


Economic complexity and the Circular Economy: Impacts, challenges and paths to circularity

Complejidad económica y la Economía Circular: impactos, desafíos y caminos hacia la circularidad

Complexidade econômica e a Economia Circular: impactos, desafios e caminhos para a circularidade

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ABSTRACT

This research aims to understand the relationship between economic complexity and the circular economy in different scenarios through a comprehensive literature review. The results emphasize the crucial role of economic complexity in sustainable development and the effectiveness of the circular economy. Studies indicate the importance of policies and strategies to promote the transition to more circular practices, considering the diversity of national contexts and encouraging innovation and collaboration between sectors. The analysis reveals that countries with higher economic complexity tend to have more robust frameworks for implementing circular economy principles. This includes advanced technological capabilities, diversified industrial bases, and strong insti-

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tutional support. By examining various case studies, the research highlights successful examples of circular economy initiatives driven by economic complexity. These initiatives often result in increased resource efficiency, reduced environmental impact, and enhanced economic resilience. Moreover, the findings suggest that fostering economic complexity can accelerate the adoption of circular economy practices. This requires targeted policy interventions, investment in education and research, and the promotion of public-private partnerships. Encouraging a culture of continuous learning and adaptation is also essential to navigate the challenges and opportunities presented by the circular economy. Overall, the study underscores the interconnectedness of economic complexity and circular economy as pivotal elements in achieving sustainable development goals.

Keywords: Economic Complexity, Circular Economy, Sustainable Development.

RESUMEN

Esta investigación tiene como objetivo comprender la relación entre la complejidad económica y la economía circular en diferentes escenarios, a través de una revisión exhaustiva de la literatura. Los resultados destacan el papel crucial de la complejidad económica en el desarrollo sostenible y en la efectividad de la economía circular. Los estudios señalan la importancia de políticas y estrategias que promuevan la transición hacia prácticas más circulares, considerando la diversidad de los contextos nacionales y fomentando la innovación y la colaboración entre sectores. El análisis revela que los países con mayor complejidad económica tienden a contar con marcos más sólidos para implementar los principios de la economía circular. Esto incluye capacidades tecnológicas avanzadas, bases industriales diversificadas y un fuerte apoyo institucional. Al examinar diversos estudios de caso, la investigación destaca ejemplos exitosos de iniciativas de economía circular impulsadas por la complejidad económica. Estas iniciativas suelen resultar en una mayor eficiencia en el uso de recursos, una reducción del impacto ambiental y una mayor resiliencia económica. Además, los hallazgos sugieren que fomentar la complejidad económica puede acelerar la adopción de prácticas circulares. Para ello, se requieren intervenciones políticas específicas, inversión en educación e investigación, y la promoción de alianzas público-privadas. Fomentar una cultura de aprendizaje continuo y adaptación también es esencial para afrontar los desafíos y aprovechar las oportunidades que ofrece la economía circular. En general, el estudio subraya la interconexión entre la complejidad económica y la economía circular como elementos clave para alcanzar los objetivos de desarrollo sostenible.

Palabras clave: Complejidad económica, economía circular, desarrollo sostenible.

RESUMO

Esta pesquisa tem como objetivo compreender a relação entre complexidade econômica e economia circular em diferentes cenários, por meio de uma revisão abrangente da literatura. Os resultados enfatizam o papel crucial da complexidade econômica no desenvolvimento sustentável e na efetividade da economia circular. Os estudos indicam a importância de políticas e estratégias para promover a transição para práticas mais circulares, considerando a diversidade dos contextos nacionais e incentivando a inovação e a colaboração entre setores. A análise revela que países com maior complexidade econômica tendem a possuir estruturas mais robustas para a implementação dos princípios da economia circular. Isso inclui capacidades tecnológicas avançadas, bases industriais diversificadas e forte apoio institucional. Ao examinar diversos estudos de caso, a pesquisa destaca exemplos bem-sucedidos de iniciativas de economia circular impulsionadas pela complexidade econômica. Essas iniciativas frequentemente resultam em maior eficiência no uso de recursos, redução do impacto ambiental e aumento da resiliência econômica. Além disso, os achados sugerem que fomentar a complexidade econômica pode acelerar a adoção de práticas circulares. Isso requer intervenções políticas direcionadas, investimento em educação e pesquisa, e a promoção de parcerias público-privadas. Estimular uma cultura de aprendizado contínuo e adaptação também é essencial para enfrentar os desafios e aproveitar as oportunidades oferecidas pela economia circular. Em síntese, o estudo destaca a interconexão entre complexidade econômica e economia circular como elementos centrais para o alcance dos objetivos de desenvolvimento sustentável.

Palavras-chave: Complexidade econômica, economia circular, desenvolvimento sustentável.

1. Introduction

The intersection between Economic Complexity and Circular Economy is emerging as a fundamental field of study for promoting sustainability in contemporary economic systems. Economic Complexity, understood as the intricate network of factors influencing economic systems, and Circular Economy, which proposes an innovative model to optimize resource use and minimize waste, present interactions that still lack in-depth analysis in the academic literature (Bagalagel & ElMaraghy, 2021; Roy *et al.*, 2022; Donis, Gómez & Salazar, 2023).

A comprehensive literature review was conducted on the Scopus and Web of Science databases to explore this relationship. Existing literature addresses isolated aspects of these concepts, but specific interconnections and mutual implications remain unclear (Ellen MacArthur Foundation, 2015; Botezat *et al.*, 2018; Roy *et al.*, 2022).

Economic Complexity represents a complex set of variables affecting economic dynamics and is fundamental to understanding traditional sustainability strategies (Bagalagel & ElMaraghy, 2021). On the other hand, the Circular Economy has emerged as an innovative approach that proposes more efficient resource management and waste minimization (Ellen MacArthur Foundation, 2015; Botezat *et al.*, 2018). However, its effectiveness can be compromised if it does not consider the nuances and challenges presented by Economic Complexity (Roy *et al.*, 2022).

This article aims to fill this gap in the literature by investigating how Economic Complexity impacts the effectiveness and implementation of the Circular Economy. The contribution of this study is the integrated analysis of the interrelationship between

Economic Complexity and Circular Economy, offering valuable insights for academics, professionals, and policymakers interested in promoting sustainable practices in complex economic systems.

2. Literature review

2.1 Circular Economy and Economic Complexity

The transition to the Circular Economy (CE) comes as a response to the growing pressure on organizations to reformulate their linear production models, driven by challenges such as climate change (Gupta, Kumar & Wasan, 2021) and solid waste management (Singh *et al.*, 2022). The COVID-19 pandemic has amplified the unsustainability of the linear model (Nandi *et al.*, 2021), highlighting its economic and environmental implications (Upadhyay *et al.*, 2021).

CE proposes an alternative paradigm, seeking to address interconnected problems such as resource waste, pollution and climate change (Geissdoerfer *et al.*, 2017). Originating from the approaches of ecological and environmental economics and industrial ecology, CE aims to decouple economic growth from environmental pressure (Ghisellini *et al.*, 2016). Sehnem and Pereira (2019) highlight CE as an evolution of previous sustainable practices, offering a more comprehensive and integrated vision.

Several definitions converge to understand CE as a closed cycle of material flows, aimed at integrated management and sustainable regeneration (Geng & Doberstein, 2008). CE goes beyond recycling, requiring the reduction of resources (Joensuu *et al.*, 2020), and its implementation aims to retain the value of resources by reducing the use of virgin materials and waste emissions (Joensuu *et al.*, 2020).

CE faces challenges and criticisms, such as the lack of studies on the risks and challenges of its implementation (Choudhary & Kumar, 2021). Collaboration between stakeholders is crucial, ranging from the acquisition of raw materials to recovery/recycling (Sudusinghe & Seuring, 2022). Klein, Ramos and Deutz (2020) identify the scarcity of studies on the role of the public sector in implementing CE.

CE positively influences the achievement of the Sustainable Development Goals (Schroeder *et al.*, 2019). However, its implementation varies globally, being more ambitious in the European Union, while countries like Brazil face obstacles such as lack of infrastructure and awareness (Acerbi & Taisch, 2020).

Despite its potential, CE is still an evolving field, requiring more specific studies targeted at sectors and regions (Primc *et al.*, 2020). The literature also highlights the importance of maturity models for understanding and evaluating the implementation of CE in organizations (Uhrenholt *et al.*, 2022).

In this context, the theme of Economic Complexity stands out, which represents a set of variables that affect economic dynamics and is fundamental for understanding sustainability strategies (Bagalagel & ElMaraghy, 2021). The intersection between Economic Complexity and Circular Economy is crucial in promoting sustainability in contemporary economic systems (Hassan *et al.*, 2023)

According to Hidalgo & Hausmann (2009), Economic Complexity goes beyond the mere diversification and sophistication of products and sectors in an economy; suggests a fundamental role in a nation's resilience and adaptability in the face of economic change. This theory, which analyzes a country's productive structure in terms of the variety

and uniqueness of its products, proposes that more diversified economies have greater capacity to face economic challenges.

Recent studies, such as that by Roy *et al.* (2022) on Circular Supply Chains (CFC), and the research by Donis, Gómez and Salazar (2023) on the production of green patents in OECD countries, highlight the influence of Economic Complexity in different contexts, but without a direct analysis of the interaction with the Circular Economy.

However, a gap in the literature is evidenced by several studies, including those by Holmes (2018), Botezat *et al.* (2018), Brown *et al.* (2019), Kreye and Donk (2021), Sun *et al.* (2022), Ahmed *et al.* (2022) and Rafique *et al.* (2022), which, although they explore aspects related to Economic Complexity, do not delve into the analysis of its interface with the Circular Economy.

Given this scenario, this research proposes to investigate how the productive structure, outlined by Economic Complexity, impacts the implementation and effectiveness of circular practices. Understanding this interconnection is vital for developing strategies and policies that lead to an effective transition towards more sustainable economic systems, synergistically integrating Economic Complexity and the principles of the Circular Economy.

3. Research design

This research was based on the systematic literature review methodology, with the aim of gaining an in-depth understanding of the intersection between Economic Complexity and the Circular Economy. The Scopus and Web of Science databases were selected as the primary sources for collecting relevant articles, given their scope and academic reputation (Mongeon & Paul-Hus, 2016).

3.1 Data collection

The searches were designed with specific criteria to ensure the relevance of the articles selected. Key terms were used to capture various dimensions of the interaction between Economic Complexity, Circular Economy and sustainability. The choice of terms such as “economic complexity,” “economic sophistication,” “product complexity,” “economic diversification,” “economic variety,” “circular economy,” “circularity,” and “sustainability” reflects the comprehensive approach adopted to cover different perspectives.

The searches were refined with specific considerations. For the terms related to the Circular Economy (“circular economy” and “circularity”), the search covered the title, abstract and keywords, ensuring a comprehensive approach. For the term “sustainability,” the search was restricted to the title, optimizing the selection process, considering the volume of papers. In both searches, no time limit was set for the selection of articles. Table 1 shows all the search terms used during the research process.

Table 1. Search terms used in the survey

Search terms
Economic Complexity and Circular Economy
Economic Sophistication and Circular Economy
Product Complexity and Circular Economy
Economic Diversification and Circular Economy
Economic Variety and Circular Economy
Economic Complexity and Circularity
Economic Sophistication and Circularity
Product Complexity and Circularity
Economic Diversification and Circularity
Economic Variety and Circularity
Economic Complexity and Sustainability
Economic Sophistication and Sustainability
Product Complexity and Sustainability
Economic Variety and Sustainability

Source: prepared by the authors

The process identified 41 articles. After a careful review, three articles were excluded due to duplication, and one was withdrawn because it did not align with the scope of the research, resulting in a final set of 37 articles for detailed analysis.

This method provided a comprehensive overview of relevant academic contributions to the interconnection between Economic Complexity, Circular Economy, and sustainability. The careful selection of terms

and thorough analysis of the articles ensured the validity and representativeness of the results, thus underpinning the conclusions of this research.

The conduct of this research followed a series of rigorous steps in line with the principles of systematic literature review. The process was structured to ensure a systematic and transparent approach, allowing the identification, selection and analysis of articles in a robust manner. The key stages are described below:

Defining the scope of the research: clear delimitation of the topics of interest, establishing the key concepts of Economic Complexity, Circular Economy and sustainability.

Database selection: identification of the most relevant databases for the area of study, with the choice of Scopus and Web of Science due to their scope and academic reputation.

Elaboration of key terms: development of a list of key terms that capture different facets of the interaction between Economic Complexity, Circular Economy and sustainability.

Execution of searches: searches were carried out in the databases, using combinations of key terms in order to cover various perspectives. For terms related to the Circular Economy, the search considered the title, abstract and keywords; while for “sustainability,” the search was restricted to the title.

Initial screening: initial analysis of the results to identify duplicates and exclude

papers that clearly did not fall within the scope of the research.

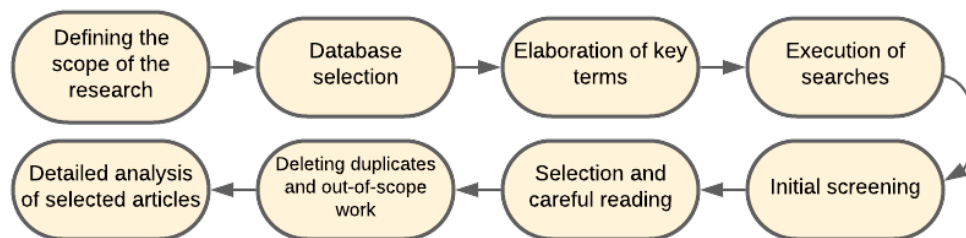
Selection and careful reading: complete reading of the remaining articles, applying the inclusion and exclusion criteria to ensure relevance in relation to the proposed themes.

Exclusion of duplicates and out-of-scope work: removal of duplicate articles and those that did not contribute directly to the analysis of the interaction between Economic Complexity, Circular Economy and sustainability.

Detailed analysis of the selected articles: in-depth reading and critical analysis of the remaining 37 articles, seeking to extract relevant information on the interconnection between the concepts of interest.

These steps were carried out methodically to ensure the validity and reliability of the results obtained. The systematic approach adopted provided a comprehensive and in-depth understanding of the existing literature on the proposed topic. Figure 1 provides a concise and schematic overview of the sequence of steps.

Figure 1. Schematic sequence of research stages



Source: prepared by the authors.

3.2 Descriptive statistics

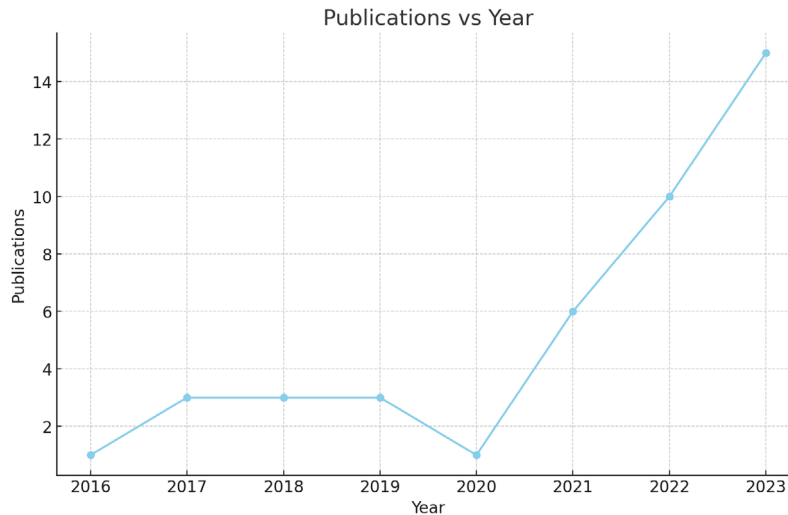
The data shows an upward trend in the number of publications over the years, with a significant increase in 2023, with 14 publications. This increase may indicate

a growing and updated interest in the intersection between Economic Complexity and Circular Economy. The years 2022 and 2021 also show a considerable number of publications, suggesting a continuity of

interest and research in this area. However, the absence of publications in 2020 and the reduced quantity in 2019, 2018 and 2017 may

indicate periods of less focus or exploration of this theme. Figure 2 illustrates the distribution of articles over the years.

Figure 2. Trend publication in this study area

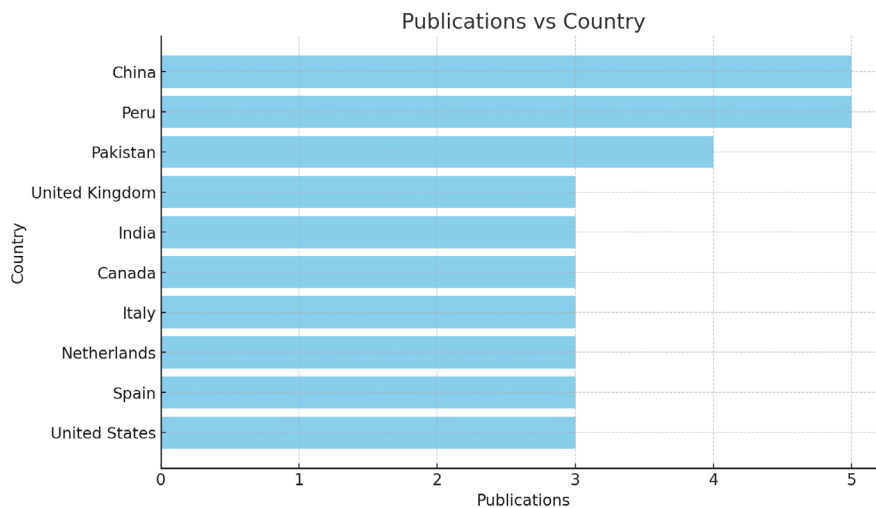


Source: prepared by the authors.

The distribution of publications by country, as shown in Figure 3, highlights China and Perú as the main contributors, each with six publications. Pakistan followed with a significant number, with five publications. Other countries such as the United Kingdom,

India, Canada, Italy, the Netherlands, Spain and the United States are also present in the research, contributing two publications each. This geographical diversity suggests a global interest and engagement in research related to Economic Complexity and Circular Economy.

Figure 3. Frequency of articles classified by context



(Source: prepared by the authors)

Table 2 presents the five predominant academic journals, classified by the number of articles published, within the scope of Circular Economy and Economic Complexity. The journal *Sustainability Switzerland* leads the list, with six articles published, demonstrating its significant contribution to the field. Next, the *Journal of Cleaner Production* occupies the second position, with four articles published, followed by *Environment Development and*

Sustainability and *International Journal of Sustainable Development and World Ecology*, both with two articles published. Finally, *Business Strategy and the Environment* appears on the list with a published article. This distribution reflects the diversity of academic sources and the growing interest in research related to the Circular Economy and economic sustainability.

Table 2. Top five journals, as determined by their number of published articles

Journal	Number of articles
Sustainability Switzerland	6
Journal Of Cleaner Production	4
Environment Development and Sustainability	2
International Journal Of Sustainable Development and World Ecology	2
Business Strategy and The Environment	1

Source: prepared by the authors.

Table 3 presents the ten most cited articles, determined by the number of citations received, in a context of circular economy and economic complexity. The study by Hassan *et al.* (2023), published in the journal *Gondwana Research*, leads the list with 120 citations in Scopus and 115 in Web of Science. Secondly, there is the work of Rafique *et al.* (2022), published in the journal *Environment, Development and Sustainability*, with 105 citations in Scopus and 102 in Web of Science. Other studies follow, such as that by Sun *et*

al. (2022) on transition to renewable energy and environmental sustainability in BRICS countries, and the work of Kayikci *et al.* (2021) on the barriers to a smart and sustainable circular economy in the automotive sector, both published in reputable magazines. These articles reflect the growing interest in the intersection between the circular economy, economic complexity and environmental sustainability, highlighting the diverse approaches and perspectives adopted by the academic community.

Table 3. Top 10 articles, as determined by their number of citations

Author	Title	Journal	Total citations
Hassan <i>et al.</i> (2023)	The impact of economic complexity, technology advancements, and nuclear energy consumption on the ecological footprint of the USA: Towards circular economy initiatives	<i>Gondwana Research</i>	Scopus: 120 Web of Science: 115

Author	Title	Journal	Total citations
Rafique <i>et al.</i> (2022)	Does economic complexity matter for environmental sustainability? Using ecological footprint as an indicator	<i>Environment, Development and Sustainability</i>	Scopus: 105 Web of Science: 102
Sun <i>et al.</i> (2022)	Renewable energy transition and environmental sustainability through economic complexity in BRICS countries: Fresh insights from novel Method of Moments Quantile regression	<i>Renewable Energy</i>	Scopus: 87 Web of Science: 80
Kayikci <i>et al.</i> (2021)	Exploring barriers to smart and sustainable circular economy: The case of an automotive eco-cluster	<i>Journal of Cleaner Production</i>	Scopus: 56 Web of Science: 46
Holmes (2018)	New spaces, ordinary practices: Circulating and sharing within diverse economies of provisioning	<i>Geoforum</i>	Scopus: 47 Web of Science: 40
Ullah <i>et al.</i> (2024)	Paving the ways toward sustainable development: the asymmetric effect of economic complexity, renewable electricity, and foreign direct investment on the environmental sustainability in BRICS-T	<i>Environment, Development and Sustainability</i>	Scopus: 45 Web of Science: 36
Saud <i>et al.</i> (2023)	Articulating natural resource abundance, economic complexity, education and environmental sustainability in MENA countries: Evidence from advanced panel estimation	<i>Resources Policy</i>	Scopus: 45 Web of Science: 38
Shahzad <i>et al.</i> (2023)	The role of biomass energy consumption and economic complexity on environmental sustainability in G7 economies	<i>Business Strategy and the Environment</i>	Scopus: 42 Web of Science: 37
Ghosh <i>et al.</i> (2022)	Modelling an empirical framework of the implications of tourism and economic complexity on environmental sustainability in G7 economies	<i>Journal of Cleaner Production</i>	Scopus: 41 Web of Science: 39
Lou <i>et al.</i> (2017)	What should be recycled: An integrated model for product recycling desirability	<i>Journal of cleaner production</i>	Scopus: 40 Web of Science: 33

Source: prepared by the authors.

The analysis of the data identified in this research provides a comprehensive and detailed view of trends and scientific contributions in the field of Economic Complexity and Circular Economy. Descriptive statistics reveal a growing academic interest over the years, with emphasis on the significant increase in publications in 2023. The geographic diversity of studies, with a notable contribution from countries such as China, Perú and Pakistan, suggests a global interest in the intersection of these themes.

Furthermore, the citation analysis highlights the influence of key studies in the field, highlighting the importance of in-depth investigations into the integration between circular economy, economic complexity and sustainability. These results underscore the ongoing need for integrative and multidisciplinary research to promote theoretical and practical advancement in the areas studied, offering a solid foundation for future scientific explorations and sustainability policies. The detailed results of this analysis will be discussed in the following section.

4. Results

The findings were based on a bibliometric analysis carried out with VOSviewer, complemented by reading the articles. This allowed for a detailed analysis of the relationships between key terms. The approach adopted goes beyond the traditional application of bibliometrics, which generally focuses on networks of authors, institutions and citations. This methodology made it possible to build a rich and dense network of key terms and their connections, in addition to identifying terms that are not fully explored in current research.

In the context of keyword analysis, “clusters” refer to groups of keywords that

have similar associations or frequently occur together in a data set. For example, in a set of scientific articles, keyword clusters may represent specific research topics or common areas of interest. VOSviewer can be used to identify and visualize these clusters, helping researchers better understand the structure and patterns of terms used in a given area of study (Arruda, 2022).

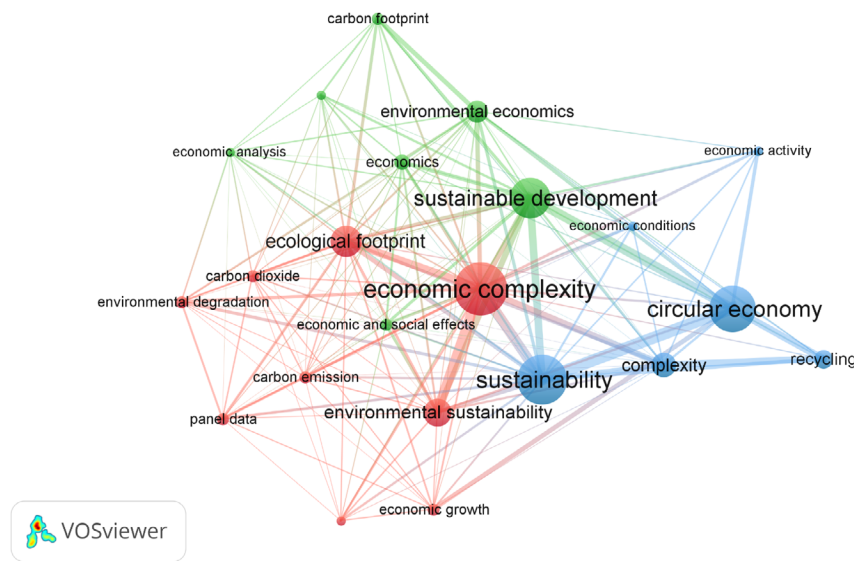
As a result of the analysis of the VOSviewer software, three clusters were identified, with cluster one (represented by the color red in Figure 4) centered around themes related to the environment, economy and data. It includes terms such as “carbon dioxide”, “carbon emission”, “ecological footprint”, “environmental degradation”, “environmental quality” and “environmental sustainability”, suggesting a focus on the relationship between human activities, carbon emissions and environmental impacts. The terms “economic complexity”, “economic growth” and “panel data” indicate a concern with economic analysis and the use of data sets to investigate environmental and economic issues in depth.

Cluster two (represented by the green color in Figure 4) focuses on the intersection between economy and environment, with an emphasis on terms such as “carbon footprint”, “economic analysis”, “economic and social effect”, “environmental economics” and “sustainable development”. These terms suggest an approach that considers the economic and social impacts of human activities on the environment, as well as the analysis of sustainable economic policies and practices, including the use of renewable energy.

Finally, cluster three (represented by the blue color in Figure 4) is related to economic and environmental concepts, with emphasis on “circular economy”, “economic activity”,

“economic conditions”, “recycling” and “sustainability”. This suggests a concern with economic models that promote sustainability, such as the circular economy, and the importance of economic activity and economic conditions in promoting sustainable practices, such as recycling and efficient use of resources. Figure 4 illustrates the relationship between the three clusters identified by the software.

Figure 4. Network of keywords in the literature on Circular Economy and Economic Complexity



Source: VOSviewer.

Table 4 summarizes the analyses carried out using the data provided by the VOSviewer software.

Table 4. VOSviewer Analysis

Cluster	Terms	Suggested relationship
Cluster 1 (red)	Carbon dioxide, carbon emission, ecological footprint, environmental degradation, environmental quality, environmental sustainability, economic complexity, economic growth, panel data	Focus on the relationship between human activities, carbon emissions and environmental impacts, with economic analysis and use of data to investigate environmental and economic issues in depth.
Cluster 2 (green)	Carbon footprint, economic analysis, economic and social effect, environmental economics, sustainable development	Approach considering the economic and social impacts of human activities on the environment, analysis of sustainable economic policies and practices, including the use of renewable energy.

Cluster	Terms	Suggested relationship
Cluster 3 (blue)	Circular economy, economic activity, economic conditions, recycling, sustainability	Concern with economic models that promote sustainability, such as the circular economy, and the importance of economic activity and economic conditions in promoting sustainable practices, such as recycling and efficient use of resources.

Source: prepared by the authors.

Table 5 organizes the main themes of studies on the intersection between Economic Complexity and Circular Economy. The relationship between Economic Complexity and Environmental Sustainability stands out, addressed by several authors, and the investigation of the determinants of ecological innovations. The transition from linear to circular supply chains is central, analyzing the obstacles and solutions to circular practices. The implementation of the Circular

Economy in complex economies highlights challenges and strategies, complemented by analyzes of public policies and business strategies. Education and simulation for sustainability and the evaluation and design of circular products are also recurring themes, reflecting the diversity of applied approaches and contexts. These themes provide a broad view of the dynamics between Economic Complexity and Circular Economy.

Table 5. Ten main themes researched in the reviewed studies and the respective authors who studied each theme

Theme	Authors
Economic Complexity and Environmental Sustainability	Rafique <i>et al.</i> (2022), Ahmed <i>et al.</i> (2022), Khan and Ximei (2022), Hassan <i>et al.</i> (2023), Saud <i>et al.</i> (2023), Ullah <i>et al.</i> (2024), Gyamfi <i>et al.</i> (2023), Numan <i>et al.</i> (2023), Ahmad e Satrovic (2023)
Green innovation and patents Servitization and sustainability	Donis, Gómez & Salazar (2023), Yoshino <i>et al.</i> (2023) Kreye e Donk (2021)
Material recovery and recycling	Jacobs <i>et al.</i> (2022), Demarcq <i>et al.</i> (2022), Keßler, Matlin & Kümmerer (2021), Lou <i>et al.</i> (2017)
Transitioning from linear to circular supply chains	Roy <i>et al.</i> (2022)
Circular Economy and regional revitalization	Brown <i>et al.</i> (2019)
Impact of Economic Complexity on the implementation of the Circular Economy	Mährlitz <i>et al.</i> (2022), Ghosh <i>et al.</i> (2022), Ha (2023)
Public policies and business strategies for sustainability	Saud <i>et al.</i> (2023), Numan <i>et al.</i> (2023), Ghosh <i>et al.</i> (2022), Mährlitz <i>et al.</i> (2022)

Theme	Authors
Education and simulation to understand sustainability	Sierra & Suárez-Collado (2021)
Evaluation and design of circular products	Greco <i>et al.</i> (2023), Lou <i>et al.</i> (2017), Demarcq <i>et al.</i> (2022)

Source: prepared by the authors.

Table 6 summarizes the main results of the literature review that sought to answer the following question: “How does Economic Complexity impact the effectiveness and implementation of the Circular Economy, and how does the Circular Economy, in turn, impact Economic Complexity in different contexts?”. Based on research by authors such as Numan *et al.* (2023), Hassan *et al.* (2023), Ghosh *et al.* (2022), Mähltitz *et al.* (2022), Roy *et al.* (2022), Jacobs *et al.* (2022), Keßler, Matlin and Kümmerer (2021), Kayikci *et al.* (2021), Cakir *et al.* (2021), Lou *et al.* (2017), and Ha (2023), valuable insights emerge about the influence of Economic Complexity on the transition to circular practices. This synthesis aims to provide a comprehensive and organized view of these results, highlighting the convergences and divergences in the conclusions of the various studies.

Table 6. Summary of results

Study	Main results
Numan <i>et al.</i> (2023)	- The importance of economic complexity in sustainable development. - Positive contribution of renewable energy in reducing the ecological footprint. - Need for policies for the transition to a Circular Economy.
Hassan <i>et al.</i> (2023)	- Positive relationship between economic complexity and ecological footprint in the USA. - The beneficial role of nuclear energy in reducing harmful emissions. - The potential of the Circular Economy to create a sustainable system.
Ghosh <i>et al.</i> (2022)	- Importance of Economic Complexity in the transition to an advanced Circular Economy. - Proposal for a research agenda, including analysis of causal relationships and economic and environmental impacts.
Mähltitz <i>et al.</i> (2022)	- Analysis of how Economic Complexity influences the implementation of the Circular Economy. - Highlighting challenges and opportunities, emphasizing the need for a systemic approach.
Roy <i>et al.</i> (2022)	- Analysis of the transition from linear to circular chains, recognizing Economic Complexity as a crucial challenge. - They mentioned examples of successful implementations.
Jacobs <i>et al.</i> (2022)	- Addressing the challenges of material recovery in Canada, highlighting the interface between product complexity and the Circular Economy. - Emphasizing the importance of design and education in promoting the recyclability of products.
Keßler, Matlin & Kümmerer (2021)	- Addressing challenges in the textile industry, mentioning the interface between Economic Complexity and Circular Economy.

Study	Main results
Kayikci <i>et al.</i> (2021)	- Highlighting the Circular Economy as a strategy for sustainability challenges in the textile industry. - Focus on the barriers to the transition to a sustainable Circular Economy, mentioning overcoming product complexity.
Cakir <i>et al.</i> (2021)	- Presentation of a new method for assessing Economic Complexity and its connection with sustainability.
Lou <i>et al.</i> (2017)	- Development of a recycling desirability index, taking product complexity into account. - Focus on the complexity of products and their recyclability.
Ha (2023)	- Examining the interface between Economic Complexity and Circular Economy. - Recognition that excessive Economic Complexity can present challenges to the effective implementation of the Circular Economy.

Source: prepared by the author.

5. Final considerations

The comprehensive analysis of the studies presented reveals a convergence of conclusions regarding the interrelationship between Economic Complexity and the Circular Economy, providing valuable insights for understanding these complex phenomena in diverse contexts. The literature suggests that Economic Complexity plays a significant role in the transition to circular practices, influencing everything from the adoption of Circular Economy strategies to the environmental and economic impacts resulting from this transition. In addition, the research highlights the potential of the Circular Economy to shape Economic Complexity, promoting innovation, diversification and sustainability.

However, it is important to recognize the inherent limitations of this literature review, including the relatively low number of articles available on the interaction between Economic Complexity and the Circular Economy. The analyses are based on specific studies, each with different methodologies and different contexts, which can make broad generalizations difficult.

Considering the gaps identified, a comprehensive research agenda is suggested to deepen the understanding of the interaction between Economic Complexity and Circular Economy:

- Investigation of the causal relationships and underlying mechanisms between Economic Complexity and the Circular Economy, providing deeper insights into how these factors influence each other.
- Analysis of the influence of Economic Complexity on the adoption of Circular Economy practices in different sectors and regions, recognizing the nuances that can arise in specific contexts.
- Evaluation of the economic and environmental impacts of the transition to a more advanced Circular Economy, including the consideration of sustainability and economic resilience indicators.

Author contributions

Tiago Estrela da Cunha Moraes: conceptualization, methodology, testing, and writing.

Marcos Ferasso: review, formatting.

Adriano Alves Teixeira: review.

Declarations

Competing interests The authors declare no competing interests. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

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