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The Role of Financial Development in ESG Performance: A Bibliometric Analysis

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ABSTRACT

This study explores the intersection between financial development and environmental, social, and governance (ESG) performance using a comprehensive bibliometric analysis. Drawing on 443 academic publications extracted from the Scopus database between 2000 and 2023, the research identifies major contributors, trending topics, and thematic evolutions in this interdisciplinary field. Using co-authorship, co-citation, and keyword co-occurrence analyses, the study reveals increasing scholarly attention on sustainable finance, ESG disclosure, and the role of institutions in fostering ESG practices. The results highlight a growing convergence between financial systems and sustainability goals, with significant research clusters emerging in Europe, North America, and Asia. The study contributes to the literature by mapping the intellectual structure of ESG–finance research and identifying gaps and future research directions. These insights are valuable for academics, practitioners, and policymakers aiming to align financial development with sustainability imperatives.

1. Introduction

The confluence of financial development (hereafter FD) and ESG (Environmental, Social, and Governance) principles is an emerging area of inquiry in contemporary economics and finance literature. The global economic system is increasingly grappling with sustainability challenges ranging from environmental degradation and climate change to social issues such as gender inequality, marginalized groups and an ever-increasing income inequality.

FD, which includes a nation's financial markets, institutions and instruments has long been recognized as an important driver of economic growth and other macroeconomic variables. On the other hand, ESG criteria have transitioned from a niche concern in the 2010s to a mainstream framework. ESG assets are expected to reach USD 41 trillion in 2025 [1], and USD 167.49 trillion by 2034 [2]. Currently ESG assets account for one-third of total global assets under management. The

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ESG framework is increasingly important for assessing the sustainability and ethical impact of investments and corporate behavior.

The dynamics of financial system development on the one hand, and economic and corporate performance on ESG metrics on the other, hold profound implications for sustainable development, policy making, and investment strategies. Therefore, understanding how the development of financial systems influences ESG outcomes—and vice versa—can illuminate pathways toward a more resilient and inclusive global economy. Moreover, as emerging markets attempt to leapfrog into sustainable finance, this interaction is becoming increasingly crucial.

Given the expanding and multifaceted literature on the intersection of FD and ESG, and how they affect each other, a systemic and comprehensive overview of the research landscape is essential. In this context, bibliometric analysis proves to be a helpful set of tools that offers a robust quantitative and qualitative approach to understand the evolution, the contributors, and its conceptual and intellectual structure [3, 4]. It allows us to move beyond traditional narrative reviews to provide a more objective, comprehensive and data-driven understanding of a research domain.

As such, our study aims to employ a set of bibliometric tools to understand the current and historical trajectory of this research field seeking to answer the following questions:

i. How has research on the FD-ESG nexus evolved over time?
ii. Who are the most influential contributors shaping this field?
iii. What are the historical intellectual roots and foundational works underpinning the FD-ESG field?
iv. What are the intellectual and conceptual structures of the FD-ESG field?

Previous bibliometric studies explored related and/or component aspects of the FD-ESG Nexus, such as the broad FD field [5], ESG in business [6], FD and environmental sustainability [7], financial inclusion [8] and FinTech-ESG nexus [9] (reviews detailed in section 3. Literature review). However, no prior work, to the extent of our knowledge, has undertaken the task to conduct a comprehensive bibliometric mapping of the broader FD-ESG nexus, while using a merged dual dataset.

This study thus aims to fill this gap by providing a holistic and integrated view of the field. By doing so, we intend to provide a valuable resource for scholars, policymakers, and practitioners seeking to navigate and contribute to this vital research area.

2. Theoretical Framework

2.1 Financial Development

FD refers to the multifaceted processes of the evolution and enhancement of a country's financial system, not merely in terms of size but also in terms of quality encompassing its institutions, markets, instruments, and the legal and regulatory framework [10, 11]. Formally, it is understood as the process aiming to overcome information asymmetries, enforcement of contracts and reducing transaction costs. A developed financial system performs five core functions [12, 13]: Mobilizing and pooling savings, rectifying informational asymmetries and allocating capital, monitoring investments and corporate governance, facilitating risk management, and easing the exchange of goods and services.

The foundational work for FD encompasses various economists mainly Schumpeter, Goldsmith, McKinnon, and Shaw, with later contributions by Levine and others. The concept has evolved significantly from its traditional focus on banking sector expansion to include broader considerations of financial access, inclusion, and societal impact [14]. Theoretical frameworks have evolved from classical models viewing finance as secondary to capital accumulation, through neoclassical approaches emphasizing efficient capital allocation, to endogenous growth theories pioneered by

economists including Paul Romer [15] and Robert Lucas [16] highlighting finance role in funding innovation and human capital development.

Early insights from Schumpeter emphasized the crucial role of financial systems as a prerequisite for innovation [17], while the McKinnon-Shaw hypothesis [18] emphasized the detrimental effects of 'financial repression' and the benefits of liberalization. Later, endogenous growth theories further integrated FD as a driver of technological progress and human capital accumulation.

The measurement and understanding of FD have mirrored its theoretical evolution, moving away from simple, unidimensional ratios prevalent in early McKinnon-Shaw based studies (e.g. Financial Interrelations Ratio (FIR), private credit to GDP) which are seen as incomplete measures [19]. Later work, drawing on endogenous growth theories, institutional approaches [20–23], and market structure perspectives, recasts FD as a multidimensional construct [24, 25]. It's better understood through 4 aspects [26, 27]: depth[1], access[2], efficiency[3], and stability of both financial institutions (like banks and insurance companies) and financial markets (such as stock and bond markets). This multidimensional approach recognizes that FD involves qualitative improvements in how financial systems function, not merely quantitative expansion of financial sector size.

A central question in FD research is its relation with economic growth [25] with a substantial body of empirical research, including seminal works by King and Levine [28], Levine and Zervos [29] and Beck *et al.*, [30], has generally established a positive, often causal, relationship where FD predicts and fosters long-run economic growth through channels such as capital accumulation and enhanced productivity. However, contemporary research also explores non-linearities [31, 32], suggesting that beyond a certain threshold, excessive financial deepening might not yield proportional economic benefits or even negative returns to economic growth, possibly by diverting talent or encouraging rent-seeking and instability. More recently Diamond *et al.*, [33] further challenge the FD-economic growth nexus by showing that enhanced financial contractibility can, under certain equilibrium conditions, counterintuitively lead to less investment in productive long-term assets and a reduction in overall welfare.

Contemporary scholarly discourse on FD increasingly integrates crucial aspects with direct societal relevance. Financial inclusion [34–38], ensuring broad and equitable access to useful and affordable financial products and services, is now considered a core component of FD, with recognized potential for poverty reduction and decreasing inequality. Complementing this, financial literacy and capability [39–41] are emphasized as vital for individuals to effectively navigate risks and benefit from financial systems. The ongoing digital transformation, driven by Financial Technology (FinTech) [37, 42, 43], is rapidly reshaping the landscape by offering new avenues for financial access, efficiency, and innovation, though it also presents novel regulatory and stability challenges. Furthermore, the link between FD and sustainability (including environmental considerations and human development) is an emerging and critical area of research, aligning with global agendas like the Sustainable Development Goals [34, 44, 45].

2.2 The ESG Framework

ESG management is described as a comprehensive management practice where enterprises effectively control environmental impacts, actively fulfill social responsibilities, and build sound governance structures in their operations [46]. It is a framework utilized by investors and stakeholders to assess sustainability performance through measurable indicators of ESG risks and

[1] size and liquidity of financial institutions and markets, e.g., private sector credit to GDP, stock market capitalization to GDP
[2] The ability of individuals and firms to utilize financial services
[3] the cost and quality of financial service provision

opportunities [47]. ESG is a multidimensional phenomenon, addressing the stakes of various stakeholders, including suppliers, customers, and statutory authorities [48]. Transparent ESG disclosures ensure that firms can win the faith and trust of all primary, secondary, and connected stakeholders. ESG scores and ratings reflect a company's performance by considering its ESG issues and help to raise environmental performance standards [48]. Teng *et al.,* [49] demonstrate that ESG performance significantly influences corporate financial outcomes, with studies showing enhanced sustainable growth for firms with superior ESG scores, particularly in environmentally sensitive industries. Parallel to firm-level ESG ratings, several data providers assign countries or sovereign ESG scores.

ESG encompasses three core pillars: Environmental, Social, and Governance. The first measures the impact on natural systems[4]. The second quantifies the impact on people and communities[5]. And the third assesses internal systems and controls[6].

The recent and increasingly widespread integration of ESG considerations into economic theory and practice represents a significant paradigm shift in modern economics, finance and business strategy. ESG is a direct expansion of traditional Corporate Social Responsibility (CSR) frameworks [47] emerging from stakeholder theory to address the multifaceted relationships between corporations and their various constituent groups. While CSR historically involved voluntary efforts to evaluate a company's impact on society and stakeholders, often without direct links to measurement or regulatory oversight, ESG represents a framework with quantifiable metrics, facilitating comparisons and prioritizing accountability and performance evaluation driven by institutional investors and regulatory authorities [47]. This growth has been partially catalyzed by financial crises, such as the 2008 global financial crisis, and high-profile corporate scandals [50].

However, the ESG landscape continues to evolve rapidly and faces challenges. There is a significant challenge regarding the lack of a unified standard when calculating ESG scores, which are mostly done by independent data providers, leading to questions about the sufficiency of their validity and reliability, especially regarding emerging markets where frameworks might not be standardized [51]. Further, manipulation and strategic behavior, such as greenwashing, where corporate ESG initiatives appear formal while lacking substantive implementation, threaten the integrity of ESG assessments and make it difficult for regulators and investors [52]. Recent research has identified a new form of manipulation termed "crosswashing", which involves companies strategically investing in sustainable activities to boost their ESG ratings [53]. State-owned enterprise contexts present particular challenges for ESG implementation, with research demonstrating that traditional ESG frameworks may be less effective in these institutional settings [54]. Recent academic research has proposed enhanced ESG frameworks that incorporate economic factors alongside traditional ESG dimensions, leading to the development of ECON-ESG conceptual models [55].

2.3 The FD-ESG intersection

FD can influence how firms and economies adopt ESG criteria. Conversely, ESG integration reshapes financial markets by altering risk profiles, investment flows, and governance practices. Theoretically, the relationship is multifaceted, operating through various channels that connect the

[4] includes areas such as emission reduction, product innovation, resource reduction, carbon emission mitigation strategies, compliance with environmental policies, and management of environmental renewal costs

[5] Key indicators include customer product responsibility, society and community impact, human rights, workforce aspects like diversity and opportunity, employment quality, health and safety, and training and development,

[6] Governance factors include board of directors aspects (board functions, board structure, compensation policy, integration vision and strategy) and shareholder rights. It involves enhancing supply chain transparency, fostering technological innovation, and strengthening supply chain collaboration

depth, access, efficiency, and stability of a country's financial institutions and markets to its environmental stewardship, social equity, and governance quality. In this section, we examine how FD affects ESG adoption and performance, and how ESG considerations in turn influence market efficiency, stability, and access. We also explore interactions in banking and corporate governance, regional differences, and the roles of policy and institutions.

A growing literature finds that FD tends to promote ESG outcomes. The basic mechanism is that FD expands access to capital and improves information flows, which can incentivize firms to pursue sustainable practices. Ng *et al.,* [56] finds that country-level FD is positively related to national ESG performance. Similarly, Hassani *et al.,* [57] found that "country level FD positively and significantly influences environmental, social and governance performance". However, they note, in their literature review that the empirical evidence for the relationship is mixed. Some studies found a positive effect of FD on ESG, generally understood to be the indirect effect of economic growth induced by FD. Recent empirical studies provide a more nuanced understanding, highlighting that the impact of financial development on ESG performance often depends on the type of financial markets, institutional quality, and development level of the economy. For instance, equity market development in industries highly dependent on external finance tends to significantly increase firms' ESG performance, whereas credit market expansion can sometimes discourage ESG investment [58]. Furthermore, evidence from country-level analyses indicates that robust financial systems generally promote higher ESG scores, particularly in countries with advanced institutional frameworks [56, 57].

FD also influences ESG investing opportunities. Maturing markets increases the demand for ESG-compliant assets. Chen *et al.,* [59] shows that firms in China with higher ESG scores have greater stock liquidity, thus easier funding, by reducing agency costs and enhancing firm reputation. Additionally, threshold effects have been documented, showing non-linear relationships between FD and social/environmental outcomes. In high-income countries, financial development reduces income inequality and improves social indicators, whereas in lower-income countries, inadequate financial depth or weak governance can limit these benefits or even exacerbate inequality [60, 61]. Similarly, environmental outcomes vary in developed economies, stronger financial development tends to reduce CO_2 intensity, whereas in emerging economies, it can increase emissions unless accompanied by appropriate environmental regulation and green finance initiatives [62]. Further, FD appears to improve sustainability performance directly. Ng *et al.*, [56] notes that FD is a vital mechanism for mitigating environmental risks. Li *et al.,* [63] shows that in the context of the BRI; China's FD significantly promoted sustainable development goals (SDGs) with different mechanisms. They showed that improvements in China's banking and capital markets scale and efficiency had greater effect in Asia and lower-income countries, whereas financial structure (e.g. balance of banking vs. markets) mattered more in Europe and rich countries. However, El Khoury *et al.*, [64] showed that there is a threshold of FD after which FD no longer improves ESG indicators.

2.3.1 The Environmental Pillar

On the Environmental (E) front, the theoretical linkage posits that more developed financial systems can play a dual role. On one hand, by facilitating efficient capital allocation, FD can channel investments towards green technologies, renewable energy projects, and pollution abatement efforts, thereby improving environmental performance and potentially aiding in the decoupling of economic growth from environmental degradation (as explored in various EKC studies, e.g. [65–67]). Developed financial markets may also become better at pricing environmental risks and incentivizing firms to adopt cleaner practices. Conversely, if FD primarily fuels resource-intensive industries without adequate environmental regulation or the internalization of externalities, it can exacerbate

environmental problems like CO2 emissions and resource depletion (e.g. the concern in some studies like Zhang [68] for China, or Sethi *et al.*, [69] for India). The emergence of sustainable finance and green bonds, often thriving in more developed financial landscapes, is a testament to the potential for FD to actively support environmental objectives [7].

The empirical literature on the effects of FD on environmental impact is divided. For instance, among several studies, Usman *et al.*, [70] found that in the 15 highest-emitting countries, FD softens the impact of environmental degradation due to the effects of economic growth from FD, concluding the double-edged effect of FD. On the other hand, Usman *et al.*, [71] found that FD and energy utilization significantly increase pollution levels. The authors' findings don't support the EKC hypothesis.

Taken together, these findings highlight that the environmental effects of FD are context dependent. While developed financial systems facilitate investments in green technologies and pollution abatement, emerging economies may experience increased environmental pressures unless complementary policies and institutional support are in place [62, 63].

2.3.2 The Social Pillar

The Social (S) dimension of the FD-ESG nexus is profoundly influenced by financial inclusion, a key component of the broader FD [72]. Theoretically, by expanding access to affordable and appropriate financial services (credit, savings, insurance, payments) to previously underserved populations and SMEs, FD can be a potent force for poverty reduction [57, 73–76], decreased income inequality[7] [60], enhanced economic empowerment (particularly for women), and improved human development indicators like health and education [77–79]. FD also can benefit the poor through the banking system's ability to facilitate transactions and provide savings opportunities [80]. The World Bank [81] shows that financial inclusion contributes to seven out of 17 SDGs, including poverty reduction, women's empowerment, and increasing resilience for vulnerable groups. Ng *et al.*, [56] using country-level data demonstrated a positive and significant impact of FD on social indicators. The financial sector is believed to be associated with social indicators such as health, education, and sanitation [57]

One of the main mechanisms through which FD can improve the social aspect is reducing income inequality. Chiu and Lee [60] found that FD decreases income inequality in high income countries. However, this improvement appears to be only after a certain threshold of FD [61]. FD also can benefit the poor through the banking system's ability to facilitate transactions and provide savings opportunities [80].

Similarly, the social impacts of FD, such as reductions in income inequality and improvements in human development indicators, are often conditional on financial depth and institutional quality. Threshold effects indicate that only sufficiently developed financial systems produce measurable social benefits, particularly in emerging economies [60, 61].

2.3.3 Governance Pillar

The FD-governance pillar is less documented than the other two [56, 57]. FD is theorized to exert significant influence both at the corporate and national levels. Developed financial markets, characterized by greater transparency and scrutiny from diverse investors (including institutional ones), often create pressures for improved corporate governance practices within firms [82]. This can include better disclosure, enhanced board oversight, and better protection of minority shareholder rights [83]. Furthermore, the overall institutional quality that often accompanies or is a

[7] *For high income countries, this improvement appears to be only after a certain threshold of FD*

prerequisite for deep and stable FD (e.g. rule of law, contract enforcement) is itself a crucial aspect of national governance. Strong institutions tend to promote genuine ESG adoption, whereas weak governance may lead firms to overstress ESG disclosures (a form of "greenwashing") [84–86]. This aligns with institutional theory, which argues that firms internalize the norms and rules of the institutional context of their countries.

National governance matters differently between emerging and developed economies. Lozano and Martínez-Ferrero [87] found that in emerging countries, country-level institutional factors dominate, whereas in developed countries internal governance (board and ownership) matter more. This distinction implies that ESG adoption strategies should be context specific. In emerging economies, strong national institutions and regulatory oversight are crucial for effective ESG implementation, whereas in developed economies, firm-level governance mechanisms, such as board oversight and shareholder engagement, play a larger role. These differences underscore that financial development alone is insufficient to guarantee ESG improvements; it interacts with institutional quality and governance structures to determine the magnitude and direction of ESG outcomes [57, 62, 87]**.** Empirical evidence suggests that the positive social and even environmental impacts of FD are conditional upon, or amplified by, strong institutional and governance frameworks [67, 88]. On the corporate level, financial institutions play a role in improving governance by undertaking preventive measures such as credit due diligence and monitoring projects to enhance loan asset quality [13, 56]. Well-developed financial systems can stimulate strong corporate governance and increase transparency between lenders and borrowers [89]. On a similar note, the development of stock markets is shown to align managers' and owners' interests, thus improving corporate governance by minimizing principal-agent problems [90]. FD can increase firms' access to global capital markets, encouraging better corporate governance [82]. Conversely, poor FD decreases the incentives for good corporate governance. For developing countries, it is shown that FD can encourage the shift away from the informal to the formal sector [91].

Empirical evidence suggests that ESG adoption varies significantly across institutional contexts, with state-owned enterprises showing different response patterns compared to private firms, and regional factors playing crucial roles in determining ESG effectiveness [54, 92]. FD is shown to improve the governance subcomponent of national ESG scores [56]. Finally, the literature reveals growing sophistication in ESG measurement methodologies, including advanced mathematical models that integrate ESG factors into asset pricing frameworks [93].

3. Literature Review

Multiple bibliometric studies have explored fields similar to our interest. In order to contextualize our focused inquiry into the FD-ESG nexus, it's instructive to first consider papers that analyze the FD and ESG field separately and more broadly. For instance, Say *et al.,* [5] charts the field of FD and its evolution, analyzing 2424 WoS documents spanning the years 1986-2023. The study reveals that economics is the dominant discipline (1158), and highlights a substantial post 2014 growth, and particularly post Covid-19. In their thematic analysis, the authors identified an increasing intersection of FD with themes such as "economic growth," "energy consumption," "CO2 emissions," and "renewable energy", signaling a growing academic focus on sustainability within the broader FD literature.

Concurrently, the expansive domain of ESG has also been the subject of extensive bibliometric analysis. For instance, Chytis *et al.,* [6] mapped ESG in business research, analyzing 1,034 Scopus articles. Similarly, they find an upward trend in ESG publication particularly post 2019. Key thematic clusters identified include "ESG performance and financial performance," "ESG investing and risk

management," and "CSR and corporate governance". Similarly, Ahuja and Rani [94] analyzed 764 recent Scopus documents and confirmed the growing prominence of ESG literature in sustainable finance. Their bibliographic coupling analysis points to key intellectual themes such as "ESG investing," "ESG disclosures and integrated reporting," "ESG performance and firm value," and "corporate governance and ESG performance". Recent bibliometric inquiries have also begun to scrutinize the integrity and standardization of these metrics. Recent bibliometric work also focuses specifically on ESG ratings and disclosures. Bucciarelli *et al.,* [95] document rapidly growing scholarship on rating divergences and show that methodological heterogeneity across rating providers (different criteria and weighting schemes) is a major source of inconsistent scores and a driver of research attention. Baibakova *et al.,* [96] classify ESG rating methodologies and highlight how these methodological differences undermine comparability. Sneideriene and Legenzova [97] map the literature on ESG disclosure and greenwashing prevention and note an accelerating emphasis on detection tools, audit mechanisms, and regulatory responses to improve the credibility of ESG reporting.

Other bibliometric studies analyzed the specific linkages between FD and environmental sustainability. Tlili [7] for instance, explored the FD and ecological footprint nexus, analyzing 124 documents from the Dimensions database (2015-2024) within the "Environmental Management" subfield. The authors highlight the relevance of the Environmental Kuznets Curve (EKC) hypothesis, particularly when strong governance and financial innovation are present, as well as noting the growing significance of sustainable finance and the role of AI/blockchain in green finance. Complementing this, Badareu *et al.,* [98] investigated the literature intersecting FD and climate change, using 730 WoS documents from 2010 to 2024. They note a post 2016 surge in publication. While these studies provide crucial insights into the 'E' component of ESG, our research expands this lens to encompass the broader social and governance dimensions of ESG performance as influenced by a wider array of FD factors.

Another significant stream of bibliometric research deals with financial inclusion, which is a key component of FD, and sustainable development. For instance, Ellili [8] explored this relationship, highlighting financial inclusion's role in promoting economic growth, reducing inequality, and mitigating climate change, structuring sustainable development into its economic, social, and environmental clusters (Table 10, Appendix). Similarly, Chandel and Arora [78] analyzed 564 Scopus documents (1999-2022) focusing on "financial inclusion" and "sustainable development". They show significant growth post 2011 and identified themes such as the critical roles of "financial technology and SDGs," "social capital," "microfinance and women's empowerment", and "green finance". While these analyses underscore the importance of financial inclusion for sustainable development, our study aims to integrate financial inclusion as one of several key dimensions within a more comprehensive framework of FD, examining its collective impact alongside markets and institutional development on overall ESG performance.

The role of financial technology (FinTech) and digital finance, as a rapidly evolving component of FD, and its relation to ESG and sustainable development constitutes another stream of bibliometric research. Jallad *et al.,* [77] analyzed 520 WoS and Scopus documents for the years 2010-2024 and charts the nexus of digital finance, financial inclusion, and SDGs, noting a thematic evolution from technology-specific research (e.g. bitcoin) towards broader systemic approaches like economic sustainability and circular economy, with key clusters around SDGs, blockchain, and microfinance. Roy and Vasa [99] focused specifically on FinTech-ESG intersection as a pivotal mechanism of sustainable finance. The author notes the emergence of prominent themes include the role of FinTech in ESG disclosures, corporate governance, and sustainability as well as emerging technologies

like AI and blockchain are highlighted for their impact on ESG reporting. Their analysis shows a surge in scientific production, particularly from 2022 onward. Continuing with FinTech-ESG nexus, Trotta *et al.,* [9] examined 83 Scopus articles from 2017 to May 2023 in finance and banking context. Their analysis shows that FinTech adoption has been found to positively affect firms' ESG performance, and that digital financial inclusion is identified as a growing research strand. They also note that literature at the intersection of FinTech and climate change is still very young, and empirical evidence is currently under-explored. Sethi and Mahadik [100] analyzed 116 Scopus papers from 2017 to 2023 to explore FinTech and Sustainability, finding an increase in output particularly since 2021 and revealing key clusters (Table 10, Appendix): FinTech adoption, sustainability performance, green finance, sustainable finance, and financial inclusion. Collectively, these studies underscore the transformative potential of FinTech, yet also its fragmented research landscape and the need for greater understanding of its comprehensive impact.

Bibliometric research has also mapped the broader terrains of sustainable and green finance, and their linkages with ESG principles or overarching sustainability agendas like the SDGs. Singh *et al.,* [101] analyzed 377 WoS documents looking into ESG imperatives of sustainable finance. They show the relevance of sustainable/green banks in sustainable development, and highlight key research themes: climate finance, sustainable or impacting business models, green bonds, green credit policy, responsible investment, and green finance. Similarly, Kashi and Shah [102] conducted a bibliometric analysis on sustainable finance analyzing 723 Scopus articles. Their network analysis showed the substantial relevance of sustainable/green banks' involvement in sustainable development. A content analysis focusing on banks' role in sustainability transition identified key research themes, including the association between sustainability performance and banks' profitability, sustainable banks' risk profiles, determinants of banks' willingness to introduce sustainability criteria, customer responsiveness to banks' sustainability performance, and relevant macroprudential regulations, monetary policies, and supervisory guidelines. Mohamad [103] focused on green and climate finance looking into 1039 Scopus articles from 1997 to 2024 revealing a thematic evolution from pre-pandemic concerns like adaptation towards post-pandemic emphases on green finance, renewable energy, and SDGs. Similarly, Chandran and Chandran [104] looking in 887 Scopus articles from 1996 to 2023 mapping green finance research. Central themes in green finance research are carbon emissions, green technology innovation, and renewable energy. Early research focused on developing and issuing instruments like green bonds and green loans. A key theme is the connection between green finance and sustainable development. Green bonds are highlighted as particularly important. Recent studies deepen this picture. Judijanto [105] performs a Scopus-based bibliometric mapping of green bonds and green finance (keyword co-occurrence, co-authorship, citation networks) and finds that climate change and renewable-energy applications dominate the field and that research is concentrated in developed markets. Complementing this, Flottmann *et al.,* [106] provides a systematic review of green debt instruments (green bonds, green loans, sustainability-linked bonds), documenting rapid growth in the literature and explicitly calling for comparative studies across instruments and between developed and emerging markets. The research evolution has moved from focusing on financial instruments to examining wider economic, environmental, and social impacts. Directly linking FD to SDGs, then [107] analyzed over 6000 Scopus papers; the study found increased attention and interest in this field, with a rise in publications, particularly in 2022. Thematically, they found 3 major keyword clusters: financial inclusion, FD, and Africa/poverty. These studies demonstrate the growing attention to various forms of finance being examined in the context of achieving comprehensive sustainability goals.

While prior research looked into the broader fields of FD and ESG separately, or delved into subcomponents of FD or ESG, no prior research to our knowledge attempted to map the broader FD-ESG nexus, using a combined dataset.

4. Methodology

This study employs a quantitative bibliometric analysis to map the research landscape intersecting FD and ESG considerations. To ensure methodological transparency and replicability [108], the data collection and initial processing steps were guided by the SPAR-4-SLR framework [109] as recommended for comprehensive reviews by Lim *et al.,* [110], see Table 1.

Table 1
SPAR-4-SLR review protocol

Phase	Consideration	Details
Assembling	Search focus	FD and ESG terms, with impact/role terms
	Search (keyword) string	See Figure 7 and Figure 8 in Appendices
	Search period	Up to May 2025
	Search database	Scopus and WoS
	Search field	Title, abstract, keywords
	Document type	Articles and review articles
Arranging	Language	No filter
	Publication stage	No filter
	Subject (research) areas	Economics, Econometrics and Finance in Scopus Economics in WoS
	Filtered results	1611 from Scopus 1254 from WoS
	Consolidated results (after merging)	2210 documents after combining and cleaning Scopus and WoS datasets
	Analysis method	Bibliometric analysis - Performance analysis - RPYS - Science mapping
Assessing	Agenda proposal method	Evolution of the field Conceptual and intellectual structure Gap spotting

Source: Adapted by the author from Paul et al., [108] and Lim et al., [109]

We retrieved data from two datasets, Scopus and Web of Science (WoS) to achieve comprehensive coverage. This dual-database approach is recognized for enhancing the robustness and completeness of bibliometric studies [109, 110]. The search was conducted to include all relevant documents published up to May 2025. The initial datasets yielded 1254 documents from WoS and 1611 from Scopus.

A carefully constructed search query was pivotal to accurately defining the scope of this study. The final query was applied to the "topic" field in WoS (titles, abstracts and keywords), and its counterpart for Scopus. Figure 7 and Figure 8 in Appendices show the final detailed query used for WoS and Scopus. Early iterations combining general FD and ESG terms yielded high volume but significant noise, including papers where terms were co-mentioned without a direct analytical link, or where terms like "sustainability" or "governance" were used too broadly. The final query incorporated impact/role terms to ensure the relevance of the documents.

Specific filters were applied: results were limited to publications categorized under "Economics" related subject areas in both WoS and Scopus. Document types were restricted to "articles" and "review papers".

The two datasets were merged using the bibliometrix package for R [111]. Duplicates were removed, and further manual inspection was conducted. As a result, 655 duplicates were removed. The final consolidated dataset comprised 2210 unique documents. Details about the final dataset are shown in Table 2.

Table 2
Overview of the final dataset

Description	Results
Main information about data	
Time span	1984: 2025
Sources (Journals, Books, etc.)	490
Documents	2210
Annual Growth Rate %	14.27% (17.04%)
Document Average Age	3.83
Average citations per doc	33.26
References	107263
Document contents	
Keywords Plus (ID)	2955
Author's Keywords (DE)	4629
Authors	
Authors	4587
Authors of single-authored docs	323
Authors collaboration	
Single-authored docs	344
Co-Authors per Doc	3,01
International co-authorships %	21,31
Document types	
Article	2035
Article; Early access	116
Article; Proceedings paper	11
Review	46
Review; Early access	2

Source: Author's calculations based on data retrieved from Scopus and WoS

The analysis of the dataset integrated three bibliometric approaches: performance analysis to evaluate research productivity, impact, and key contributors. We also employed Reference Publication Year Spectroscopy (RPYS) to identify historically significant publications and intellectual turning point. These two were conducted using the bibliohiny web interface for bibliometrix on R [111]. Finally, we conducted science mapping, in which we performed co-citation analysis of references to reveal foundational knowledge, and Keyword Co-occurrence Analysis to reveal conceptual and thematic structure. These analyses were conducted using VOSviewer [112]. For the co-citation analysis, we established a minimum threshold of 30 citations per reference to ensure that only the most influential works were included, resulting in 144 references. For the keyword co-occurrence analysis, a minimum occurrence threshold of 10 was applied to filter out noise, yielding a network of 288 keywords. In both analyses, clusters were identified using the VOSviewer clustering technique, which relies on the association strength normalization method to group items based on their link strength relative to the expected number of links.

The interpretation of all quantitative results and visualizations generated through these methods was guided by the sensemaking framework outlined by Lim and Kumar [113]. This involved scanning the outputs for significant patterns, sensing the underlying meanings and evolutionary dynamics, and

substantiating the interpretations through critical analysis and triangulation across the different performance and mapping results.

5. Performance analysis

5.1 Productivity and impact

Figure 1 shows the volume of annual publications and total citations (TC) per year providing a preliminary picture of the evolution of research that intersects FD and ESG. Focusing on the volume of annual publications shows that this field of research was virtually non-existent or extremely niche for a long period. This may be the result of the fact that explicit studies looking into the relationship between FD and ESG were not a recognized and active research area. Foundational works about FD and ESG/CSR may have been developing separately during this period.

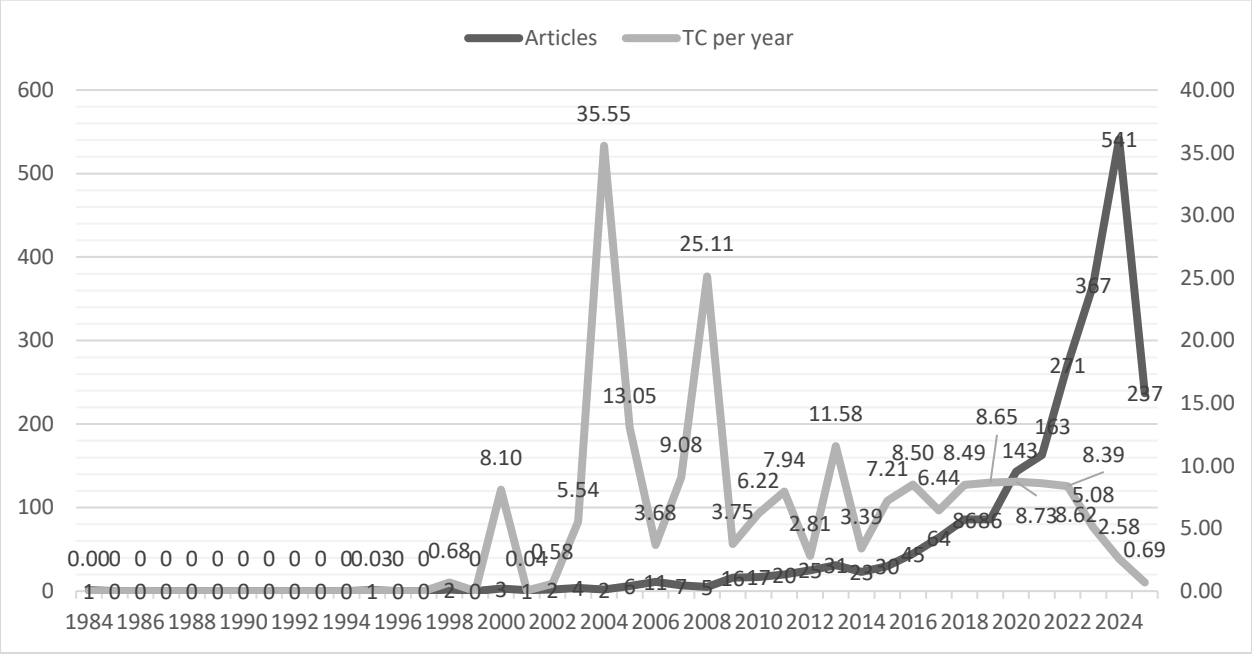

Fig. 1. Volume of annual publication and total citations per year

From around 2005/2006 we observe an early growth phase. There is a noticeable, albeit modest, increase in the number of articles. This indicates that this field of research started to gain some traction and witnessed an increased scholarly attention. Events like the 2008 financial crisis might have spurred some interest in governance, social impacts, and the role of the financial sector. The lead-up to the SDGs (formalized in 2015) could also be a factor.

From around 2015/2016 the field witnessed and accelerated in the number of publications, marking a clear inflection point where the field is becoming more established and attracting more research attention. The formal adoption of the SDGs in late 2015 and the Paris Agreement likely provided significant impetus.

From 2020 onwards, however, there is an explosion in research output. This dramatic surge indicates that this field is currently a highly active and mainstream area of research. This may be the result of heightened investor focus on ESG, regulatory developments, increased data availability, and growing academic recognition of the field's importance.

Figure 1 also illustrates the average annual citation impact of articles published each year. This metric, often referred to as Average Citations per Year (ACPY), represents the total citations received by articles published each year, averaged by the number of articles and normalized by the number

of years since publication, thus providing an age-independent measure of citation impact. Figure 1 shows that in the early years of 2000, 2004, and 2008 witnessed the emergence of highly influential cohorts. The year 2000 shows an ACPY of 8.1 despite only 3 articles. A standout paper is the one by Morduch [114] which is reviewed more in depth in 5.2. The year 2004 shows an ACPY of 35.55 with only 2 articles. This is largely driven by Guiso *et al.,* [115] receiving 1552 citations. The year 2008 occurring around the time of the financial crises demonstrates an ACPY of 25.11 from 5 articles, driven largely by Djankov *et al.,* [83] receiving 2101 citations.

Over the subsequent years, the field appears to be developing consistency, with impactful research being consistently produced, even if not reaching the exceptional peaks of 2004 or 2008. The recent decline of years 2023-2025 doesn't indicate a drop in research quality but is natural and to be expected. This is an artifact of the metric: these papers are too new to have accumulated a significant citation history and the normalization period.

5.2 Key readings informed by highly cited research

In this section we will look at the most impactful papers in our dataset, looking first at the most globally cited papers, then the most locally cited papers, and finish by looking at the most cited references by articles in our dataset.

5.2.1 Most global cited papers

Table 7 (Appendix) shows the 20 papers with most global citations in our dataset. This metric shows the most impactful papers that dealt with the FD-ESG nexus. We chose to review 20 papers given the broadness of the field we aim to dissect, as well as the large number of papers in our dataset. While these papers may not directly address the comprehensive FD-ESG nexus, they provide crucial theoretical frameworks, empirical methodologies, and foundational findings for its core components.

Delving into the absolute citation leaders in our dataset, the most cited paper is Djankov *et al.,* [83] with 2101 citations and deals primarily with the G pillar. The paper analyzing legal rules across 72 countries introduced a new, theoretically grounded 'anti-self-dealing index' focusing on private enforcement mechanisms such as disclosure, approval, and litigation that protect minority shareholders from expropriation by corporate insiders. Through cross-sectional OLS, the authors show that stronger legal protection against self-dealing is robustly associated with more developed stock markets—evidenced by higher market capitalization, more listed firms and IPOs, and lower block premiums and ownership concentration. This seminal paper establishes that specific legal governance mechanisms are fundamental to the scale, efficiency, and perceived fairness of financial markets, a key aspect of overall FD. The second most cited paper Guiso *et al.,* [115], on the other hand, deals primarily with the 'S' aspect. The authors, by exploiting regional variations in social capital (proxied by electoral participation and blood donation rates) within Italy and using household survey data, found that in high-social-capital areas, households were more likely to use formal financial instruments like checks and stocks, had better access to institutional credit, and relied less on informal credit, particularly, where formal legal enforcement is weaker, suggesting that social capital, through enhanced trust and norms of cooperation, acts as a crucial informal institution that reduces transaction costs and information asymmetries, thereby facilitating financial interactions and development. The third most cited paper in our dataset is Gygli *et al.,* [116] which focuses on measuring globalization by introducing a revised and improved version of the KOF Globalization Index measuring economic, social, and political dimensions of globalization across a wide range of countries and years (1970-2016), and making a key distinction between de facto (actual flows) and

de jure (policies/conditions) globalization and the creation of a separate index for financial globalization. They show that globalization, measured by the new index, promotes economic growth, but the impact varies depending on the dimension (economic, social, political) and whether it is measured de facto or de jure. For instance, for the social dimension, the positive effect on growth was driven by de facto social globalization in non-OECD countries. The fourth paper by the number of citations is Balsalobre-Lorente *et al.,* [117] with 1072 citations. This paper deals primarily with the environmental pillar examining the drivers of CO2 emissions in 5 EU countries between 1985 and 2016. Their panel data analysis, grounded in the Environmental Kuznets Curve (EKC) hypothesis, found evidence for an N-shaped relationship between economic growth and CO2 emissions. Crucially, they demonstrated that renewable electricity consumption and energy innovation significantly improve environmental quality by reducing emissions, while natural resource abundance also played a mitigating role. However, they also noted that trade openness and the interaction between economic growth and renewable electricity could, under certain conditions, increase emissions, underscoring the complex dynamics. Although this study does not directly incorporate FD as an explanatory variable for CO2 emissions, its findings on the importance of renewable energy and energy innovation point directly to areas where the nature and direction of FD are critical.

The rest of the papers in Table 7 (Appendix) delve into more specific thematic areas. A significant stream of research within our dataset deals directly with the interplay of FD and environmental quality. Jalil and Feridun [65] with 890 total citations conduced a co-integration analysis of China between 1953 and 2016 finding that FD decreased environmental pollution, with carbon emissions being mainly determined by income, energy consumption, and trade openness (potential channels include attracting FDI, R&D and innovation, lower costs for environmental projects); their work also confirmed an Environmental Kuznets Curve (EKC) for China. Providing a European perspective, Shahbaz *et al.,* [66] (849 citations); employing novel unit root tests and bootstrapping ARDL; found that in France between 1955 and 2016, FD improves environmental quality by lowering carbon emissions. Their findings support the pollution-haven hypothesis for FDI in France and validated the EKC. Tamazian and Rao [67] (834 citations) also confirmed the EKC hypothesis, using a GMM estimation on a panel of 24 transitional economies between 1993 and 2004. The authors emphasized the importance of both institutional quality and FD for environmental performance. Specifically, the authors caution against financial liberalization without an accompanying strong institutional framework, though FDI helps with lower CO2 emissions. Shahbaz *et al.,* [118] (654 citations) focusing on South Africa and using ARDL approach found that FD (specifically banking sector development) lowered CO2 emissions. Other studies, on the other hand, found a positive relationship between FD and carbon emissions, as Zhang [68] (804 citations), explored the influence of China's FD on carbon emissions (2000-2009) and considering two perspectives: FD scale and efficiency, for both financial intermediation and stock markets, found a significantly positive relationship between FD and carbon emissions scale. Similarly, Boutabba [119] (580 citations) using ARDL and VECM found that for the Indian economy between 1971 and 2008, FD increased CO2 emissions with unidirectional causality. Ren *et al.,* [120] (674 citations) looking specifically on the influence of China's digitalization on energy consumption finding that internet development positively affects the scale of energy consumption (via economic growth) but negatively impact energy consumption structure (leading to cleaner mix) and intensity. Crucially, they identify FD as one of the key intermediary channels for this improvement. Finally, in a broad study across 73 developing countries (1990-2016), Jahanger *et al.,* [121] (536 citations), using second-generation panel cointegration tests, found that while natural resource consumption increases ecological footprints, technological innovation inhibits them. Significantly, FD was found to *decrease* ecological footprints overall and for Asian nations, though

this was not the case for African or Latin American economies. Collectively, the papers studying the FD-E nexus reveal a complex and context-dependent relationship.

A second stream of research focuses mainly on the G pillar of the ESG framework. A foundational paper by Djankov *et al.,* [83] reviewed above highlights how specific legal and institutional framework and regulations regarding practices like self-dealing are crucial for investor protection and the development of securities markets. Morck *et al.,* [122] focus specifically on the interplay between corporate control and broader economic outcomes. They examine how concentrated ownership structures[8], prevalent outside the US and UK, lead to significant agency problems which can escalate to macroeconomic significance, impacting innovation, resource allocation, and overall growth. A key theoretical contribution is developing the concept of 'economic entrenchment', where controlling owners leverage their amplified political influence to distort public policy and institutions, thereby preserving their control and potentially retarding financial market development and broader economic progress. Effectively, the authors show a strong connection between corporate governance and FD with indirect implications for social well-being through its effects on growth and resource allocation. Focusing specifically on emerging markets, Claessens and Yurtoglu [123] synthesized extensive research showing that better corporate governance leads to greater access to financing, a lower cost of capital, and improved firm performance. The authors also emphasize the role of legal foundations and note that voluntary governance mechanisms are less effective in environments with weak overall institutional quality and highlight a gap in empirical evidence directly linking corporate governance to social and environmental performance, thereby pointing towards areas where the G-S and G-E nexus require further exploration. Finally, from this list, Doidge et al., [82] investigates the relative importance of country-level versus firm-level characteristics in determining corporate governance practices. Their empirical analysis, using various governance ratings, finds that country characteristics, including the level of state investor protection, economic development, and importantly, FD (measured by stock market capitalization/GDP), explain significantly more of the variation in governance ratings than firm-specific attributes. They propose a model where firms choose governance levels based on a cost-benefit analysis, which is heavily influenced by the home country's institutional and financial environment. This research strongly establishes that the macro-level FD and institutional quality are primary determinants of firm-level 'G' (Governance) practices, with financial globalization potentially moderating this by offering access to alternative governance standards and capital markets.

Moving to the set of papers that focuses on the social aspect. The previously reviewed Guiso *et al.,* [115] underscore that social context is a fundamental determinant of FD and inclusion, shaping individuals' ability and willingness to participate in formal financial markets. Complementing this, Morduch [114] provides a critical analysis of financial inclusion through the lens of microfinance, examining the tension between achieving financial sustainability for microfinance institutions (MFIs) and maximizing their poverty alleviation impact. The author challenges the "win-win" proposition that financial self-sufficiency of MFIs inherently leads to the greatest social impact and argues that programs targeting the "core" poor often face higher costs and may require subsidies to be viable. The author highlights that a singular focus on financial viability can lead MFIs to serve fewer poor clients, potentially leaving the most vulnerable behind, positing that diversity of MFI models, some potentially with targeted subsidies alongside innovations in service delivery, is necessary to effectively address the multifaceted nature of poverty. This paper is pivotal as it addresses and scrutinizes the societal impact of a key financial inclusion mechanism.

[8] *For instance, when a few wealthy families control large swathes of an economy through mechanisms like pyramidal structures*

Beyond the direct impacts on specific ESG pillars, several highly cited papers within our dataset explore the broader macroeconomic interconnections between FD, economic growth, energy consumption, and trade, often providing essential context for understanding the channels through which financial systems influence environmental and social outcomes. Shahbaz *et al.,* [124] investigate these multivariate relationships for China over the period 1971-2011 confirming long-run relationships - often with feedback loops - finding that energy use, FD, capital, and international trade (exports and imports) all have a positive impact on China's economic growth. Crucially for the FD-ESG nexus, their Granger causality analysis revealed bidirectional causality between FD and energy use, as well as between FD and economic growth. Al-Mulali *et al.,* [125][9], while not primarily an FD paper, found that the EKC hypothesis doesn't hold in the Vietnamese context and that capital and imports increased pollution. Such findings have implications for FD-E nexus, for instance through FD facilitating economic development. Their recommendation explicitly links increased capital to promoting energy efficiency and renewable energy to reduce pollution. Similarly, Acheampong [126][10] applies a PVAR model to analyze the dynamic causal relationship between economic growth, carbon emissions (CO2), and energy consumption on a large panel of 116 countries from 1994 to 2014. While the paper doesn't include FD, or any of its subcomponents, as a variable, their findings that the relationships between growth, energy, and emissions are regionally heterogeneous imply that the environmental impacts of economic activity, and thus the challenges and opportunities for sustainable finance will vary significantly by region. Moreover, their finding of potential macroeconomic costs of environmental policies suggests that financial mechanisms designed to support environmental goals must consider these potential trade-offs.

5.2.2 Most Local Cited Papers

A complementary perspective to the review of the most globally cited papers is gained by examining papers that exhibit high citation counts within our specific dataset. This helps to identify research that has been particularly instrumental in shaping the internal dialogue, specific research trajectories, and thematic concentrations of the scholarly community focused precisely on the FD-ESG nexus as captured by our study's scope. This set of papers can also be understood through its relation to the ESG framework. The E pillar is again a prominent theme. Three papers directly model FD as a determinant of environmental quality, primarily CO2 emissions, yielding diverse findings. Shahbaz *et al.,* [127] (55 local citations) provide evidence from Malaysia from 1971 to 2011. Employing a bound testing approach to cointegration and VECM Granger causality, they found that FD reduces CO2 emissions in the long run through lowering costs for environmental and eco-friendly projects and investments. They also confirm bidirectional causality between FD and CO2 emissions, and between FD and economic growth, highlighting the interconnectedness of these factors. Moreover, FDI is shown to retard environmental quality. In contrast, Sethi *et al.,* [69] (9 local citations) examining India from 1980 to 2015 find a detrimental impact, indicating that FD, alongside globalization, economic growth, and energy consumption, is positively related to CO2 emissions in the long run. Yuxiang and Chen [128] (16 local citations) focusing on China on the provincial level, show that FD tended to reduce industrial pollution intensities in China in recent years, thereby improving environmental performance. A fourth paper by Jamel and Maktouf [129] analyzes a panel of 40 European economies from 1985 to 2014 using OLS within a Cobb-Douglas production function framework. Their results are interesting: While they find bidirectional causality between GDP and pollution and between GDP and FD, they report a neutrality hypothesis for the direct link between

[9] The paper has the keyword "financial development" in the "author's keywords"
[10] Similarly, the paper has the keyword "financial development" in the "author's keywords"

financial sector development and CO2 emissions in the European context studied. The remaining papers within the E theme do not directly incorporate FD as a primary variable. Instead, they focus on the nexus between economic growth, energy consumption, and environmental degradation, providing crucial context for the conditions under which FD might operate [130–132].

The social aspect also features prominently within this set of papers. The most locally cited in this set, Guiso *et al.,* [115] is reviewed in section 5.2.1 Most global cited papers. However, this analysis reveals more foundational works. Emara and El Said [88] (16 local citations) employed a GMM dynamic panel model for 44 emerging markets and MENA countries (1990-2018) and found that financial inclusion positively impacts GDP per capita growth, but this effect, particularly for household access in the MENA region, is conditional upon strong governance, including the rule of law, control of corruption, and political stability. Sharma [133] (9 local citations) focusing on the effect of financial inclusion in India uses VAR models and Granger causality (2004-2013). The study finds a positive association and bidirectional causality between geographic financial outreach and economic development, and unidirectional causality from deposit/loan accounts to GDP, supporting the notion that expanding financial inclusion (S-pillar of FD) contributes to economic growth. Similarly, Kumar [134] used panel data (1995-2008) to identify determinants of financial inclusion in India and found that branch network expansion has a beneficial impact, but regional socio-economic setups, industrialization, and employee base are also crucial, indicating that both supply-side financial infrastructure and demand-side social and economic contexts shape financial inclusion. Importantly, Ghosh and Vinod [79] reveal gender disparity dynamics within financial inclusion using a multivariate regression analysis showing that female-headed households in India are significantly less likely to access formal finance and more likely to use informal sources. Another two papers explored financial inclusion and income inequality. Claessens and Perotti [135] argued that while FD can reduce inequality, skewed access often results from political influence and institutional capture leading to financial reforms benefiting elites and potentially increasing inequality. Adams and Klobodu [136] found that while FD may increase income inequality in sub-Saharan Africa, controlling corruption significantly reduces it.

It is noteworthy that these locally influential studies focusing on both environmental and social outcomes of FD, the quality of governance, whether national institutional frameworks, control of corruption, or corporate governance practices, emerges as a recurrent and critical mediating factor.

5.3 References spectroscopy

Reference Publication Year Spectroscopy (RPYS) is a method used in bibliometric analysis to investigate the historical origins, intellectual roots, and landmark papers of a research field. This provides a deeper historical perspective on the intellectual foundation of the FD-ESG nexus. RPYS is designed to identify historically significant publications and intellectual turning points that have shaped a specific research field [137, 138] unlike analyses focusing on the direct impact of contemporary research.

The RPYS analysis was performed using the bibliometrix R package on a set of 53,838 references extracted from 2210 documents from our FD-ESG dataset. Figure 2 shows the RPYS spectrogram, which plots two series against the Reference Publication Year (RPY). The first shows the number of local citations received by all references published in a given RPY. The second shows the deviation of these citations from a 5-year rolling median, which is a technique used to make peaks more visible. A high median deviation peak for a specific year indicates that significantly more references from that year are cited compared to adjacent years.

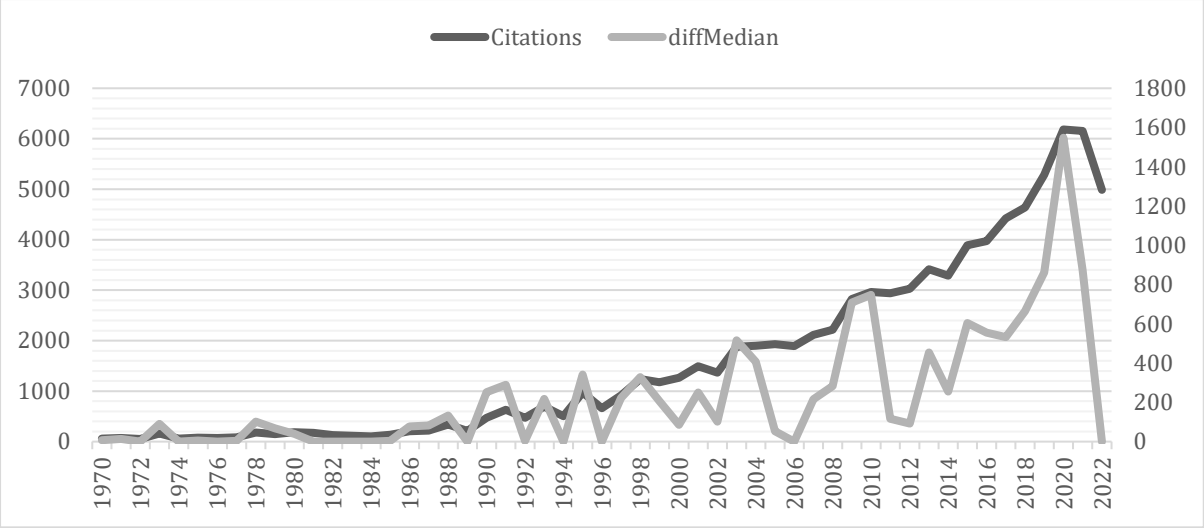

Fig. 2. RPYS spectrogram

For each significant peak year identified via diffMedian, we identified papers responsible for that peak as shown in Table 9 (Appendix). The content and contribution of these influential historical papers were then analyzed to construct a narrative of the intellectual development underpinning the FD-ESG nexus.

RPYS reveals several early periods of influence. 1971 shows an initial minor peak (diffMedian=13), primarily driven by Ehrlich and Holdren [139] with 27 local citations, which challenged complacency regarding population growth's environmental impact, introducing early frameworks like I=PAT to understand the interplay between population, affluence, and technology on environmental degradation. Its relation to the FD-ESG literature highlights some recognition of demographic and consumption pressures as a backdrop to sustainability discussions. The year 1973 peak (diffMedian=90) is largely attributed to McKinnon's [140] " Money and Capital in Economic Development" with 43 citations, and Shaw's [141] "financial deepening in economic development" with 40 citations. These two seminal books establish the concepts of financial repression and financial liberalization, and their impact on capital accumulation and economic development. They provide the foundational theoretical background for subsequent research on FD and ESG. A minor peak also exists for 1975 driven by Brown *et al.,* [142] with 34 local citations contributing to constancy testing for regression temporal analysis. A relatively significant peak shows for the year 1978 (diffMedian= 102) driven mainly by Koenker and Bassett [143] with 39 local citations, and Kraft and Kraft [144] with 35 local citations. The first introduced regression quantiles, and the second is an early empirical work about the energy-growth nexus. The late 80s, particularly 1988 (diffMedian 132) continued to build foundational blocks, Lucas [145] with 67 local citations provides theoretical insights into economic development. Methodologically, Phillips and Perron [146] and Johansen [147] were two pivotal papers for time-series econometrics (unit root tests, and cointegration vectors, respectively).

The 1990s saw the introduction of more sophisticated panel data techniques and a growing focus of environmental impacts. The first peak of 1991 (diffMedian=289) is mainly driven by Arellano and Bond [148] with 146 local citations. This paper is a highly influential paper for panel data econometrics. Less influential is the working paper by Grossman and Krueger [149] on the environmental impacts of the NAFTA agreement with 54 local citations, bringing the trade-environment linkage to the forefront, introducing empirical analysis of the Environmental Kuznets Curve (EKC) concept. A subsequent peak in 1993 (diffMedian=218) saw multiple influential

contributions. King and Levine [150] revolve around the relationship between FD, entrepreneurship, and long-term economic growth. King and Levine [28] show that well-developed financial systems are key drivers of long-term economic growth, supporting Schumpeter's view that finance fuels innovation and development. This year also included significant theoretical papers by Stock and Watson [151] on income distribution and macroeconomics Banerjee and Newman [152] on occupational choice and development, and Stock and Watson [153] econometric contributions about cointegration vectors. 1995 (diffMedian= 342) is another year marked by Arellano and Bover's [154] work with 135 local citations on instrumental variable estimation of error-component models. The 1998 peak is characterized by La Porta *et al.'s* [155] work on law and finance emphasizing the role of legal institutions in FD, and Blundell and Bond's [156] work on dynamic panel data models.

The new millennium integrated Econometrics, environmental issues, and institutions. The year 2001 (diffMedian=250) is marked by a methodological paper by Pesaran *et al.* [157] work on "Bounds Testing Approaches to the Analysis of Level Relationships". It also features Antweiler *et al.'s* [158] transitions. Similarly have showed Acemoglu and and Robinson [159.] 2003 (diffMedian=516) continues the econometric theme with work by Im *et al.*, [160] on unit roots for heterogeneous panels. It also features Rajan and Zingales [161] on the political economy of FD. 2009 and 2010 feature particularly pronounced peaks. 2009 (diffMedian=708) is marked by Tamazian *et al.*'s [162] work on economic and FD impacts on environmental degradation. 2010 (diffMedian=748) is largely driven by empirical work on the energy-finance nexus by Sadorsky [163] and Tamazian and Rao's [67] second work on economic, financial and institutional development impacts on the environment.

Recent influential literature emerges from the 2010s and early 2020s. 2013 (diffMedian=454) is dominated by empirical studies linking multiple variables such as FD, energy, economic growth, CO2 emission, trade, etc. [118, 164–166]. 2015 with a peak of 604 diffMedian continues this trend with contributions from on similar themes often for specific regions or countries (MENA, the EU, Tunisia) [167–169]. 2020 features the biggest peak with a diffMedian of 1548, pointing to recently published but highly influential works. Key papers include Le *et al.,* [170] work on financial inclusion and CO2 emissions, and the reference to the World Bank Development Indicators indicating that contemporary research heavily relies on this comprehensive dataset for empirical analysis of development and ESG-related indicators.

Our diffMedian data shows very prominent peaks in recent years, which is not usual for RPYS. This indicates that the FD-ESG research field is a recent and still nascent research field. Earlier peaks were not specific for the FD-ESG nexus but lay foundational theoretical and methodological works. The 2010s onward feature more thematic peaks, with works that are highly empirical, country-specific, and typically incremental rather than conceptual or theoretical. However, despite these recent peaks being more prominent, there is no single set of works driving it. Early years were marked by concentrated influence pinpointing "citation classics" or "historical roots". On the other hand, later years were marked by the diffusion of influence.

5.4 Key contributors

5.4.1 Authors

Table 3 panel A shows the most prolific authors by a number of articles in our dataset. Shahbaz M. emerges as the most productive author with 30 articles, demonstrating a sustained research interest starting from 2013. His works usually explore the relationship between FD, energy consumption, economic growth, and other factors. Following him are Wang Y., Khan., and Asongu S. known for his work in development economics in Africa, and Lee C. who focuses on themes such as energy economics, FD, and environmental issues. The relatively recent start years (Table 4 (PY_start))

for some highly productive authors reflects the growing importance and the development of the FD-ESG field.

Table 3
Most prolific contributors by a number of articles

Panel A		Panel B		Panel C		Panel D	
Authors	Articles	Sources	Articles	Affiliation	Articles	Country	Freq
Shahbaz M	30	Resources Policy	182	Xi'An Jiaotong University	54	China	1331
Wang Y	26	Energy Economics	91	School of Management and Economics	53	India	331
Khan M	25	Environment, Development and Sustainability	70	University of International Business and Economics	48	USA	328
Asongu S	24	Journal of the Knowledge Economy	65	Southwestern University of Finance and Economics	46	Pakistan	288
Lee C	19	International Journal of Energy Economics and Policy	60	Comsats University Islamabad	34	UK	189
Wang X	18	Economic Research-Ekonomska Istrazivanja	58	Lebanese American University	32	France	182
Liu Y	17	Energy Policy	53	Nanchang University	32	Malaysia	177
Li Y	16	Applied Economics	50	Universiti Putra Malaysia	32	Australia	176
Liu X	16	Cogent Economics \& Finance	45	Renmin Univ China	31	Turkey	150
Ozturk I	14	International Journal of Social Economics	42	Wuhan University	30	Nigeria	140

Source Author's calculations based on data retrieved from Scopus and WoS

On the impact front, Shahbaz M. also emerges as the most impactful author, which indicates not only high output but also scholarly impact. This pattern features also for the other productive authors which indicates a core group of highly productive and impactful authors, such as Shahbaz M., Lee C., Wang Y., Asongu S. and Ozturk I.

Table 4
Top 10 authors by H-index

Author	H_Index	Tc	Py_Start
Shahbaz M	25	7281	2013
Lee C	16	1626	2010
Wang Y	13	885	2012
Asongu S	12	716	2015
Khan M	11	581	2019
Ozturk I	11	1417	2014
Al-Faryan M	9	373	2022
Li Y	9	480	2011
Wang C	9	517	2013
Wang X	9	609	2021

Source: Author's calculations

5.4.2 Journals

Table 3 Panel B shows the most prolific journals by a number of articles. Resources Policy stands out as the most prolific journal by a good margin. Its focus is on the economics and policy of natural and material resources, highly relevant to the E pillar of ESG. Following this, Energy Economics and Energy Policy focus on research on energy economics, finance, and policy issues related to energy supply and use. Continuing with the theme of journals focusing on the E pillar, Environment, Development and Sustainability directly addressing the sustainability aspect. Journal of the Knowledge Economy focuses on knowledge and innovation likely capturing research on how FD supports sustainable innovation. The International Journal of Energy Economics and Policy and Economic Research-Ekonomska Istrazivanja are other notable outlets. *The latter* is a journal covering economic issues in Central and Eastern Europe, suggesting a regional interest or specialization. Applied Economics, a general economics journal, also features, indicating that FD-ESG topics are gaining traction beyond specialized field journals.

Table 5 shows journals impact. By local citations within our dataset Energy Policy is the most frequently cited source, followed closely by Environmental Science and Pollution Research (ESPR), and Energy Economics. *ESPR* is a broad journal covering environmental science and pollution, indicating that research within the FD-ESG nexus frequently draws upon or is cited by studies in this broader environmental field. Other highly locally cited journals like Renewable & Sustainable Energy Reviews and Journal of Cleaner Production further emphasize the importance of environmental and sustainability-focused outlets. Foundational economics journals like the American Economic Review and development-focused journals like World Development also show a significant local citation impact. This metric shows which journals are being cited by documents from our dataset. By H-index, Panel B of Table 5 shows that Energy Economics, Resources Policy and Energy Policy demonstrate high impact. This shows that the resource and energy aspects of the FD-ESG nexus is very prominent. The same pattern emerges when looking at global citations. Notably, the Journal of Financial Economics and the American Economic Review, appear here with significant TC suggesting that while they may not publish a high *volume* of FD-ESG-specific papers (contributing 7 and 1 documents respectively to our dataset), the papers they do publish have a very broad and substantial impact on the FD-ESG research.

Table 5
Journals' impact by various metrics

Panel A		Panel B		Panel C	
Sources	Local Citations	Source	Tc	Source	H-Index
Energ Policy	3138	Energy Economics	15222	Energy Economics	55
Environ Sci Pollut R	2891	Energy Policy	8605	Resources Policy	40
Energ Econ	2725	Resources Policy	5611	Energy Policy	37
Renew Sust Energ Rev	1731	Journal of Financial Economics	3290	Economic Research-Ekonomska Istrazivanja	22
J Clean Prod	1599	Economic Modelling	1957	Environment, Development and Sustainability	20
Am Econ Rev	1273	Economic Research-Ekonomska Istrazivanja	1552	Economic Modelling	17
World Dev	1162	American Economic Review	1552	Journal of the Knowledge Economy	16
J Econometrics	1116	Structural Change and Economic Dynamics	1443	Applied Economics	16

Table 5
Continued

Panel A		Panel B		Panel C	
Energy	1061	World Development	1388	International Journal of Social Economics	14
Econ Model	1059	Environment, Development and Sustainability	1358	Economic Analysis and Policy	13

Source: Author's calculations based on data retrieved from Scopus and WoS

These numbers paint the picture of which types of journals disseminate the research on FD-ESG. First, we observe the dominance of Energy and Environmental Journals ranking high across productivity and impact metrics indicating that the FD-ESG nexus is heavily intertwined with energy transitions, resource management, pollution control, and sustainable development. Second, the appearance of highly prestigious general economics journals (e.g. *American Economic Review*) and finance journals (e.g. *Journal of Financial Economics*) in the high TC and local citation lists, even if not in the top productivity list, signifies that foundational economic theories and financial principles are crucial underpinnings for FD-ESG research. Third, there is an emerging importance of sustainability-focused outlets.

5.4.3 Affiliations

The institutional contributions to the FD-ESG nexus research reveal a strong concentration of activity, particularly within Chinese universities, alongside notable contributions from other Asian and Middle Eastern institutions. Table 3 shows that Xi'An Jiaotong University is the most prolific institution closely followed by the "School of Management and Economics"[11] and other Chinese institutions. This may be the results of the general trend of increasing Chinese scientific output and its large academic system and national Strategic Priorities on sustainable development, green finance, and environmental governance in its national policies. However, other regions also feature, such as COMSATS University Islamabad from Pakistan, the Lebanese American University from Lebanon, and Universiti Putra Malaysia.

5.4.4 Countries

The examination of scientific output shows that China leads by a substantial margin, related to the dominance of Chinese institutions and authors. Following China, India, the USA, and Pakistan emerge as other major contributors, each representing a considerable volume of research. The presence of both large, developed economies and significant emerging/developing economies (India, Pakistan) in the top tier indicates a broad global interest in the FD-ESG nexus. Other countries in the top 10, including the UK, France, Malaysia, Australia, Turkey, and Nigeria, further underscore the global relevance of this research area.

In terms of impact (Table 6), China again leads in total citations, followed by the USA. Pakistan and Australia also show high TC, indicating that their contributions are widely recognized. Notably, India, despite its high productivity, ranks 6th in TC, resulting in a lower average article citation count (19.10) compared to other highly productive nations.

[11] *While this is a generic faculty name, its high frequency, likely aggregating output from a leading department within a major university (potentially in China, given the overall trend)*

Table 6
Countries' impact by total citations and average article citations

Country	TC	Country	Average Article Citations
China	18534	Switzerland	164.60
USA	8029	Canada	115.60
Pakistan	4943	Mauritius	84.00
Australia	4372	Greece	77.80
France	3200	Netherlands	73.20
India	2700	USA	71.10
Tunisia	2573	France	66.70
Malaysia	2328	Australia	66.20
United Kingdom	2238	Italy	64.90
Italy	2077	Tunisia	64.30

Source: Author's calculations based on data retrieved from Scopus and WoS

The landscape shifts significantly when considering Average Article Citations. Switzerland stands out with an exceptionally high average of 164.60 citations per article, followed by Canada and Mauritius, though for the latter this might be based on a smaller number of highly impactful papers. Several European countries like Greece, Netherlands, France, Italy, alongside the USA and Australia, also demonstrate high average citations. Tunisia also ranks high in TC and average article citations indicating notable contributions to the field. Impact analysis suggests that while China and India lead in volume, research from these other, often developed, nations tend to have a higher average impact per article. This could be attributed to factors such as publication in higher-impact journals, a focus on topics with broader international resonance, or more established international research networks.

Analyzing the country of the corresponding author. Figure 3 shows research leadership and collaboration patterns. China leads followed by India and the USA. China has a very high SCPs compared to MCP, despite leading in both categories by volume, which indicates a significant portion of its leading research is domestically driven. For India, this pattern is more prominent with an MCP of 8.5%. however, western nations such as the USA, the UK and France exhibit significantly higher proportions of MCPs, indicating stronger leadership roles in international collaborative research within the FD-ESG nexus. This often reflects established international networks and funding opportunities that foster cross-border research.

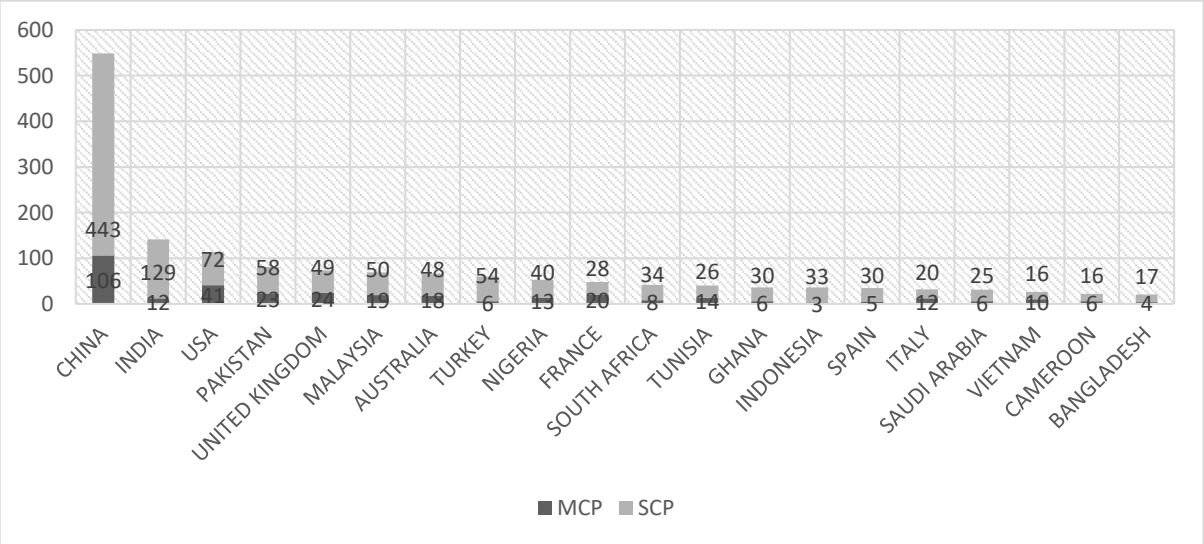

Fig. 3. Most relevant countries by corresponding author

6. Science mapping

6.1 Intellectual structure

To delineate the intellectual structure and foundational knowledge upon which the FD-ESG nexus is built, we conducted a co-citation analysis which examines the relationship between co-cited references used by articles in our dataset, thereby providing an understanding of the development of its foundational concepts [108, 110]. For this purpose, we employed VOSviewer software. A minimum citation threshold of 30 local citations was set, resulting in 144 references meeting this criterion. We utilized a thesaurus file to enhance the accuracy of our results and removed erroneous entries. Drawing on the sensemaking approach [113], we assigned a label to each cluster and identified its overarching theme.

The visualization of the co-citation network (Figure 4) reveals 4 distinct co-citation clusters (CCC onwards). The size of the nodes corresponds to the number of times a reference has been cited within our corpus, and the links between them indicate their co-occurrence. 1, the first and largest cluster, contains 49 references, prominent on the left side of the map, centers on theoretical and empirical examination of relationships between economic activity and environmental impacts, heavily featuring time-series econometric methodologies. This cluster brings together seminal works establishing and exploring the EKC hypothesis. The cluster is dense (high intra-cluster links) and visually distinct, indicating strong internal cohesion. A cornerstone in this cluster is Grossman and Krueger [171] with 126 citations and a total link strength (TLS) of 1340. The paper is a seminal work empirically examining the relationship between per capita income and various environmental indicators, finding that for many pollutants, environmental degradation first worsens and then improves with economic growth. This establishes the EKC hypothesis as a central theme. Complementing this are the two nodes Stern [172] and Dinda [173], which present surveys and critiques of the EKC hypothesis. The second most important node in this cluster is Pesaran *et al.,* [157] with 167 citations and 1453 TLS previously reviewed in 5.3 References spectroscopy, which introduced ARDL bounds testing approach becoming a cornerstone of long-run relationship analysis between non-stationary time series, which is a common characteristic of economic, environmental, and financial data. Earlier works on causality and co-integration by Engle and Granger [174] and Granger [175] and unit roots tests by Phillips and Perron [146] also form the methodological backbone of this cluster. The relationship between trade and environment is another key theme as evidenced by the existence of the key seminal paper, Antweiler *et al.,* [158] on free trade and the environment. Notably, this cluster features recent empirical applications of these concepts to different contexts. Mainly from the top 10, Shahbaz *et al.*'s [176] work on Indonesia examining the relationship between economic growth, energy consumption, FD, trade and CO2 using ARDL and VCEM techniques; and Farhani and Ozturk [167] investigate these causal relationships for Tunisia.

Positioned on the right side of the map, CCC 2 (green in Figure 4) contains 42 references and focuses on foundational theories linking FD to economic growth and income distribution, supported by panel data econometric methodologies. This cluster is also visually dense and cohesive. A significant portion of this cluster is dedicated to econometric methods. Top three nodes were dedicated to econometric methods Arellano and Bond [148], Arellano and Bover [154], and Blundell and Bond [156]. These three are previously reviewed in section 5.3 References spectroscopy focusing on panel data techniques and GMM. Two other top 10 papers from this cluster deal with GMM: Windmeijer's [177] work on finite sample corrections of GMM estimators, and Hansen [178] which laid the foundational work for GMM systems. These techniques became standard tools for handling issues like individual effects, lagged dependent variables, and endogeneity in growth and finance regressions. The other portion of this cluster is theoretical. Levine [179] argues that well-developed

financial systems are crucial for economic growth by mitigating information and transaction costs, thus influencing savings, investment, innovation, and long-run growth rates. Levine's later work [13], also featuring in this cluster further appraises and critiques the theory and evidence on the FD-economic growth nexus. The theoretical underpinnings are also presented by Lucas [145] and King and Levine [28] previously reviewed in section 5.3 References spectroscopy. This includes Kuznets [180], which is a highly influential seminal work on the impact of development on income distribution and introduced the famous EKC. Collectively, CCC 2 combines theoretical explorations of the FD-economic growth nexus with sophisticated econometric techniques, illuminating "what to test" and "how to test".

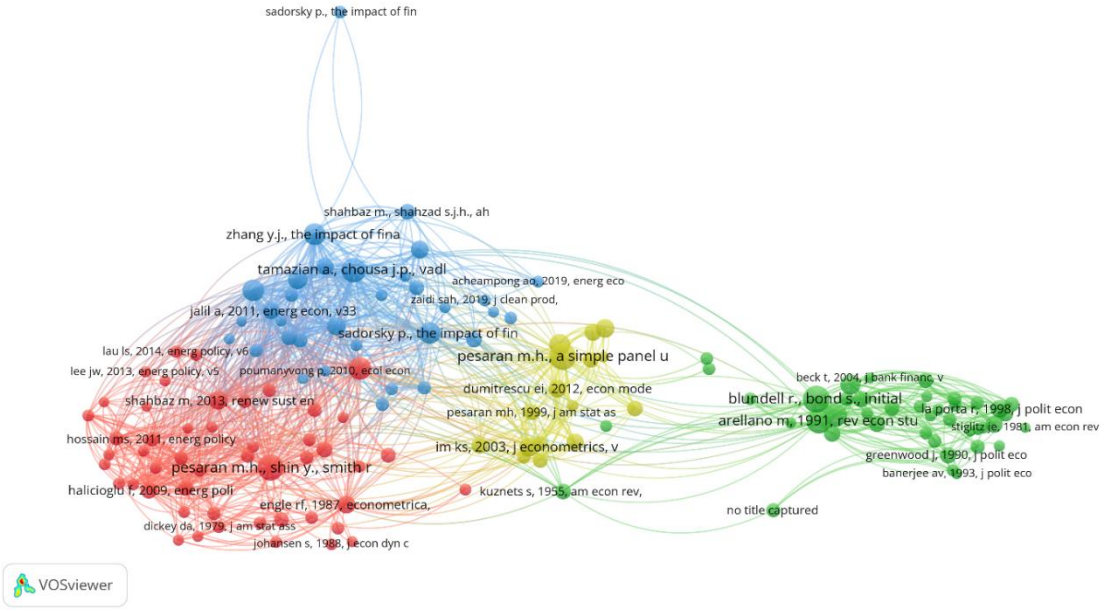

Fig. 4. Co-citation co-occurrence map

The blue cluster, CCC 3, contains 33 items and is located in the upper-central and left-leaning part of the map. It represents a body of empirical literature applying econometric methods to the FD-energy-economic growth-Trade-environment nexus in different contexts. This cluster is more diffused than CCC1 and CCC2 but shows internal connections around key authors and themes. This cluster has strong connections with CCC 1 and CCC 4, and a high TLS per article suggesting intellectual overlap. A common theme within this cluster is the impact of FD on energy consumption and environmental degradation. Sadorsky [163], previously reviewed in section 5.3 References spectroscopy found the relationship between stock market variables and energy consumption. His subsequent work [181] extended this analysis to Central and Eastern European frontier economies finding similar results. The role of FD in influencing CO2 emissions is another core area. Tamazian *et al.,* [162] found that for BRIC countries FD decreased CO2 emissions. Abbasi and Riaz [182] found similar results for Pakistan. On the other hand Boutabba [119] (also one of the most globally cited papers from our dataset, see section 5.2.1 Most global cited papers) found that for India, the opposite is true. Similarly, Zhang [68] (also one of the most globally cited papers from our dataset, see section 5.2.1 Most global cited papers) found similar results for China. These varying country-specific findings highlight the contextual nature of the FD-environment relationship. Several papers also test or discuss the EKC, Ozturk and Acaravci [165] and Jalil and Feridun [65] (see section 5.2.1 Most global cited papers) found evidence for EKC in Turkey and China respectively. The methodologies employed within CCC 3 typically involve time-series analyses such as ARDL bounds testing, VECM Granger

causality, and structural break unit root tests. These methods are applied to different contexts, often developing economies, which allows for nuanced policy recommendations.

The fourth cluster, CCC 4, is positioned centrally and towards the bottom of the map, nested between the other 3 clusters, while keeping its own visual cohesion. It focuses mainly on panel data econometric methodologies, and acts as a methodological hub. It is almost entirely composed of influential papers that have proposed, developed, or refined techniques for dealing with common challenges in panel data, such as unit roots, cointegration, cross-sectional dependence, and dynamic heterogeneity. The largest node in CCC 4 is Pesaran [183], which introduces the Cross-sectionally Augmented Dickey-Fuller (CADF) test, addressing the critical issue of cross-sectional dependence often present in macroeconomic and financial panel data. This is followed by Im *et al.,* [160] and Levin *et al.,* [184], which are prior works on unit root testing. The estimation of dynamic and heterogenous panels is a key theme, represented by Pesaran *et al.,* [185] which proposed the PMG estimator allowing for short-run coefficients and error variances to differ across groups, while keeping long-run coefficients identical. Further, testing for causality in panels is addressed by Dumitrescu and Hurlin [186] proposing a simple test based on averaging individual Wald statistics of Granger non-causality; and Breusch and Pagan's [187] classic on Lagrange multipliers. The topic of co-integration in panels is also addressed by Pedroni's [188, 189] works and Kao's [190] work on residual-based cointegration tests. Finally, Pesaran's [191] work addresses how to handle unobserved common factors.

6.2 Conceptual Structure

Keyword co-occurrence analysis focuses on keywords instead of publications, as such this technique explores the actual content of publications and their themes. Keyword co-occurrence analysis helps further illuminate and elaborate the content of each thematic cluster. We constructed a thesaurus file for accuracy and eliminated keywords that are too general for any useful thematic interpretation (such as "economy", "economic", "analysis"). We set a threshold of 10 minimum occurrences. This resulted in a map with 288 total keywords

Figure 5 shows the network visualization of the keyword co-occurrence analysis, and it features 4 clusters. We assigned thematic descriptions to each cluster shown in Table 11 (Appendix), which also shows the top 10 keywords for each cluster by number of links. The first 3 keyword co-occurrence clusters (KCC) are cohesive and distinct. However, KCC 4 is small (containing just 11 keywords) and appears dispersed.

The first major KCC by number of keywords is the red cluster containing 122 keywords and located on the lower-left side of the map. It revolves around the multifaceted aspects of financial inclusion and its interplay with governance structures, institutional quality, and broader socio-economic development outcomes, particularly within the context of developing countries. This cluster is visually dense, with "financial inclusion" (375 occurrences, 1761 TLS) serving as its central and most dominant keyword, heavily linked to "developing countries", "investment", and "growth". Moreover, the strong co-occurrence of "institutions", "governance", and "institutional quality" underscores the critical role these elements play in fostering or hindering inclusive financial systems and their developmental impact. This cluster frequently mentions the banking sector and includes the reduction of income inequality. Geographically, the keyword "Africa" features in this cluster. Interestingly, keywords such as "R&D" (33 occurrences, but with an unusually high average normalized citation score of 2.4594) and "technology" also appear, suggesting an emerging recognition of the role of research, development, and technological advancement. Similarly, "digital financial inclusion" has a very recent average publication year of 2023.963 and a high average normalized citation score (1.515), highlighting a rapidly growing theme. Other notable keywords

include "stock market", "corruption", "financial services", "ICT", "efficiency", "microfinance", and "financial literacy". These usually appear with a recent average publication year, mostly post-2020. This suggests that KCC1 represents a dynamic and growing research stream focusing on the S and G pillars of ESG.

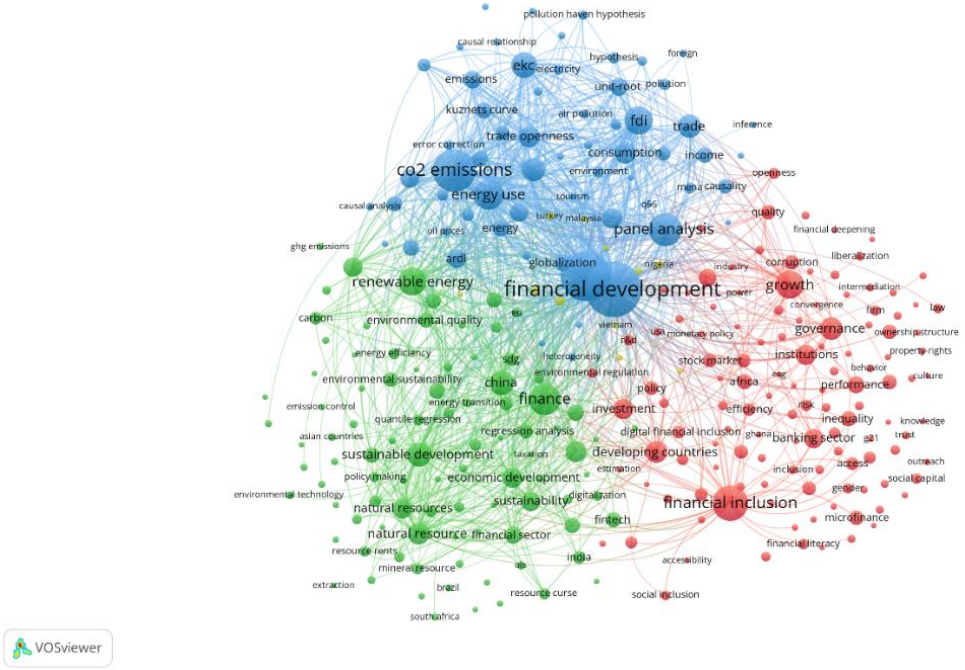

Fig. 5. Keyword co-occurrence map

The second most prominent cluster, containing 93 keywords, is situated more centrally and towards the bottom right. It centers around the intersection of finance and sustainability, environmental concerns, resource management, and innovation, often with a geographical emphasis on major economies like China and India. Its main keyword is "finance" bridging various sub-themes. A core focus of KCC2 is "renewable energy" and "sustainable finance" with high occurrences, total link strength and post-2022 average publication years. This highlights the critical role of financial mechanisms in promoting the transition towards greener economies. "Innovation," "technological innovation", "FinTech", and "environmental innovation" feature very recent average publication years and are frequently co-occurring, indicating the importance of innovation for achieving sustainability through financial mechanisms. The management of "natural resources", and their impact on "economic development" are key considerations within this cluster. "Environmental impacts" are further captured by keywords like "co2" and "climate change". Methodologically, "gmm" appears as a frequently used econometric technique. Notably, this cluster as a whole appears to be the most recent in terms of average publication year as shown in Figure 6.
The third major cluster, KCC3, depicted in blue and located central-to-top-left, is characterized by its strong focus on the macroeconomic nexus involving FD, economic growth, energy consumption, international trade, and their collective impact on CO2 emissions. The keywords "economic growth" and "financial development" are the most occurring not only in this cluster but for the whole map indicating their crucial role. A defining feature of this cluster is the extensive use of "panel analysis", "ARDL", and "cointegration analysis". These methodical keywords co-occur with keywords such as "CO2 emissions", "energy use", "energy consumption" and "energy". The role of economic integration is also highlighted through keywords such as "FDI", "trade", "international trade", "trade openness", and "financial liberalization". Further, the cluster features keywords such as

"globalization" and "urbanization" which suggest the exploration of how broader developmental trends mediate the FD-ESG relationship, especially the E pillar of ESG. Other notable keywords from the broader cluster include "causality", "income", "consumption", "environmental degradation", and "oil prices". The KCC3 maps exceptionally well with CCC3 in section 6.1 Intellectual structure.

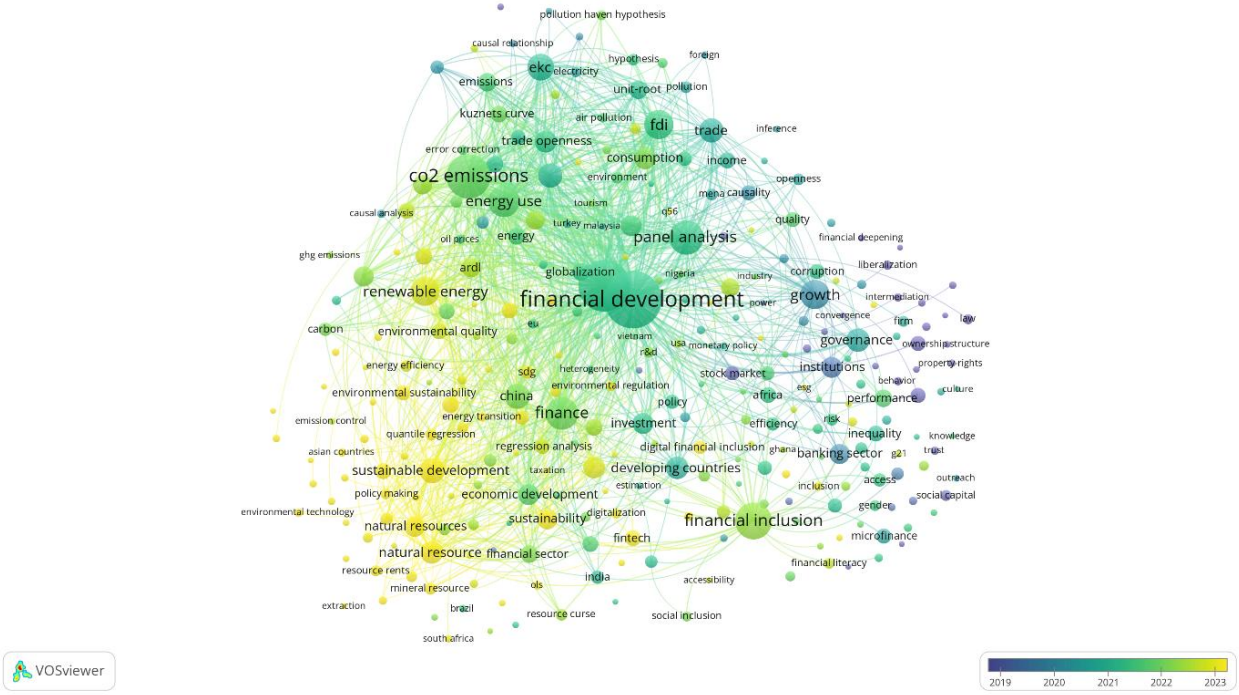

Fig. 6. Keyword co-occurrence network by average publication year

The last cluster, KCC4 depicted in yellow, is small and dispersed, containing only 11 keywords. This may be a natural byproduct of bibliometric analyses. However, it seems to group ASEAN countries, as well as Islamic countries. It features a specific form of finance "Islamic finance", a significant and distinct area of FD in many of the countries featured in this cluster. It also features analytical tools such as "bibliometric analysis" and "Spatiotemporal analysis".

7. Conclusion and Discussion

In this study, we aimed to systematically map the evolving research field intersecting FD and ESG, revealing its intellectual foundations, conceptual structure, key contributors, and historical trajectory, employing various bibliometric tools including performance metrics, RPYS, and science mapping.

Our analyses reveal numerous key insights. To begin with, there is an overlap between the different analyses, revealing a set of works that are shaping the field, which includes theoretical, methodological, and empirical works. Furthermore, the field is marked by the dominance of the environmental pillar of ESG. This is shown in the reviews of the most cited papers (Table 8, Appendix), the RPYS, and the two science mapping analyses. However, for keyword co-occurrence analysis, there is a prominent presence of keywords related to the social and governance pillars. This may suggest that research on these two aspects is gaining wide traction, though not long enough to appear more prominently in the other analyses. It may also be due to the diffusion of citations for these two pillars. The field overall is very recent and rapidly evolving. While the foundational economic and econometric concepts date back several decades, the explicit and voluminous research directly addressing the FD-ESG nexus has surged dramatically, particularly from 2015 onwards, with an

explosion post-2020. This recency is further evidenced by the RPYS analysis, which, unusually, showed its most prominent diffMedian peaks in recent years (e.g. 2010, 2015, and especially 2020). Another factor that can explain the underrepresentation of the S and G pillars is the choice to limit our bibliometric dataset to the Economics categories of Scopus and WoS. Though FD is strongly rooted in economics, the S and G pillars inherently draw from a broader range of disciplines such as sociology, development studies, management, and business.

Looking forward, the field is set to continue growing and gaining mainstream scholarly attention. The explosive growth in publications post-2020 isn't transitory. This trajectory is likely to continue, driven by real-world urgency (climate change, social inequality, developing countries' challenges), increasing investor demand for ESG integration, and evolving regulatory landscapes globally. Moreover, the field is shifting towards more nuance and complexity. While early research sought simple relationships between FD and individual ESG components, the field is likely moving towards a more nuanced understanding of complex, non-linear relationships, threshold effects, and mediating/moderating factors. In addition, most of the foundational and current work is at the macro/country level. There will be a growing need for a better understanding of micro-foundations. For instance, research should examine how individual firms and financial institutions respond to and drive the FD-ESG nexus. Equally important, the field features high methodological sophistication, which will probably continue to be innovated upon, driven by the improving quality and quantity of ESG data. The findings from the papers in this field show high contextual specificity, which will drive future research to focus on specific regions, as well as more comparative studies. Combined with better data and methodologies, the field will move beyond correlations towards identifying causal mechanisms and channels through which FD and ESG co-influence one another. Another notable observation is the recency of foundational influence as evidenced by the prominent recent peaks in our RPYS. It suggests the FD-ESG nexus, as a distinct and integrated field of study, is still actively defining its core contemporary foundations. This also explains the lack of direct and explicit FD → ESG (as a whole) papers or vice versa. Despite the recent explosion of interest and output, the potential for FD overall, or subcomponents of FD, to improve and ensure better ESG performance is not yet fully actualized.

This field of research relies on a large set of sophisticated econometric methodologies. The different analyses we conducted throughout this study reveal a set of core techniques that are dominant throughout but evolved through time. The first is time series econometrics. Earlier studies relied on basic regression analysis and constancy testing, causality testing, unit root tests, and cointegration vectors and error correction models. Later, techniques such as ARDL, VECM, and structural break unit root tests feature more prominently. The second is panel data econometrics, applying GMM systems, dynamic panel data GMM estimators, instrumental variable estimations, and panel cointegration. More advanced techniques include panel unit root tests with cross-sectional dependence, covariate-augmented Dickey-Fuller, panel Granger non-causality tests, and estimations with multifactor error structures. Other methodologies include cross-sectional OLS, regression quantiles, multivariate regression analysis, and second-generation panel cointegration tests.

Theoretically, the field draws upon several theoretical frameworks. First, there is the set of theories that deals with FD and economic growth, such as the McKinnon-Shaw hypothesis (financial liberalization/repression), Schumpeterian growth theory (finance-innovation nexus), endogenous growth theory, and general finance-growth nexus theories provided by Levine [13, 179]. The second category includes environmental economics frameworks, mainly the EKC hypothesis, the pollution hypothesis, related trade-environment theories, and the I=PAT framework. The third set deals with

institutional economics and governance theories, featuring law and finance theory, theories of political economy and institutional qualities, stakeholder theory, and agency theory.

Key authors revealed through our analysis include Shahbaz M., who is the most prolific author in our dataset and also features in both our RPYS and co-citation analysis. Pesaran M.H. is another author who is highly influential in the field despite not featuring among the most prolific authors. However, RPYS and co-citation analysis reveal his methodological contributions that the field relies upon. Arellano M. and Bond S. also contribute methodologically to the field. Theoretically, Levine and King contribute heavily to understanding the FD-economic growth nexus. Similarly, Grossman and Krueger are strong contributors to the environment-economic theory and empirics. Finally, Ozturk, Sadorsky, and Tamazian contribute empirically to the FD-energy-environment nexus.

These findings carry implications for policymakers, institutional investors, and regulatory bodies. A more robust understanding of the FD-ESG relationship can inform the design of financial regulations, development aid strategies, and ESG reporting standards, particularly in developing economies where institutional capacity and ESG performance are deeply intertwined.

While this study offers a comprehensive bibliometric mapping of the FD-ESG research nexus, it is limited by the choice of databases, language bias (English-only publications), and potential omissions of gray literature or early-stage preprints. Additionally, bibliometric techniques do not substitute for an in-depth qualitative or meta-analytical review.

Appendix

Table 7
Top 20 most globally cited papers

Author	Total Citations	TC per Year	Normalized TC	Type	Year	Title	Publication
[83]	2101	116.72	4.65	journal Article	2008	The law and economics of self-dealing	Journal of Financial Economics
[115]	1552	70.55	1.98	journal Article	2004	The Role of Social Capital in Financial Development	American Economic Review
[116]	1128	161.14	18.62	journal Article	2019	The KOF Globalization Index – revisited	The Review of International Organizations
[117]	1072	134	15.78	journal Article	2018	How economic growth, renewable electricity and natural resources contribute to CO2 emissions?	Energy Policy
[122]	916	43.62	3.34	journal Article	2005	Corporate Governance, Economic Entrenchment, and Growth	Journal of Economic Literature
[65]	890	59.33	7.47	journal Article	2011	The impact of growth, energy and financial development on the environment in China: A cointegration analysis	Energy Economics
[66]	849	106.13	12.5	journal Article	2018	Environmental degradation in France: The effects of FDI, financial development, and energy innovations	Energy Economics
[67]	834	52.13	8.38	journal Article	2010	Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies	Energy Economics

Table 7
Continued

Author	Total Citations	TC per Year	Normalized TC	Type	Year	Title	Publication
[68]	804	53.6	6.75	journal Article	2011	The impact of financial development on carbon emissions: An empirical analysis in China	Energy Policy
[82]	675	35.53	3.91	journal Article	2007	Why do countries matter so much for corporate governance?	Journal of Financial Economics
[120]	674	134.8	15.63	journal Article	2021	Digitalization and energy: How does internet development affect China's energy consumption?	Energy Economics
[118]	654	50.31	4.35	journal Article	2013	The effects of financial development, economic growth, coal consumption and trade openness on CO2 emissions in South Africa	Energy Policy
[125]	612	55.64	7.72	journal Article	2015	Investigating the environmental Kuznets curve hypothesis in Vietnam	Energy Policy
[124]	611	47	4.06	journal Article	2013	The dynamic links between energy consumption, economic growth, financial development and trade in China: Fresh evidence from multivariate framework analysis	Energy Economics
[119]	580	48.33	14.25	journal Article	2014	The impact of financial development, income, energy and trade on carbon emissions: Evidence from the Indian economy	Economic Modelling
[114]	548	21.08	2.6	journal Article	2000	The Microfinance Schism	World Development
[123]	537	41.31	3.57	journal Article	2013	Corporate governance in emerging markets: A survey	Emerging Markets Review
[91]	537	41.31	3.57	journal Article	2013	CO2 emissions, energy consumption and economic growth nexus in MENA countries: Evidence from simultaneous equations models	Energy Economics
[121]	536	134	15.96	journal Article	2022	The linkages between natural resources, human capital, globalization, economic growth, financial development, and ecological footprint: The moderating role of technological innovations	Resources Policy
[126]	535	66.88	7.88	journal Article	2018	Economic growth, CO2 emissions and energy consumption: What causes what and where?	Energy Economics

Table 8
Top 20 most locally cited papers

Authors	Local Citations	Global Citations	Item Type	Publication Year	Title	Publication
[127]	55	531	journal Article	2013	Does financial development reduce CO2 emissions in Malaysian economy? A time series analysis	Economic Modelling
[115]	24	1552	Journal Article	2004	The Role of Social Capital in Financial Development	American Economic Review
[128]	16	132	Journal Article	2011	Financial development and environmental performance: evidence from China	Environment and Development Economics
[88]	16	148	Journal Article	2021	Financial inclusion and economic growth: The role of governance in selected MENA countries	International Review of Economics & Finance
[79]	15	150	Journal Article	2017	What Constrains Financial Inclusion for Women? Evidence from Indian Micro data	World Development
[129]	14	128	Journal Article	2017	The nexus between economic growth, financial development, trade openness, and CO2 emissions in European countries	Cogent Economics & Finance
[116]	14	1128	Journal Article	2019	The KOF Globalization Index – revisited	The Review of International Organizations
[135]	13	293	Journal Article	2007	Finance and inequality: Channels and evidence	Journal of Comparative Economics
[131]	12	281	Journal Article	2020	Energy consumption, economic growth and environmental degradation in OECD countries	Economic Modelling
[192]	10	193	Journal Article	2012	Financial development and economic growth: Recent evidence from China	Journal of Comparative Economics
[134]	10	97	Journal Article	2013	Financial inclusion and its determinants: evidence from India	Journal of Financial Economic Policy
[83]	9	2101	Journal Article	2008	The law and economics of self-dealing	Journal of Financial Economics
[133]	9	173	Journal Article	2016	Nexus between financial inclusion and economic growth: Evidence from the emerging Indian economy	Journal of Financial Economic Policy
[132]	9	124	Journal Article	2019	Economic growth and environmental degradation in Vietnam: Is the environmental Kuznets curve a complete picture?	Emerging Markets Review
[100]	9	101	Journal Article	2020	Globalization, financial development and economic growth: Perils on the environmental sustainability of an emerging economy	Journal of Policy Modeling
[193]	8	257	Journal Article	2013	Financial development, ICT diffusion and economic growth: Lessons from MENA region	Telecommunications Policy

Table 8
Continued

Authors	Local Citations	Global Citations	Item Type	Publication Year	Title	Publication
[130]	7	85	Journal Article	2016	The relationship between real GDP, CO₂ emissions, and energy use in the GCC countries: A time series approach	Cogent Economics & Finance
[136]	6	43	Journal Article	2016	Financial development, control of corruption and income inequality	International Review of Applied Economics
[194]	6	114	Journal Article	2021	How does corporate social responsibility affect financial performance, financial stability, and financial inclusion in the banking sector? Evidence from Pakistan	Research in International Business and Finance
[122]	5	916	Journal Article	2005	Corporate Governance, Economic Entrenchment, and Growth	Journal of Economic Literature

Table 9
Identified papers from RPYS spectrogram Peaks for each year

Year	Item Type	Author	Title	Publication Title	Local Citations	Share of total
1971	Journal Article	Ehrlich, Paul R.; Holdren, John P.	Impact of Population Growth: Complacency concerning this component of man's predicament is unjustified and counterproductive.	Science	27	36,99%
1973	book	McKinnon, Ronald I.	Money and Capital in Economic Development		46	28,221%
1973	book	Shaw, Edward S.	Financial deepening in economic development		40	24,540%
1975	Journal Article	Brown, R. L.; Durbin, J.; Evans, J. M.	Techniques for Testing the Constancy of Regression Relationships Over Time	Journal of the Royal Statistical Society Series B: Statistical Methodology	34	43,590%
1978	Journal Article	Koenker, Roger; Bassett, Gilbert	Regression Quantiles	Econometrica	39	21,667%
1978	Journal Article	Kraft, John; Kraft, Arthur	On the Relationship Between Energy and GNP	The Journal of Energy and Development	35	19,444%
1988	Journal Article	Lucas, Robert E.	On the mechanics of economic development	Journal of Monetary Economics	67	19,706%
1988	Journal Article	Phillips, Peter C. B.; Perron, Pierre	Testing for a unit root in time series regression	Biometrika	54	15,882%
1988	Journal Article	Johansen, Søren	Statistical analysis of cointegration vectors	Journal of Economic Dynamics and Control	36	10,588%

Table 9
Continued

Year	Item Type	Author	Title	Publication Title	Local Citations	Share of total
1991	Journal Article	Arellano, Manuel; Bond, Stephen	Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations	The Review of Economic Studies	146	23,211%
1991	report	Grossman, Gene; Krueger, Alan	Environmental Impacts of a North American Free Trade Agreement		54	8,585%
1993	Journal Article	King, R. G.; Levine, R.	Finance and Growth: Schumpeter Might Be Right	The Quarterly Journal of Economics	67	9,696%
1993	Journal Article	King, Robert G; Levine, Ross	Finance, entrepreneurship and growth	Journal of Monetary Economics	43	6,223%
1993	Journal Article	Galor, Oded; Zeira, Joseph	Income Distribution and Macroeconomics	The Review of Economic Studies	35	5,065%
1993	Journal Article	Banerjee, Abhijit V.; Newman, Andrew F.	Occupational Choice and the Process of Development	Journal of Political Economy	34	4,920%
1993	Journal Article	Stock, James H.; Watson, Mark W.	A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems	Econometrica	32	4,631%
1993	book	Garber, Peter M.; Grossman, G. M.	Mexico-us free trade agreement		32	4,631%
1995	Journal Article	Arellano, Manuel; Bover, Olympia	Another look at the instrumental variable estimation of error-components models	Journal of Econometrics	135	13,903%
1995	Journal Article	Grossman, G. M.; Krueger, A. B.	Economic Growth and the Environment	The Quarterly Journal of Economics	102	10,505%
1998	Journal Article	Blundell, Richard; Bond, Stephen	Initial conditions and moment restrictions in dynamic panel data models	Journal of Econometrics	148	11,916%
1998	Journal Article	La Porta, Rafael; Lopez-de-Silanes, Florencio; Shleifer, Andrei; Vishny, Robert W.	Law and Finance	Journal of Political Economy	82	6,602%
2001	Journal Article	Pesaran, M. Hashem; Shin, Yongcheol; Smith, Richard J.	Bounds testing approaches to the analysis of level relationships	Journal of Applied Econometrics	144	9,651%
2001	Journal Article	Antweiler, Werner; Copeland, Brian R; Taylor, M. Scott	Is Free Trade Good for the Environment?	American Economic Review	45	3,016%
2001	Journal Article	Acemoglu, Daron; Robinson, James A	A Theory of Political Transitions	American Economic Review	41	2,748%
2003	Journal Article	Im, Kyung So; Pesaran, M.Hashem; Shin, Yongcheol	Testing for unit roots in heterogeneous panels	Journal of Econometrics	96	5,106%

Table 9
Continued

Year	Item Type	Author	Title	Publication Title	Local Citations	Share of total
2003	Journal Article	Rajan, Raghuram G; Zingales, Luigi	The great reversals: the politics of financial development in the twentieth century	Journal of Financial Economics	71	3,777%
2010	Journal Article	Sadorsky, Perry	The impact of financial development on energy consumption in emerging economies	Energy Policy	98	3,307%
2010	Journal Article	Tamazian, Artur; Bhaskara Rao, B.	Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies	Energy Economics	84	2,835%
2013	Journal Article	Ozturk, Ilhan; Acaravci, Ali	The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey	Energy Economics	89	2,605%
2013	Journal Article	Shahbaz, Muhammad; Kumar Tiwari, Aviral; Ozturk, Ilhan; Farooq, Abdul	Are fluctuations in electricity consumption per capita transitory? Evidence from developed and developing economies	Renewable and Sustainable Energy Reviews	88	2,575%
2013	Journal Article	Shahbaz, Muhammad; Kumar Tiwari, Aviral; Nasir, Muhammad	The effects of financial development, economic growth, coal consumption and trade openness on CO2 emissions in South Africa	Energy Policy	59	1,727%
2013	Journal Article	Islam, Faridul; Shahbaz, Muhammad; Ahmed, Ashraf U.; Alam, Md. Mahmudul	Financial development and energy consumption nexus in Malaysia: A multivariate time series analysis	Economic Modelling	55	1,610%
2015	Journal Article	Omri, Anis; Daly, Saida; Rault, Christophe; Chaibi, Anissa	Financial development, environmental quality, trade and economic growth: What causes what in MENA countries	Energy Economics	56	1,440%
2015	Journal Article	Kasman, Adnan; Duman, Yavuz Selman	CO2 emissions, economic growth, energy consumption, trade and urbanization in new EU member and candidate countries: A panel data analysis	Economic Modelling	45	1,157%
2015	Journal Article	Farhani, Sahbi; Ozturk, Ilhan	Causal relationship between CO2 emissions, real GDP, energy consumption, financial development, trade openness, and urbanization in Tunisia	Environmental Science and Pollution Research	45	1,157%
2020	Journal Article	Le, Thai-Ha; Le, Ha-Chi; Taghizadeh-Hesary, Farhad	Does financial inclusion impact CO2 emissions? Evidence from Asia	Finance Research Letters	40	0,647%

Table 10
Top 10 papers by links from each Co-Citation cluster

Item Type	Publication Year	Authors	Title	Publication Title	Weight <Links>	Weight < Total link strength>	Weight < Citations >
Cluster1: The Environmental Kuznets Curve, Trade-Environment Linkages, and Econometric Applications							
Journal Article	1995	Grossman, G. M.; Krueger, A. B.	Economic Growth and the Environment	The Quarterly Journal of Economics	128	1340	126
Journal Article	2001	Pesaran, M. Hashem; Shin, Yongcheol; Smith, Richard J.	Bounds testing approaches to the analysis of level relationships	Journal of Applied Econometrics	125	1453	167
Journal Article	1969	Granger, C. W. J.	Investigating Causal Relations by Econometric Models and Cross-spectral Methods	Econometrica	125	529	38
Journal Article	1987	Engle, Robert F.; Granger, C. W. J.	Co-Integration and Error Correction: Representation, Estimation, and Testing	Econometrica	121	1025	82
Journal Article	2004	Stern, David I	The Rise and Fall of the Environmental Kuznets Curve	World Development	120	802	50
Journal Article	2001	Antweiler, Werner; Copeland, Brian R; Taylor, M. Scott	Is Free Trade Good for the Environment?	American Economic Review	119	629	45
Journal Article	2013	Shahbaz, Muhammad; Hye, Qazi Muhammad Adnan; Tiwari, Aviral Kumar; Leitão, Nuno Carlos	Economic growth, energy consumption, financial development, international trade and CO2 emissions in Indonesia	Renewable and Sustainable Energy Reviews	118	1215	88
Journal Article	2004	Dinda, Soumyananda	Environmental Kuznets Curve Hypothesis: A Survey	Ecological Economics	118	833	62
Journal Article	1988	Phillips, Peter C. B.; Perron, Pierre	Testing for a unit root in time series regression	Biometrika	117	682	54

Table 10
Continued

Item Type	Publication Year	Authors	Title	Publication Title	Weight <Links>	Weight < Total link strength>	Weight < Citations >
Journal Article	2015	Farhani, Sahbi; Ozturk, Ilhan	Causal relationship between CO2 emissions, real GDP, energy consumption, financial development, trade openness, and urbanization in Tunisia	Environmental Science and Pollution Research	116	693	45
Cluster 2: Financial Development, Growth, Inequality, and Panel Data Econometrics							
Journal Article	1998	Blundell, Richard; Bond, Stephen	Initial conditions and moment restrictions in dynamic panel data models	Journal of Econometrics	132	1066	175
Journal Article	1991	Arellano, Manuel; Bond, Stephen	Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations	The Review of Economic Studies	130	1039	146
Journal Article	1995	Arellano, Manuel; Bover, Olympia	Another look at the instrumental variable estimation of error-components models	Journal of Econometrics	127	962	135
Journal Article	1988	Lucas, Robert E.	On the mechanics of economic development	Journal of Monetary Economics	126	517	67
Journal Article	1997	Levine, Ross	Financial Development and Economic Growth: Views and Agenda	Journal of Economic Literature	124	603	100
Journal Article		Kuznets, Simon	Economic Growth and Income Inequality	The American Economic Review	124	708	61

Table 10
Continued

Item Type	Publication Year	Authors	Title	Publication Title	Weight <Links>	Weight < Total link strength>	Weight < Citations >
Journal Article	1993	King, R. G.; Levine, R.	Finance and Growth: Schumpeter Might Be Right	The Quarterly Journal of Economics	119	556	67
bookSection	2005	Levine, Ross	Chapter 12 Finance and Growth: Theory and Evidence	Handbook of Economic Growth	107	443	57
Journal Article	1982	Hansen, Lars Peter	Large Sample Properties of Generalized Method of Moments Estimators	Econometrica	106	251	32
Journal Article	2005	Windmeijer, Frank	A finite sample correction for the variance of linear efficient two-step GMM estimators	Journal of Econometrics	100	370	39
Cluster 3: Empirical Investigations of the Financial Development-Energy-Environment Nexus in different contexts							
Journal Article	2009	Tamazian, Artur; Chousa, Juan Piñeiro; Vadlamannati, Krishna Chaitanya	Does higher economic and financial development lead to environmental degradation: Evidence from BRIC countries	Energy Policy	131	1907	152
Journal Article	2010	Sadorsky, Perry	The impact of financial development on energy consumption in emerging economies	Energy Policy	130	1416	119
Journal Article	2014	Boutabba, Mohamed Amine	The impact of financial development, income, energy and trade on carbon emissions: Evidence from the Indian economy	Economic Modelling	127	1246	92

Table 10
Continued

Item Type	Publication Year	Authors	Title	Publication Title	Weight <Links>	Weight < Total link strength>	Weight < Citations >
Journal Article	2011	Sadorsky, Perry	Financial development and energy consumption in Central and Eastern European frontier economies	Energy Policy	127	921	79
Journal Article	2010	Tamazian, Artur; Bhaskara Rao, B.	Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies	Energy Economics	126	1392	84
Journal Article	1999	Frankel, Jeffrey A; Romer, David	Does Trade Cause Growth?	American Economic Review	126	676	45
Journal Article	2011	Jalil, Abdul; Feridun, Mete	The impact of growth, energy and financial development on the environment in China: A cointegration analysis	Energy Economics	123	1334	77
Journal Article	2016	Abbasi, Faiza; Riaz, Khalid	CO2 emissions and financial development in an emerging economy: An Augmented VAR approach	Energy Policy	123	826	55
Journal Article	2011	Zhang, Yue-Jun	The impact of financial development on carbon emissions: An empirical analysis in China	Energy Policy	122	1446	116

Table 10
Continued

Item Type	Publication Year	Authors	Title	Publication Title	Weight <Links>	Weight < Total link strength>	Weight < Citations >
Journal Article	2013	Ozturk, Ilhan; Acaravci, Ali	The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey	Energy Economics	121	1475	113
Cluster 4: Econometric Methods							
Journal Article	2007	Pesaran, M. Hashem	A simple panel unit root test in the presence of cross-section dependence	Journal of Applied Econometrics	137	1553	183
Journal Article	2003	Im, Kyung So; Pesaran, M.Hashem; Shin, Yongcheol	Testing for unit roots in heterogeneous panels	Journal of Econometrics	130	1086	96
Journal Article	2002	Levin, Andrew; Lin, Chien-Fu; James Chu, Chia-Shang	Unit root tests in panel data: asymptotic and finite-sample properties	Journal of Econometrics	129	841	73
Journal Article	1999	Pesaran, M. Hashem; Shin, Yongcheol; Smith, Ron P.	Pooled Mean Group Estimation of Dynamic Heterogeneous Panels	Journal of the American Statistical Association	127	712	64
Journal Article	2012	Dumitrescu, Elena-Ivona; Hurlin, Christophe	Testing for Granger non-causality in heterogeneous panels	Economic Modelling	126	886	81
Journal Article	1980	Breusch, T. S.; Pagan, A. R.	The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics	The Review of Economic Studies	124	531	60
Journal Article	1999	Pedroni, Peter	Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors	Oxford Bulletin of Economics and Statistics	124	624	47

Table 10
Continued

Item Type	Publication Year	Authors	Title	Publication Title	Weight <Links>	Weight < Total link strength>	Weight < Citations >
Journal Article	1999	Kao, Chihwa	Spurious regression and residual-based tests for cointegration in panel data	Journal of Econometrics	123	646	55
Journal Article	2006	Pesaran, M. Hashem	Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure	Econometrica	122	573	71
Journal Article	2004	Pedroni, Peter	Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the ppp hypothesis	Econometric Theory	120	838	66

Table 11
Top 10 keywords for each cluster by links

Keyword	weight<Links>	weight<Total link strength>	weight<Occurrences>	score<Avg. pub. year>	score<Avg. citations>	score<Avg. norm. citations>
Cluster 1: Financial Inclusion, Governance, and Socio-Economic Development in Developing Countries						
Financial inclusion	247	1761	375	2022.208	16.8427	0.7936
Developing countries	225	1142	141	2020.844	52.0426	1.2731
Investment	224	1071	126	2021.0794	30.9127	1.1389
Growth	221	1618	236	2020.0381	51.339	1.0242
Institutions	196	917	127	2019.4646	32.2756	0.688
Governance	194	1022	156	2020.6154	21.4744	0.5207
Institutional quality	181	747	95	2022.4	30.1263	1.1479
Banking sector	176	647	111	2019.8919	28.5495	0.8408
Policy	176	439	60	2021.2	32.55	1.195
Performance	162	560	91	2021.6813	35.0879	1.0073
Cluster 2: Sustainable and Environmental Finance: Innovation, Natural Resources, and Development						
Finance	267	2993	298	2021.9094	43.4497	1.3913
China	240	1827	178	2021.9831	58.9157	1.9268

Table 11
Continued

Keyword	weight<Links>	weight<Total link strength>	weight<Occurrences>	score<Avg. pub. year>	score<Avg. citations>	score<Avg. norm. citations>
Renewable energy	227	2435	243	2022.7325	41.4897	1.558
Sustainable development	219	1965	175	2023.0571	22.0743	1.5673
Innovation	218	1192	135	2022.7704	39.1481	1.8819
Economic development	214	1256	127	2021.7008	36.1024	1.4011
Sustainability	206	1174	110	2023.2636	21.3182	1.5796
GMM	198	753	78	2022.3205	36.5128	1.4184
Natural resource	190	1901	145	2023.0138	29.2207	1.4966
CO2	190	1323	114	2022.1491	51.5351	1.5835
Cluster 3: Macroeconomic Dynamics: Financial Development, Energy, Growth, Trade, and CO2 Emissions						
Economic growth	279	6288	725	2021.2703	47.2952	1.2899
Financial development	277	7278	917	2021.1778	49.3533	1.2089
Panel analysis	257	2740	328	2021.2866	47.0579	1.2823
CO2 emissions	249	5107	538	2021.8086	58.5	1.5523
Energy use	238	2857	278	2021.7086	63.3129	1.5042
FDI	219	2135	236	2021.4025	62.9449	1.37
Cointegration analysis	218	1710	168	2020.8929	63.0119	1.2724
Empirical analysis	212	1156	122	2021.4918	65.7213	2.0353
Trade	193	1439	159	2020.7358	79.6289	1.4286
Trade openness	191	1239	130	2021.2615	53.8846	1.4111
Cluster 4: Regional Studies, Specific Financial Systems (e.g., Islamic Finance), and Meta-Research in the FD-ESG Field						
Pakistan	113	273	30	2021.5	52.7333	1.6931
Turkey	87	188	19	2021	48.4211	1.1453
Asean	83	156	20	2023.05	6.2	0.7713
Nigeria	80	160	22	2021.7727	21.5455	1.1236
Export	78	140	17	2022	63.9412	1.1031
Vietnam	68	114	14	2021.6429	67.6429	1.4396
Indonesia	59	89	13	2019.3077	81.2308	1.1654
Malaysia	52	90	14	2020.8571	27.0714	0.8275
Spatiotemporal analysis	49	93	11	2022.9091	44.3636	3.1255
Bibliometric analysis	38	51	11	2023.2727	14.3636	1.0381
Islamic finance	21	27	12	2021.5	14.0833	0.5353

```
(TITLE-ABS-KEY("financial develop*" OR "financial
deepening" OR "financial system develop*" OR
"banking sector develop*" OR "stock market*
develop*" OR "financial inclusion" OR "financial
access" OR "financial sector develop*"))

AND

(TITLE-ABS-KEY("ESG" OR "Environmental, social, and
governance" OR "environmental" OR "social" OR
"governance" OR "corporate responsibility" OR
"corporate governance" OR "corporate social
responsibility" OR "CSR"))

AND

(TITLE-ABS-KEY("impact" OR "role" OR "effect" OR
"influence" OR "determinant" OR "relationship" OR
"performance" OR "outcome" OR "link" OR "nexus"
OR "connection" OR "driver" OR "contribution"))
```

Fig. 7. Search query for Scopus

```
((TS=("financial develop*" OR "financial deepening"
OR "financial system develop*" OR "banking sector
develop*" OR "stock market* develop*" OR "financial
inclusion" OR "financial access" OR "financial sector
develop*")) AND TS=("ESG" OR "environmental,
social, and governance" OR "environmental" OR
"social" OR "governance" OR "corporate
responsibility" OR "corporate governance" OR
"corporate social responsibility" OR "CSR")) AND
TS=("impact" OR "role" OR "effect" OR "influence"
OR "determinant" OR "relationship" OR
"performance" OR "outcome" OR "link" OR "nexus"
OR "connection" OR "driver" OR "contribution")
```

Fig. 8. Search query for WoS

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Data Availability Statement
All the data are included in the manuscript and supplementary files.

Conflicts of Interest
The author declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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