (EU ETS).	The main purpose of the paper is to evaluate the efficiency, information assimilation, and liquidity in the EU ETS futures market during its Pilot (2005–2007) and Kyoto (2008–2012) phases. The key findings show that market efficiency improved over time, with reduced trading frictions, higher volumes, and lower volatility.
11	Segura, S. et al.	2014	18	EU ETS CO2 emissions constraints and business performance: a quantile regression approach	Spain	The study applies quantile regression techniques to analyse the relationship between the surplus of emission allowances (SA) and business performance (BP).	The main purpose is to evaluate how CO2 emissions constraints under the EU ETS affect firm-level business performance in Spain. The study concludes that EUA prices were insufficient to incentivize emission reductions, and recommends complementary measures, such as subsidies for investment in green technologies.
12	Ervine, K.	2014	46	Diminishing Returns: Carbon Market Crisis and the Future of Market-Dependent Climate Change Finance	Europe	The study uses a critical political economy approach grounded in qualitative analysis of global carbon markets, policy documents, and secondary data.	The main purpose is to examine the crisis of global carbon markets and its implications for climate finance in the Global South. The paper indicates that the heavy dependence of carbon finance on volatile carbon markets makes it unreliable, as seen in the collapse of carbon prices (2011: carbon was the world's worst-performing commodity).
13	Purdon, M.	2015	44	Opening the Black Box of Carbon Finance “Additionality”: The Political Economy of Carbon Finance Effectiveness across Tanzania, Uganda, and Moldova	Tanzania, Uganda, and Moldova	Empirical comparative case study approach and Ex-post comparative baseline methodology	The study highlights two key findings. First, additionality is not a binary concept, as project conditions may change during the implementation or crediting period, potentially invalidating the initial claim of additionality. Second, carbon finance projects may be more effective when the actors involved, including NGOs and government bodies, pursue both liberal and developmental economic objectives.
14	Mengze, H., & Wei, L.	2015	125	A Comparative Study on Environment Credit Risk Management of Commercial Banks in the Asia-Pacific Region	Asia-Pacific countries: Australia, Canada, China, Japan, Hong Kong, Singapore, South Korea, Thailand, the U.S., and Russia	The authors use a quantitative comparative study across banks in Asia-Pacific countries.	The study finds that banks in Canada, the U.S., and Japan exhibited the strongest Environmental Credit Risk Management (ECRM) performance, while those in Russia and Singapore performed the weakest. Adoption of voluntary sustainability codes, such as the Equator Principles and UNEP FI, together with the provision of green financial products, were positively associated with stronger ECRM outcomes.

15	Park, A., & Ravenel, C.	2015	7	An Alignment Proposal: Boosting the Momentum of Sustainability Reporting	USA	The article uses a conceptual and policy analysis approach, drawing on Bloomberg LP's role as a financial information intermediary.	The main purpose is to propose alignment among competing sustainability reporting frameworks in order to reduce confusion, enhance comparability, and accelerate the integration of ESG data into mainstream investment decision-making.
Publications between 2016–2020							
16	Soundarrajan, P., & Vivek, N.	2016	382	Green finance for sustainable green economic growth in India	India	The study uses a conceptual and descriptive analysis based on secondary data, literature review, and case illustrations of green finance initiatives in India.	The purpose is to analyse the role of green finance in achieving sustainable green economic growth in India and to validate its feasibility in Indian industries as a way to balance ecological degradation from carbon emissions. The key findings are that green finance is essential for channeling investments into eco-friendly technologies and industries, creating comparative advantage, and promoting long-term competitiveness.
17	Linnenluecke, M. K., Smith, T., & McKnight, B.	2016	158	Environmental finance: A research agenda for interdisciplinary finance research	Global analysis	The article is conceptual and uses a literature review and agenda-setting approach, synthesizing insights from finance, economics, natural sciences, and organizational strategy to establish the foundations of environmental finance and propose directions for future interdisciplinary research.	The main purpose is to define environmental finance as an emerging field, summarize its development, and outline research avenues that link financial practices with environmental change, sustainability challenges, and the transition to a clean-tech economy.
18	Ding, A., Daugaard, D. & Linnenluecke, M.K.	2020	33	The future trajectory for environmental finance: planetary boundaries and environmental, social and governance analysis	Global analysis	The study is conceptual, based on a literature review and theoretical integration. It synthesizes insights from finance, ESG analysis, and the Planetary Boundaries framework to propose future research directions.	The purpose is to link finance research with the Planetary Boundaries framework and demonstrate how Environmental, Social, and Governance (ESG) analysis can be extended beyond corporate performance to account for ecological thresholds. ESG analysis has grown rapidly but remains too focused on shareholder wealth and narrow performance metrics.
19	Wardle, M. & Mills, S.	2018	4	Transparency and disclosure – do policy frameworks enhance financial centre reputation?	Europe	The study employs a quantitative index-based analysis using data from the Global Green Finance Index (GGFI).	The purpose is to evaluate whether policy frameworks on transparency and disclosure strengthen the reputation of global financial centres in green finance. The results show that while transparency and disclosure are important baseline credibility factors, they do not significantly enhance reputation.

20	Dou, X. & Qi, S.	2019	37	The choice of green bond financing instruments	China	The study applies an empirical quantitative approach using a Logit regression model to analyse the determinants influencing Chinese non-financial enterprises in choosing between labeled green bonds and ordinary (non-labeled) bonds.	The purpose is to examine the factors driving the issuance choice between labeled and non-labeled green bonds in China, particularly focusing on the effects of policy differences created by the country's multi-sector bond supervision system. Companies issuing enterprise bonds are more likely to choose labeled green bonds compared to those issuing corporate bonds or medium-term notes.
21	Sun, Y., Sun, M. & Tang, X.	2019	11	Macro Analysis of Renewable Energy Impacting on the Electric Power Future Market in the World	China	The study is based on a conceptual and macro-level analysis using secondary data from sources such as the U.S. Energy Information Administration (EIA), BP Statistical Review, and REN21 reports.	Purpose: To assess how the development of renewable energy will influence the electric power futures market globally, with particular focus on the United States. Market speculation and psychological expectations will increasingly reflect renewable energy developments, reinforcing price volatility but also creating hedging and arbitrage opportunities.
22	Mielke, J.	2019	31	Signals for 2°C: the influence of policies, market factors and civil society actions on investment decisions for green infrastructure	Europe	The study uses a mixed-methods approach (explanatory sequential design), combining focus groups and interviews in the preparatory phase, a quantitative ranking survey with large European insurance companies and associations.	The purpose is to analyse how policy, market, and civil society signals influence green infrastructure investment decisions of large European insurers, with an emphasis on understanding which signals can effectively redirect finance flows in line with the Paris Agreement's 2°C target.
23	Tu, C., Ehsan Rasoulin ezhad, E. & Sarker, T.	2020	163	Investigating solutions for the development of a green bond market: Evidence from analytic hierarchy process	Vietnam	The study employs the Analytic Hierarchy Process (AHP), a multi-criteria decision-making (MCDM) method, to evaluate and rank factors influencing the development of Vietnam's green bond (GB) market.	Purpose: To identify and rank the most influential factors driving the development of Vietnam's green bond market, providing evidence-based insights for policymakers. The legal framework for GB operations, the monetary policies of the State Bank of Vietnam, and the official interest rate of green bonds are the top accelerators for GB market growth.
Publications between 2021–2025							
24	Tolliver, C., Fujii, H., Keeley, A. R., & Managi, S.	2021	321	Green Innovation and Finance in Asia	Asia	The paper is primarily a comparative review and empirical analysis. It uses secondary data from OECD, World Bank, IEA, UNCTAD, and Bloomberg.	The purpose is to examine the state of green innovation and green finance in major Asian economies and assess their role in advancing sustainable growth while balancing rapid economic development with environmental challenges. China and South Korea recorded larger growth in environmentally adjusted multifactor productivity (EAMFP) than developed countries, reflecting strong gains

							in efficiency and environmental performance.
25	Alamillos, R. R. & Mariz, F.	2022	131	How Can European Regulation on ESG Impact Business Globally?	European Union	The study is based on a qualitative methodology. It combines an in-depth literature review of European regulatory developments over the past 20 years with expert interviews to understand the mechanisms through which EU ESG regulations affect global business and policymaking.	The purpose is to analyse how the European Union's ESG regulations—covering disclosure rules, taxonomy for sustainable finance, due diligence, carbon markets, and trade restrictions—shape business practices not only within the EU but worldwide. The paper particularly explores the “Brussels Effect” in the ESG field. The regulations help prevent greenwashing and promote transparency but also pose risks of regulatory arbitrage if jurisdictions adopt diverging frameworks.
26	Hailiang, Z., Iqbal, W., Yin Chau, K. Y., Raza Shah, S. A., Ahmad, W. & Hua, H.	2023	65	Green finance, renewable energy investment, and environmental protection: empirical evidence from B.R.I.C.S. countries	BRICS economies: Brazil, Russia, India, China, and South Africa	The study uses panel econometric analysis with annual data from 2000 to 2018 across BRICS countries (Brazil, Russia, India, China, South Africa). It constructs a Green Finance Index using the entropy method, incorporating variables such as green investment, green insurance, and green securities.	The purpose is to investigate the relationship between green finance development and environmental performance in BRICS economies, assessing how green financial instruments contribute to reducing carbon emissions and supporting sustainable growth. Policy interventions, such as promoting green bonds and encouraging private and institutional investors (e.g., pension funds), are critical to strengthen green finance markets.
27	Fuest, C. & Meier, V.	2023	15	Green Finance and the EU-Taxonomy for Sustainable Activities: Why Using More Direct Environmental Policy Tools Is Preferable	European Union	The article is theoretical and analytical, employing a welfare economic model to evaluate the interaction between EU green finance policies (specifically the taxonomy) and existing environmental instruments like the EU Emissions Trading System (ETS).	The purpose is to assess whether the EU taxonomy on sustainable finance effectively contributes to climate policy goals, and to compare its effectiveness with more direct tools such as emission allowance systems. Green finance can function as a commitment device, binding future governments to stricter climate goals, but this comes at an efficiency cost.

28	Tufail, M., Song, L. & Khan, Z.	2024	40	Green finance and green growth nexus: evaluating the role of globalization and human capital	19 OECD member states	The study applies advanced panel econometric techniques to data from 19 OECD countries (2000–2021).	The article aims to investigate the role of green finance, human capital, globalization, and economic growth in promoting green growth in OECD economies, and to provide policy implications for sustainable development. International collaboration—between OECD and non-OECD countries—is crucial for harmonizing standards and scaling global green finance.
29	Su, Y. & Lee, C. C.	2025	18	Green finance, environmental quality and technological innovation in China	G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States)	The study employs panel econometric techniques with data from G7 countries (2000–2020).	The purpose is to analyse the impact of green finance, renewable energy consumption, and technological innovation on renewable energy investment in G7 countries, while also exploring the role of financial development and carbon emissions. Financial development strengthens the positive impact of green finance on renewable energy investment.
30	Ren, Z., Bo, Y. & Lei, Y.	2025	3	Green financial policy, environmental regulation, and energy use efficiency	China	The study uses panel data from 280 prefecture-level cities in China (2010–2021) and applies a difference-in-differences (DiD) model to evaluate the impact of green finance reform and innovation pilot zones on green total factor energy efficiency (GTTEE).	The purpose is to assess whether China's green finance pilot policies improve urban green total factor energy efficiency and to clarify the mechanisms—especially the role of environmental regulation—in shaping policy effectiveness. The impact is stronger in eastern cities compared to central and western regions, reflecting regional heterogeneity in industrial structures and resources.