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GREEN INVESTMENT BANKS AND THEIR ROLE IN DEVELOPING THE CIRCULAR ECONOMY: A BIBLIOMETRIC ANALYSIS

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The transition toward a circular economy has increased the importance of green investment banks in financing sustainable projects and supporting low-carbon development. This paper aims to analyze the scientific literature on green investment banks and their contribution to the circular economy through a bibliometric approach. The study is based on a bibliometric analysis of 671 scientific papers indexed in the Scopus database between 1986 and April 2025, processed using VOSviewer software. The results indicate a significant increase in scientific interest in green finance after 2018, emphasizing the growing role of green banking in supporting renewable energy, green technologies, and sustainable investments. The study also highlights key financial mechanisms used by green investment banks, including green lending, green bonds, co-financing instruments, and technical assistance. The originality of the paper lies in combining bibliometric analysis with a conceptual perspective on sustainable finance and circular economy development.

Keywords: *circular economy, green banks, services of green investment banks, green finance, sustainable development, green investments, bibliometric analysis.*

BĂNCILE DE INVESTIȚII VERZI ȘI ROLUL LOR ÎN DEZVOLTAREA ECONOMIEI CIRCULARE: O ANALIZĂ BIBLIOMETRICĂ

Tranziția către economia circulară a crescut importanța băncilor de investiții verzi în finanțarea proiectelor sustenabile și susținerea dezvoltării cu emisii reduse de carbon. Lucrarea își propune să analizeze literatura științifică referitoare la băncile de investiții verzi și contribuția acestora la economia circulară prin intermediul unei abordări bibliometrice. Studiul se bazează pe analiza a 671 de lucrări științifice indexate în baza de date Scopus în perioada 1986 – aprilie 2025, procesate cu ajutorul software-ului VOSviewer. Rezultatele evidențiază o creștere semnificativă a interesului științific pentru finanțarea verde după anul 2018, subliniind rolul tot mai important al băncilor verzi în susținerea energiei regenerabile, tehnologiilor verzi și investițiilor sustenabile. Studiul evidențiază, de asemenea, principalele mecanisme financiare utilizate de băncile de investiții verzi, precum creditele verzi, obligațiunile verzi, cofinanțarea și asistența tehnică.

Cuvinte-cheie: *economie circulară, bănci verzi, servicii ale băncilor de investiții verzi, finanțare verde, dezvoltare durabilă, investiții verzi, analiză bibliometrică.*

JEL Classification G21, G24

Introduction

Today, climate change is affecting every country on every continent and the countries of the world the countries of the world, specifically the 192 ONU member states together with Romania, adopted the renowned 2030 Agenda for Sustainable Development in September 2015 in Paris to combat these climate disturbances. In this context, challenges are also manifesting themselves in the global financial system. The transition to a low-carbon economy (circular economy) may generate new financing opportunities for the financial system.

An IMF report defines green investments as "investments needed to reduce greenhouse gas emissions and emissions of air pollutants without significantly reducing the production and consumption of non-energy goods" [11, p. 336].

Green finance supports both areas with a positive environmental impact and polluting sectors. It is clear that the transition to a new era of green finance is not optional, but mandatory for the entire current financial system. Most specialized studies show that the alignment towards a sustainable economy, supported in particular on green finance offered by green investment banks (GIVs), will lead to a number of improvements on economic activities being the financing of environmentally friendly business investments or sustainable agriculture.

To date, investment banks have focused mainly on emission mitigation projects emphasizing renewable energy and energy efficiency, sending a signal to the market that these investments are delivering a climate-protecting benefit. The choice of sectors and projects to invest in is the responsibility of local policy makers and market participants, who can identify the market needs and objectives that investment banks are designed to serve [9, p. 1-2].

In this context, we set as the main objective of this study to conduct a bibliometric analysis of the concepts of green finance and sustainable banking, as well as to analyze the services of green investment banks and their contribution to the circular economy. Thus the paper is structured in several parts: introduction, methodology used, presentation of results and obviously the final conclusions.

1. The role of green investment banks in the development of the circular economy

Banks are considered as important financial intermediaries in the economy, which collect liquidity from surplus surplus units and distribute it to those with shortages. Thus banks, through their financial activities, support economic development to progress in a stable way. Thus in order to meet the sustainable development goals, banking institutions need to get involved in green activities [10].

Banks have an important role in financing the transition to a new zero-carbon economy. To answer the key questions of whether banks are succeeding in meeting the goals of the Paris Agreement or how much of banks' global profits/revenues are concentrated and generated by sustainable lending, investing or underwriting, we consulted leading sustainable economy research organization Corporate Knights (CK). The term sustainable banking is increasingly being coined and used in the literature. A contemporary sustainable bank fulfills both environmental, sustainability and governance (ESG) principles, promoting sustainable development, and principles of ethical conduct, as an example can serve: transparency of management towards the public and transparency of banking products in the context of green risks. Thus, this abstraction characterizes the market, implying that the sustainability of sustainable investments made by profit-seeking investors increasingly exists on the large scale of the circular economy [6].

The following ranking focuses mainly on the highest sustainable revenue ratio in the year 2023 of the world's sustainable banks. According to statistics presented by the Net-Zero Banking Alliance (NZBA), 113 banks were eligible in 2023, 22 more than in 2022. The number of banks for which the CK was able to calculate a non-zero sustainable revenue ratio (eng. non-zero sustainable revenue ratio) increased from 60% to 87% between 2022 and 2023. These 87 banks collectively earned $53 billion in sustainable revenues from their loan portfolios, investment portfolios, and underwriting and advisory services over the period [4].

Table 1. Ranking of green banks by level of sustainable banking revenues in 2023, mln $

Ranking	Bank	Country	Sustainable income rate %	Total sustainable revenues	Total sustainable credit portfolio
1	Vancity	Canada	24.3	189	5
2	Procredit Holding	Germany	22.2	124	1898
3	Triodos Bank	Netherlands	21.3	123	4541
4	Amalgamated Bank	SUA	18.8	53	1482
5	Turkiye Sinai Kalkinma Bankasi	Turkey	17.5	382	5268
6	The City Bank	Bangladesh	16.1	126	1744
7	Banco Pichincha	Ecuador	15.8	230	2044
8	SpareBank 1 Østlande	Norway	14.9	68	2088
9	UOB	Singapore	12.8	1822	44,676
10	Nykredit	Denmark	12.2	344	16,140

Source: Adapted from [4]

According to Table 1, the world's strongest and best-performing sustainable bank is Canada's Vancity Bank, with a sustainable revenue ratio of 24.3% and a loan portfolio of around $5 million. The ranking is followed by Procredit Holding (22.2%) in Germany and Triodos Bank (21.3%) in the Netherlands.

Once in operation, green banks offer a wide range of innovative financial instruments, engaging in different financing techniques such as lending, co-investments, offering financing products such as loans, leasing, credit facilities, carrying out market development activities, technical assistance, design and delivery of key products, data collection, analysis and reporting, etc. Green banks do not only offer services related to financing, design or access to information, but also provide technical assistance related services to banks, developers and clients to provide guidance and market information [2, 8]. Green Banks facilitate private investment into domestic low-carbon, climate-resilient infrastructure [7].

2. Mechanisms through which green investment banks support the circular economy

Green investment banks play an essential role in supporting the transition towards a circular economy by mobilizing financial resources for environmentally sustainable projects and by reducing investment risks associated with green technologies [5]. Unlike traditional financial institutions, green investment banks are specifically oriented toward financing projects with positive environmental externalities, particularly in sectors such as renewable energy, waste management, recycling infrastructure, and energy efficiency [9].

One of the main mechanisms through which green investment banks contribute to the circular economy is green lending. Through preferential loans and green credit facilities, these institutions finance projects focused on resource efficiency, clean production technologies, sustainable infrastructure, and circular business models aimed at reducing waste and extending product life cycles [8]. Green credit policies also encourage companies to adopt environmentally responsible practices and sustainable production processes [12].

Another important mechanism is represented by public-private partnerships and co-financing structures. Green investment banks often collaborate with governments, private investors, and international financial institutions in order to attract additional capital for sustainable investments. By using risk-sharing instruments, guarantees, and blended finance mechanisms, green banks help reduce the financial uncertainty associated with innovative environmental projects [3]. This approach facilitates private sector participation in financing circular economy initiatives that might otherwise face difficulties in obtaining funding from conventional banks.

Green bonds represent another strategic financial instrument used to support the transition toward a circular economy. According to [1], green bonds are increasingly used to finance renewable energy projects, sustainable transport systems, water management infrastructure, and recycling facilities. These instruments contribute to the mobilization of long-term capital necessary for achieving climate neutrality and sustainable economic growth.

In addition to financing activities, green investment banks also provide technical assistance, consultancy services, and support for innovation and research in sustainable technologies [8]. Through these activities, green investment banks act not only as financial intermediaries but also as strategic actors facilitating the transition toward a low-carbon and circular economy.

3. Research methodology

The research methodology combines bibliometric analysis with a qualitative interpretation of the scientific literature regarding green investment banks and the circular economy. Bibliometric analysis was selected because it allows the identification of publication trends, influential authors, dominant thematic clusters, and the evolution of scientific interest in the field over time. In addition, the study includes a conceptual analysis of the mechanisms through which green investment banks support circular economy initiatives, thus complementing the quantitative dimension of the research. The research process involved several stages. First, scientific papers indexed in the Scopus database were identified using the keywords "green banks and green investments" and "green banks and circular economy". The analysis covers the period between 1986 and April 2025. Subsequently, exclusion criteria were applied in order to eliminate editorial materials and non-relevant subject categories. The selected data were exported in RIS format

and processed using the VOSviewer software, which enabled the visualization of co-authorship networks, keyword frequency, thematic clusters, and publication dynamics.

The interpretation of the bibliometric results focused on identifying the main research directions and understanding how green investment banks contribute to financing sustainable and circular economic activities. Therefore, the methodology combines quantitative bibliometric techniques with qualitative interpretation in order to provide a more comprehensive perspective on the analyzed topic. In this endeavor, we were able to collect data using the Scopus international database where the search protocol applied was as follows:

Table 2. Grouping of Scopus search results

Database	Scopus	Results
Topic	„green banks and green investments" și „green banks and circular economy"	**771**
Period of analysis	1986 – april 2025	
Published works	All types of documents	
Application of exclusion criteria		**671**

Source: own elaboration using Scopus database

This resulted in 771 published scientific papers on green finance and sustainable banking, as well as green investment banks' services and their contribution to the circular economy, but the following exclusion criteria were applied: the removal of erratum and editorial papers, and the restriction of Scopus research categories to the following categories: Economics, Econometrics and Finance; Environmental Science; Social Sciences; Business, Management and Accounting; Energy; Mathematics. Thus, we obtained 671 papers published between 1986 and April 2025. The data were exported from the Scopus platform with the EndNote (RIS) option and further processed in the VoSViewer program to perform a keyword and author-based biliometric analysis.

4. Results and discussions

In order to create a profile of the topic green finance and sustainable banking, as well as the services of green investment banks and their contribution to the circular economy, we have presented below the evolution of publications according to the data obtained by applying the search protocol mentioned in the previous section on Scopus.

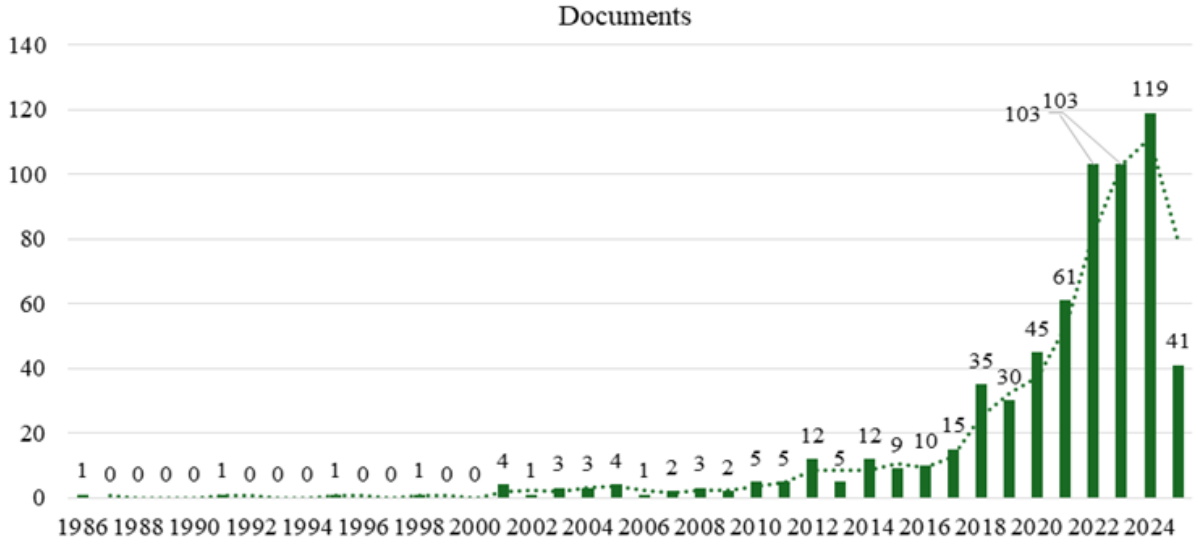

Figure 1: Evolution of papers by year of publication in Scopus

Source: own elaboration using Scopus database

Figure no. 1 shows an oscillating evolution of the papers published between 1986 and April 2025, but with considerable growth points between 2018 and 2024 and in 2024 the highest number of papers is recorded when 119 papers were published and indexed, which shows the increased interest of researchers on this topic during that period.

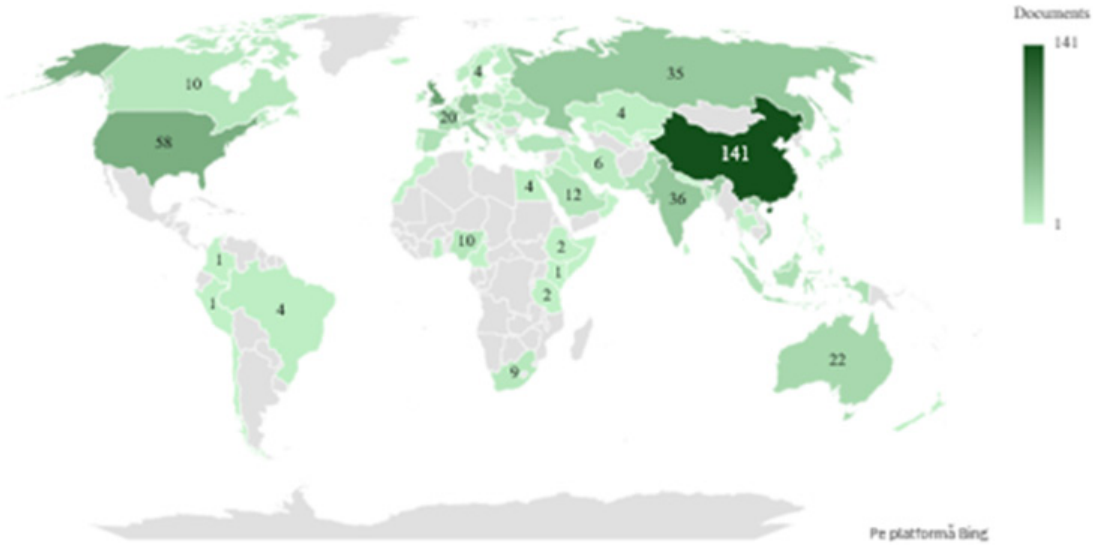

Figure 2: Number of scientific research published globally based on Scopus data
Source: own elaboration using Microsoft 365 software (2024)

In terms of country analysis on the Scopus database, it can be seen in Figure 2 that China ranks first with 141 papers, then the second place is occupied by the United Kingdom with 70 papers, followed by the third and fourth place occupied by the USA (with 58 scientific papers) and Germany (with 38 scientific papers). It is worth noting that Romania also appears in 31st place with 7 papers, which shows that our country is showing an interest in this topic. Based on the data downloaded from the Scopus platform and with the help of the VOSviewer software, we performed a quantitative mapping of the thematic of green finance and sustainable banking, as well as of green investment banks' services and their contribution to the circular economy both at global and regional level through a bibliometric analysis of publications to highlight the importance of this topic.

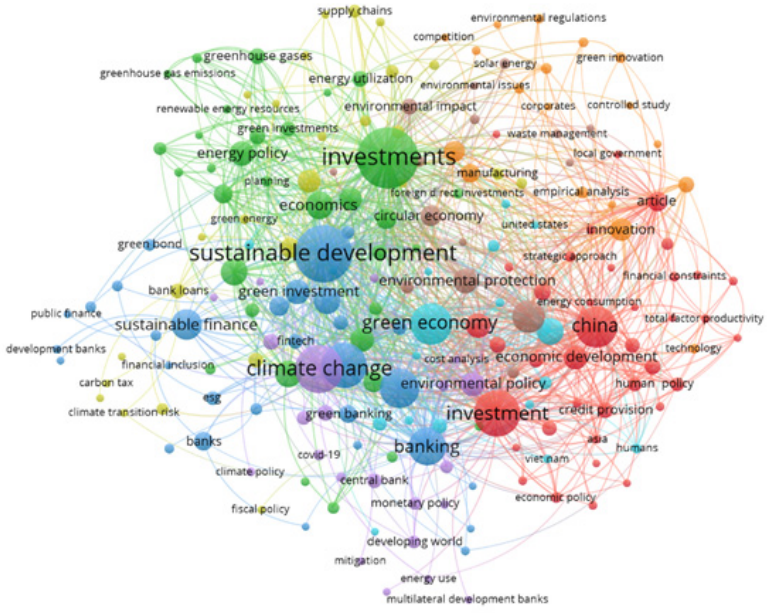

Figure 3. Keyword frequency network for the theme green banks and green investment, and green investment banks' services and their contribution to the circular economy on Scopus (1986- April 2025)
Source: own elaboration using VOSviewer software

From Figure 3 we observe that the network groups the terms into eight clusters according to their relevance, where their frequency is highlighted by the size of the circles. The first and largest cluster comprises 38 terms (highlighted by red color) and is focused on the concept of investment, including terms such as green credit policy, credit insurance, economic development, world bank and others. The second cluster, consisting of 34 items, brings to the fore the concepts of green investment, alternative energy, globalization, developing countries, energy efficiency, gas emission, green growth and others. The third cluster (dark blue color in Figure 3) comprises 30 items and emphasizes sustainable development along with terms such as green banking, financial institutions, green finance, green finance, green bonds, Fintech, public finance, sustainability, etc. The fourth cluster (yellow color in Figure 3) is composed of 26 items including the following terms: bank lending, costs, financial stability, green credits, green support factor, etc. The fifth cluster (purple color in Figure 3) is circumscribed around 22 items including: central bank, European Union, monetary policy, financial market, financing, etc. The sixth cluster consists of 18 terms and is focused on the concept of green economy, including terms such as gross domestic product, financial institutions, inflation, clean energy, policy making, etc. The penultimate cluster (orange color in Figure 3) contains 18 items such as: green innovations, green technology, environmental regulation, government, research and development, etc.

The eighth and last cluster in this analysis (highlighted in brown in Figure 3) comprises 15 terms such as: circular economy, European green deal, environmental economics, global warming, recycling, sustainable development goal and others.

Figure no. 4. Authors' network on the analyzed topic
Source: own elaboration using VOSviewer software

In what follows, in Figure no. 4, we also analyzed the links between authors where articles on green banks and green investing have been published, as well as the services of green investment banks and their contribution to the circular economy on Scopus, using the co-authorship visualization function of the VOSviewer software. On the basis of the 671 scientific articles on the Scopus platform, a total of 1586 different authors are identified.

Table 3. Top 10 most cited scientific papers on the topic green banks and green investments, as well as green investment banks' services and their contribution to the circular economy on Scopus (1986- April 2025)

Autors	Name of paper	Number of citations
Li (2018)	China's manufacturing locus in 2025: With a comparison of "Made-in-China 2025" and "Industry 4.0"	769
Schilling and Logan (2008)	Greening the rust belt: A green infrastructure model for right sizing America's shrinking cities	603
Battiston et al. (2017)	A climate stress-test of the financial system	500
Campiglio (2016)	Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy	456
He et al. (2019)	Can green financial development promote renewable energy investment efficiency? A consideration of bank credit	404
Ganda (2019)	The impact of innovation and technology investments on carbon emissions in selected organisation for economic Co-operation and development countries	394
Hepburn et al. (2020)	Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?	390
Wen, Lee & Zhou (2021)	Green credit policy, credit allocation efficiency and upgrade of energy-intensive enterprises	381
Dafermos, Nikolaidi & Galanis (2018)	Climate Change, Financial Stability and Monetary Policy	368
Khan et al. (2020)	Measuring the impact of renewable energy, public health expenditure, logistics, and environmental performance on sustainable economic growth	337

Source: own development using the Scopus database

Table 3 shows the top 10 articles that have the most citations of academic papers that have addressed the topic of green finance and sustainable banking, as well as green investment banks' services and their contribution to the circular economy on Scopus. The paper by Li (2018) has the most citations with 769 citations, followed by the paper by Schilling and Logan (2008) with 603 citations.

Conclusions

For most countries in the world, implementing climate policies and stimulating green finance is an important economic opportunity. Facilitating green finance aims to avoid the scenario of a slower transition to a low-carbon economy materializing. Supporting green finance could increase access to finance for businesses for green/sustainable projects. Analysis by country shows that China is particularly interested in studying this topic, followed by England and the USA. Romania appears in 31st place with 7 papers, which shows that our country shows little interest in this topic.

The funding capacity of green investment banks will be essential to promote a socially decisive agenda, and green investment banks are potential strongholds to support public interest. A green investment bank will need to be financially sustainable, ensuring sufficient revenues to fulfill its mandate, while at the same time aiming to enable a green and equitable transition and democratic decision-making.

Despite the relevance of the obtained results, this study has several limitations. The bibliometric analysis was conducted exclusively using the Scopus database, which may exclude relevant publications indexed in

other international databases such as Web of Science or Google Scholar. In addition, the analysis focused primarily on publication trends and thematic structures without investigating empirical case studies regarding the practical performance of green investment banks.

Future research directions may include comparative analyses between different national models of green investment banking, empirical investigations regarding the financial performance of green projects financed by green banks, and the evaluation of the impact of green financial instruments on the implementation of circular economy objectives. Further studies could also explore the role of digitalization, fintech solutions, and ESG regulations in strengthening the relationship between sustainable finance and the circular economy.

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