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CIRCULAR ECONOMY FUNDING AND ITS POTENTIAL IMPACT ON FINANCIAL PERFORMANCE: A BIBLIOGRAPHIC REVIEW

Abstract: Circular Economy initiatives have created new challenges and opportunities for companies. Literature on the Circular Economy Funding is scarce as well as it is for Circular Economy impact on Financial Performance.

Understanding the scientific knowledge about the connection of the Circular Economy with these two different concepts is important to advance theory and identify the literature gap in this field. To achieve this, we used a bibliometric analysis tool: R Bibliometrix. Relevant literature up to 2022 is collected using the Web of Science database. First, this study intends to analyze the literature from multiple aspects, including journals, keywords, and countries, to define the characteristics of publications. Then, a bibliographic factorial analysis is conducted. Despite the high contribution of present publications, this is a recent area in the literature, so updating scientific production is a relevant contribution.

Keywords: Circular Economy; Sustainability; Public Funding; Financial Performance; Bibliometric Analysis; bibliometrix.

1. INTRODUCTION

The greater the circularity of materials in product chains, the smaller the natural resources needed to produce new materials, so, avoiding material production benefits the environment. The most of studies on circular economy traditionally focus on the environmental aspect, however, the main issue, regarding the industrial adoption of these initiatives is the financial viability (Bockholt et al., 2020).

Knowing that funding eases the challenges faced by companies in a highly competitive environment, incentivizes their growth, and bolsters the region in which they operate (Brzakova & Pridalova, 2016), turns out to be a crucial instrument for promoting the adoption of these policies and initiatives (Wang et al., 2014). Thus, on the other hand, is pertinent to study the potential relationship between the concepts of funding and the circular economy but, on the other hand, comprehending the benefits and potential impacts of the circular economy on financial performance is also crucial. The circular economy might optimize the use of resources by extending their lifespan, reducing waste, and promoting closed-loop systems that minimize the extraction of new raw materials, leading to more resilient and stable economic systems. Given that the circular economy has become an area of increasing concern, the amount of academic research on this topic has increased significantly in recent years, becoming increasingly difficult to keep up with all the latest studies. So, the present study aims to map the research trends of the circular economy in terms of funding and financial performance based on a bibliometric approach. Specifically, the objectives of this article are to answer the following questions:

1. Which countries have contributed the most to this field research?
2. How do the countries relate to and cooperate with each other in academic research?
3. What are the most journals and keywords that are worth attention?
4. What are the research hotspots in this field?

By contributing to the systematization of the existing literature in the field of circular economy, it is hoped that this article can provide an "overview" of this topic for future studies and help researchers to identify topics that deserve further

analysis. The study is articulated as follows. Section 2 presents a brief theoretical framework of the relationship established and studied between the circular economy, funding and financial performance. Section 3 describes the research methods we used to collect and analyze the data. Section 4 illustrates the main results of the bibliometric analysis and Section 5 presents the conclusions and implications for research.

2. LITERATURE REVIEW

2.1. Funding and Financial Performance in Circular Economy

The concept of circular economy has considerable attention from both academic scholars and practitioners, as it is viewed as a practical means for businesses to implement the widely-discussed objective of sustainable development (Ghisellini et al., 2016).

One of the prevalent definitions attributed to the circular economy pertains to an industrial system that is restorative or regenerative in both intention and design. This approach eschews the traditional paradigm of 'end of life' in favor of a restorative approach. Additionally, the circular economy emphasizes the use of renewable energy, disapproves of toxic chemicals that may impede reuse, and aims to eradicate waste through an enhanced focus on material design, products, systems, and business models (Kirchherr et al., 2017).

A circular economy involves a fundamental shift from the traditional linear economic model towards a circular system. The primary objective of this transition is to decrease the dependency on raw materials and energy and mitigate the adverse environmental impact of production and consumption. The key goals of a circular economy include minimizing the flow of materials, improving energy efficiency, and ensuring the sustainable renewal of natural and social capital across various stages. By adopting a circular economy, the production process requires fewer resources to maintain a steady level of output, either through a reduction in resource consumption or the substitution of virgin materials with recycled ones (Scarpellini et al., 2020).

The contemporary literature underscores that the circular economy model accentuates the financial gains for companies and the reduction of resource consumption (Geissdoerfer et al., 2017). There is evidence that the adoption of circular economy initiatives can have a positive impact on financial performance (Yu et al., 2022). Similarly, Kwarteng et al. (2022) shows that the implementation of circular economies policies, such as the reducing, reusing, recycling, recovery, and restoration of resources used in manufacturing, distribution, and consumption processes, contributes to improved financial efficiency.

Being circular economy contribute to financial performance, funding is presented as one big catalyst. Capital-intensive industries can benefit from the adoption of circular economy principles in achieving long-term sustainability. However, the high initial costs associated with implementing clean and lean production practices and technologies present a significant financial barrier for companies. The lack of financial resources and funding is considered the primary impediment for these industries in transitioning towards a circular model (Khan & Ali, 2022).

According to Triguero et al. (2022), the adoption of eco-innovation practices can be positively impacted by funding sources such as grants, guarantees, or loans. External factors, such as government support, are also critical determinants in the successful transition toward a circular economy model.

3. METHODOLOGY

Bibliometric analysis is a systematic method that involves quantifying and examining the patterns of scientific publications, citations, and collaborations within a particular field or research area. In recent years, various bibliometric software tools have been developed to aid researchers in analyzing and visualizing bibliometric data. In this study, we used the Bibliometrix R package as scientometric software tool (Aria and Currurullo, 2017) to analyze the research output, citation patterns, and collaboration networks in the field of circular economy funding and its impact on Financial Performance. The primary objective of this analysis is to acquire a comprehensive understanding of the research landscape in this domain.

3.1. Data Collection

To obtain the publications' dataset we used the Web of Science (WOS), a powerful research database that offers access to a vast collection of scientific literature. It is operated by Clarivate Analytics and provides advanced search capabilities that allow users to conduct keyword searches and export the returned records. Inside WOS, we selected de following databases: Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), and Emerging Sources Citation Index (ESCI).

We queried the platform with the following keywords, under the fields: title, abstract or keywords: (“Circular Economy” AND “Funding”) OR (“Circular Economy” AND “Financial Performance”) OR (“Circular Business Model” AND “Funding”) OR (“Circular Business Model” AND “Financial Performance”). The search is limited to documents written in English in the form of articles, review articles and proceeding papers. Documents published in the incomplete year of 2023 were not included. The platform WOS allows the user to select documents by categories, reducing the probability of out of context document integration. The categories select were: Environment Sciences, Green Sustainable science Technology, Environmental Studies, Engineering Environmental, Management, Business, Economics and Business Finance. Table 1 presents the applied search criteria and the number of documents that remained in the process of the conducted analysis.

Table 1 - Search criteria in WOS platform

Search Criterias	Entry	Results
Search field	Article title, Abstract, Keywords	-
Keywords and Boolean terms	“Circular Economy” AND “Funding” OR “Financial Performance” “Circular Business Model” AND “Funding” OR “Financial Performance”	156
Filter 1	Publication year: 2023 (NOT)	147
Filter 2	Document types: Articles, Review articles, Proceeding Paper	144
Filter 3	Language: English	140
Filter 4	Web of Science Categories: Environment Sciences, Green Sustainable science Technology, Environmental Studies, Engineering Environmental, Management, Business, Economics and Business Finance.	112

The next step involved the reading of the abstracts of the 112 resulting scientific publications. Only the articles approaching the scope of the study were selected. As a result, a total of 103 documents were considered relevant to the research.

The results were exported in plain text format from the WOS. Plain text format provides a convenient way to store and process bibliographic data outside of the WOS platform. It is a simple, human-readable format that can be easily imported into various software tools and programming languages for further analysis. In this case, the extracted dataset was imported into the R tool bibliometrix (Aria & Cuccurullo, 2017), a user-friendly software capable of identifying emerging trends, influential authors, and key research topics. Its flexible and customizable nature makes it a valuable tool for bibliometric analysis.

3.2. Data Analysis

Our analysis focused on scientific publications related to annual, country, and source production. By studying the annual production, we gained insight into the development of the theme over time. Similarly, by examining country production, we were able to assess the global reach of the theme. Finally, our investigation into source production provided us with valuable information about the top publishers in this field.

The analysis of the most frequently used words is a crucial aspect of this bibliometric study, as it enables us to gain a better understanding of the prevalent themes, concepts, and topics within the research field. By examining the most commonly used words, we can identify the key topics that are frequently discussed in the literature on the Circular Economy together with Funding and Financial Performance.

Conceptual Structure represents relations among concepts or words in a set of publications. Factorial Analysis was the chosen method for conceptual structure study, as it allows for data dimension reduction, and it is useful to identify subfields and clusters of topics. We have used Multiple Correspondence Analysis since it permits us to represent a summary of the relationship existing between a set of categorical variables forming multiple contingency tables (Di Franco, 2016), we opted to represent these values in a dendrogram diagram.

4. FINDINGS

4.1. Circular Economy relationship with Funding and Financial Performance

This bibliometric analysis presents an overview of 103 documents sourced from 52 journals, books, and other scholarly sources between 2012 and 2022. The analysis examines the growth rate, age, and citation impact of these documents, as well as the keywords, authors, and collaboration patterns present in the literature. Figure 1 presents the main metrics.

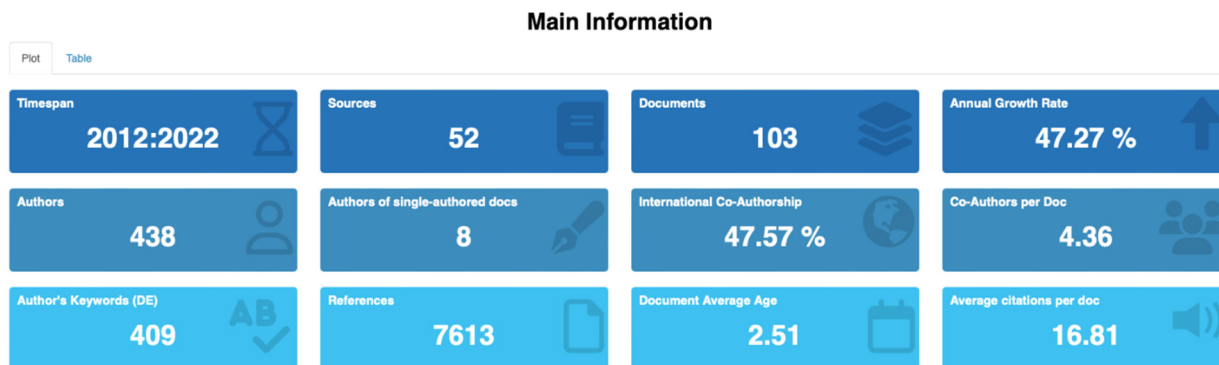


Figure 1 - Main Information

4.1.1. Annual Scientific Production

The Figure 2 shows the trend in quantity of documents published between 2012 and 2022. A slowly growing trend from 2012 until 2020, with some variations, later, in 2022 it highly surged. It is a recent topic, with growing interest and study, the graph suggests that the relationship of the Circular economy with Funding and Financial performance is emerging at a notoriously high rate. Of the total of 103 analyzed documents 48 of them were published just in 2022, nearly 47%.

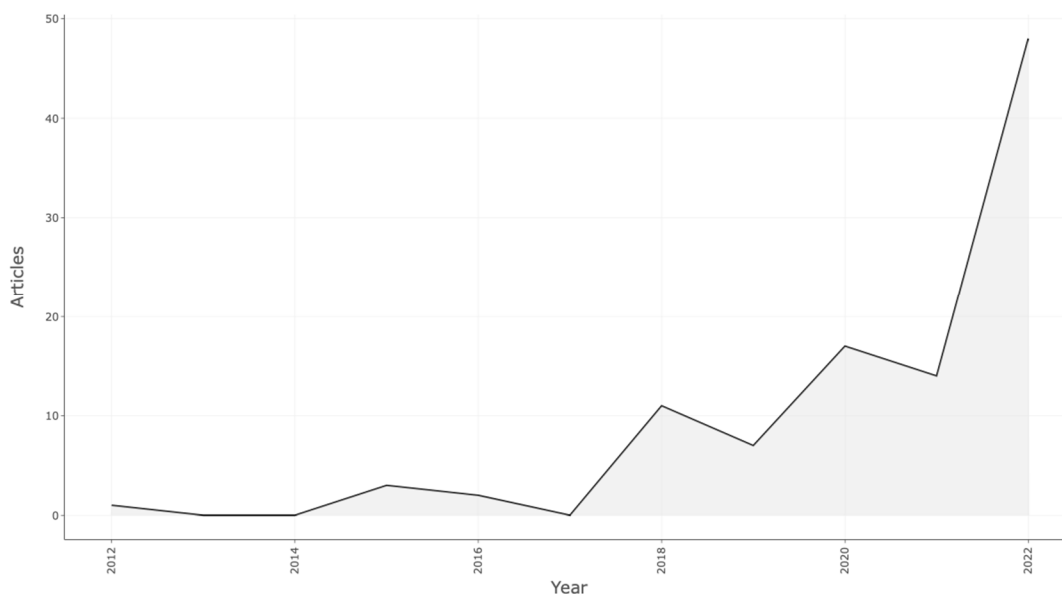


Figure 2 The annual number of publications

4.1.2. Scientific Production by Country

This analysis indicates the number of documents published by each country. This measure requires at least one author from a particular country, so the document is associated with the country. Figure 3 represents the distribution of the most productive countries, where the darkest blue areas are the most productive ones. The United Kingdom leads with 37 documents and 36% of the global scientific production, followed by China, with 33 documents (32%), and Italy with 25 documents (24%).

Figure 4 represents the country's collaboration in scientific production. The pink bar represents Multiple Country Publications (MCP) and the cyan bar represents Single Country Publications (SCP). MCP allows researchers to combine different countries' expertise and resources to develop complex research questions and produce high-quality research

outputs. Between the group of countries that published the most, we can highlight Romania, Spain, and Sweden with full SCP. We can also find Countries that only have MCP, being Netherlands, Austria, and France.

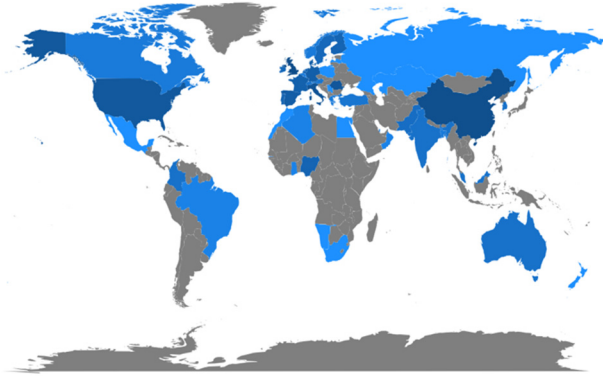


Figure 3 Scientific Production Global Map

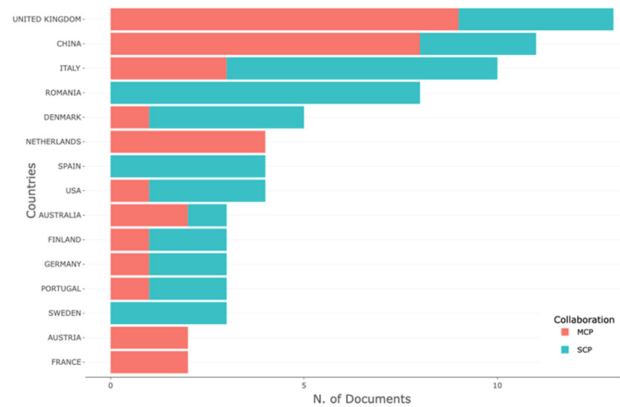


Figure 4 Collaborations by Country

4.1.3. Scientific Production by Source

The source h-index, Figure 5, is calculated based on the number of papers published by the source and the number of citations that each paper has received. To obtain the h-index, a source's publications are ranked in descending order of the number of citations they have received. The h-index is then defined as the highest number of h such that the researcher has h publications that have each received at least h citations.

The h-index can be used as a metric to evaluate the impact of different sources on publishing in the Circular Economy together with Funding or Financial Impact. In this field *Journal of Cleaner Production* leads, followed by *Sustainability* and *Business Strategy and the Environment*, respectively.

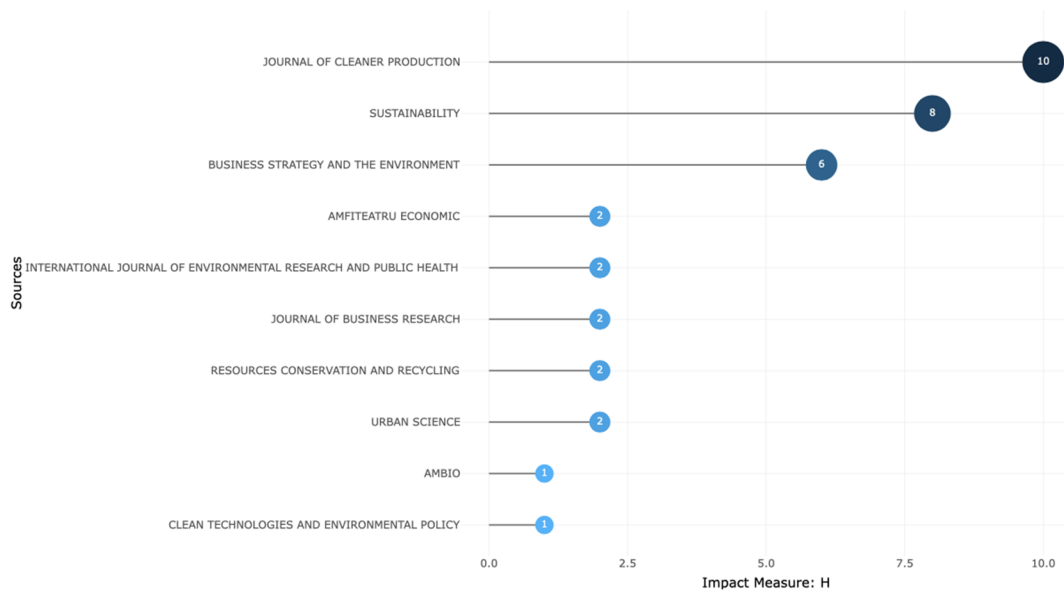


Figure 5 Most Relevant Sources

4.1.4. Most Frequent Words

The most frequent word analysis, Figure 6, is based on the keywords plus the recorded documents. Keywords Plus is generated by a computer algorithm, rather than being assigned by authors or indexers. It provides a way to expand a search and retrieve articles that are related to the original query (author's keywords) but may not include the exact terms used in the search.

The concepts with the highest frequency are "circular economy" and "financial performance", which are no surprise once they are part of the search query, so they naturally surged as frequently addressed topics.

Apart from these two concepts, others may indicate a strong connection with the researched field, and a potential key to further studies. Management and Impact are the most recurrent words, with 18 occurrences, followed by Barriers with 15

occurrences, Sustainability appearing 14 times, and Corporate Social Responsibility and Supply Chain Management both with 11 occurrences.



Figure 6 Most Frequent Words

4.2. Factorial Analysis

We performed an analysis of the keywords plus using a Factorial Approach, which enables the reduction of data dimensionality and representation of the data in a low-dimensional space. The dendrogram was chosen as the graphical representation of the factorial analysis, as depicted in Fig 7. The height in the dendrogram represents the distance or proximity between words or clusters of words, signifying the degree of mutual essence between them. The closer the words appear, the larger the proportion of documents that discuss them together. We identify closely situated words as similar words or words that contribute to a common topic.

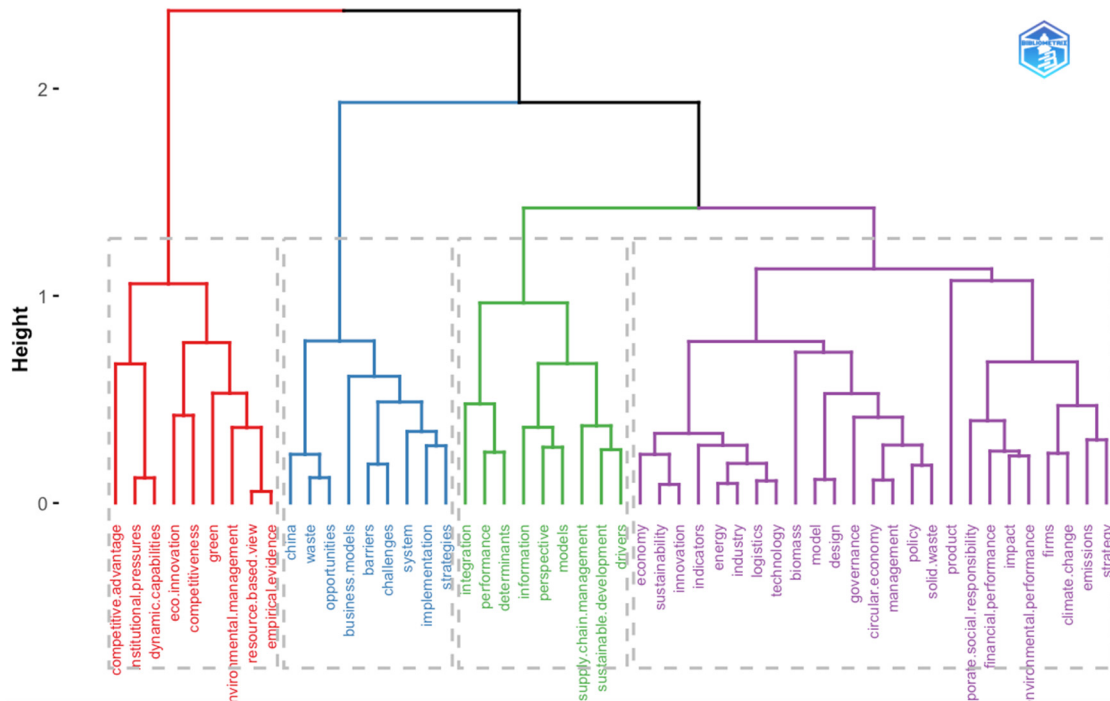


Figure 7 Topic Dendrogram (Factorial Analysis)

The four principal clusters that we have identified are conveniently color-coded. The interpretation of the meaning of these clusters was primarily based on a review of the documents analyzed in this study. However, we recognize that this interpretation may not be entirely unquestionable, and other interpretations may be possible. As such, the interpretation provided below is presented with the fundamentals of the literature supporting it.

The red cluster compiles keywords related to *competitiveness*, *environmental management*, and *ecological innovation*. Literature shows that competitiveness is a major driver to engage in green activities and stimulate environmental management initiatives (Chatzistamoulou & Tyllianakis, 2022).

The blue cluster gathers topics such as *business models*, *strategies*, *challenges*, and *opportunities*. The implementation of circular economy business models has become a subject of interest in recent literature, with a focus on the challenges, such as the high investment needed and lack of governmental support, and also on the opportunities, as firm growth and economic and environmental benefits (Demirel & Danisman, 2019).

The green cluster includes words such as *supply chain management* and *information*. A strong connection between these concepts is referred to in literature, S. Khan et al. (2021) defends that the possession of informational advantages can provide firms with a valuable means to evaluate their circular performance across various supply chain processes, particularly in comparison to their competitors.

Last cluster, represented in purple, groups some of the *macro disciplines* and *environmental* and *financial performance*. This cluster indicates how multidisciplinary and embracing environmental and financial performance is, appearing in the literature related to various fields of knowledge.

From the analysis carried out, it is also notorious the proximity of these concepts: *Circular Economy*, *Management*, and *Solid Waste*. The use of virgin materials can be substituted by industrial and consumer wastes, thereby effectively mitigating the inefficient and hazardous disposal of such wastes. The solid waste consists of roughly 85% biomass and other combustible substances that serve as a blend of energy-rich fuels highly contributing to a Circular Economy (Fiksel et al., 2021).

Another strong connection is shown between *financial performance* and *environmental performance*. Authors like Scarpellini et al., (2020) show us that Circular Economy related activities introduced by businesses improve the environmental and financial performance of firms in a CE framework. The overall literature reveals a close positive correlation between these concepts.

5. CONCLUSION

We conducted a bibliometric analysis to identify relevant literature up to 2022 and analyzed the characteristics of the publications from various aspects, including journals, keywords, and countries. Literature defines the concept of circular economy and its potential benefits for the environment, including the use of renewable energy and the reduction of waste and resource consumption. Analyzed literature also highlights the importance of funding for promoting circular economy initiatives and the positive impact that circular economy has on financial performance. By the employed conceptual structure study, four principal clusters have been identified in the literature through factorial analysis. These clusters

represent topics that are frequently discussed within the same documents. Notably, a strong positive correlation between financial and environmental performance has been observed in the literature.

Overall, the article concludes that circular economy is a recent area in the literature, and updating scientific production knowledge is a relevant contribution to the field.

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