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Review

Investigating Circular Business Model Innovation through Keywords Analysis

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Abstract: Ongoing economic, social and environmental developments have forced the production system to undertake a profound transformation, shifting from a linear to a circular model. The transformation towards a circular economy poses significant challenges for established companies, in many cases requiring a strong modification of their current business models, start-ups and new ventures. Firms need to completely rethink their value proposition, modifying how the product or service is produced, delivered to the customers and disposed of. As a result, interest in business model innovation with a view to a circular system has increased significantly over the last five years, leading to a flourishing literature production. Although several literature reviews have been published on the topic of the circular business model, few of them include the innovation dimension. Moreover, the time horizon covered by the previous reviews extends to 2019 and in one case to 2020. Since 2020 saw a 135% increase in scientific production compared to the previous year, it is necessary to update the prior works, taking into account the new contributions. Our paper aims to bridge this gap by proposing a literature review based on keywords analysis. In this way, it is possible to analyze the issues addressed in the circular business model innovation (CMBI) by categorizing them as core, emerging/phantom, trendy or intermittent. This analysis is particularly suitable for identifying future research directions as signaled by the emerging themes.

Keywords: circular economy; circular business model; circular business model innovation; literature review; keywords analysis

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1. Introduction

Ongoing economic, social and environmental developments have forced the production system to undertake a profound transformation, shifting from a linear to a circular model. To date, the linear model, which is based on the extraction of raw materials from nature in order to produce goods and services, has prevailed. Once consumed, the outputs produced lose value and are disposed of as waste. This linear model has allowed an accelerated progress in the welfare of a large part of humanity, but the finite nature of natural resources is forcing a paradigm shift. In fact, the circular economy proposes the replacement of the linear model with a circular one, based on the 3Rs: reduce (a reduction of the use of raw materials and thus the environmental impact of production), reuse (through the extension of the life cycle of goods) and recycle (waste diversion). Scholars have subsequently proposed more detailed "R" frameworks, such as those with 6Rs or 9Rs. As far as the 9Rs framework is concerned, it is the most nuanced one, divided into three main subdomains: R strategies related to a smarter use or production of products (refuse, rethink, reduce), R strategies related to product lifespan extension (reuse, repair, refurbish, remanufacture) and R strategies related to the useful application of materials [1].

The circular model aims to keep products, components and materials at their highest value at every stage of their life cycle [2]. The concept of circular economy has quickly captured the interest of policymakers, practitioners and researchers, with a considerable

increase in the number of articles covering this topic over the last decade [3]. The transformation towards a circular economy poses significant challenges for both established companies, in many cases requiring a strong modification of their current business models, start-ups and new ventures Changes in products or services, networks of relationships, production processes and revenue models are often required, forcing companies to innovate their business models to adopt circular ones [4]. To be compliant with the principles of a circular economy system, the business model must be based on using as few resources as possible, making them last as long as possible and capturing as much value as possible in the process. Thus, companies need to completely rethink their value proposition, modifying how the product is produced, delivered to the customers and disposed of [5]. As a result, interest in business model innovation with a view to a circular system has increased significantly over the last five years, leading to an ever-increasing literature production. Although circular business model innovation (CBMI) has rapidly gained popularity both in the scientific community and among practitioners and policymakers, its theorization is relatively recent, so many aspects are yet to be explored.

Although several literature reviews, whose scopes are summarized in Table 1, have been published on the topic of circular business models, only few include the innovation dimension. The majority of them focus mainly on clarifying which practices can facilitate the transition to or creation of circular business models or which tools enable their implementation. Moreover, the time span covered by previous reviews extends to 2019, and in only one case to 2020. Since 2020 saw a 135% increase in scientific production compared to the previous year, it is necessary to update the prior works, taking the new contributions into account. With that in mind, our paper aims to bridge this gap by proposing a literature review based on keywords analysis. In particular, it has a three-part objective:

(a) understanding how the intellectual structure of CBMI is organized,
(b) understanding which are the trendy topics of research within the literature on CBMI, and
(c) understanding which are the emergent topics of research within the literature on CBMI.

The rationale behind the three-part objective lies in the desire to map the scientific contributions related to CBMI following a well-defined pattern. In fact, the methodology chosen to conduct the review allows us to frame the main topics of research. In this way, it is possible not only to identify which are the recurrent themes addressed by the scholars, but also to differentiate them according to their relevance for the scientific community. In particular, objectives (b) and (c) underline the existence of two categories of topics of high interest: the trendy ones, i.e., those for which the attention of scholars has reached high peaks in a small number of years, and the emergent ones, which need to be monitored because they are predictive of future research directions.

The paper is structured as a literature review based on the keywords extracted from a sample of selected articles, following the framework of [6]. By analyzing keywords on the basis of two dimensions, i.e., dominance and persistence, we identified key issues for the study of CBMI and the emerging themes of discussion. This paper is structured in six sections: after this introduction, Section 2 discusses the literature background of CBMI, Section 3 explains the adopted methodology, Sections 4 and 5 present review results and the discussion and Section 6 provides suggestions for future research and highlights the limitations of the study.

Table 1. Reviews on circular business models.

Title	Authors	Scope	Time Span Covered by the Review	Innovation Dimension
A review and evaluation of circular business model innovation tools	[7]	Classification of CBMI tools	Until February 2019	X
Circular business models for the bio-economy: A review and new directions for future research	[8]	Main barriers against the shift towards bio-economy-based circular business models.	Until February 2019	
Circular business models: A review	[5]	1. Historic overview of the concepts of CBM and CBMI. 2. Overview of CBM and CBMI definitions. 3. Synthesis of conceptual frameworks.	2006–2018	X
Circular economy business models: the state of research and avenues ahead	[9]	Understanding the most prevalent topics and the emerging topics in the field of business models in circular economy.	2013–2019	
Circular supply chain management: A state-of-art review and future opportunities	[10]	Focus on circular supply chain management with the aim of individuating success factors, obstacles, innovative frameworks and new circular business models.	Until July 2019	
Smart Manufacturing Systems and Applied Industrial Technologies for a Sustainable Industry: A Systematic Literature Review	[11]	Understanding the technologies that promote new circular business models.	1985–2020	
Sustainable business model innovation: A review	[12]	Understanding of the necessary key activities, potential challenges and available tools to shift firms' business models to more sustainable ones.	Until February 2018	X

2. Theoretical Background

2.1. Sustainable Business Models: The Circular Business Model

The business model concept gained popularity in the 1990s during the e-commerce boom; it was used to communicate complex business ideas in an immediate manner to potential investors [13]. The business model summarizes the organizational and strategic choices of a firm in order to gain competitive advantage. It represents "the logic by which an organization creates, delivers and captures value for the organization itself, its customers and its different stakeholders" [14] (p. 14). It is characterized by value proposition, value creation and delivery, and value capture mechanisms. The value proposition refers to the product and service offering, with the aim of generating an economic return; the value creation and delivery is about how the value is provided; the value capture includes the ways in which the company makes money, i.e., the revenue model. According to [15], the business model represents the organizational and financial architecture of a company and defines how it will convert resources and capabilities into economic value. The current economic system is facing multiple challenges of an environmental and social nature, such as climate change, the increasing devastation of nature and the scarcity of natural resources, which demonstrate the unsustainability of the production and consumption models used until now [16]. In order to efficiently respond to these challenges, companies need to make significant changes to their activities, such as an increased stakeholder engagement and the rapid transformation of their business models [17]. The prerequisite for responding to such socio-ecological megatrends is the introduction of a sustainable business model

(SBM) that defines the company's financial and economic objectives as well as social and environmental ones [18]. The sustainable business model is a conventional business model modified in order to integrate the sustainability dimension into the organization. Specifically, what makes a business model sustainable is the presence of practices and principles that enable the company to achieve its sustainability ambitions and the integration of sustainability into the three dimensions of value proposition, value creation and delivery, and value capture [18]. Stubbs and Cocklin [19] point out that a sustainable business model combines the creation of measurable environmental and social value with economic value, considering the environment and the society as key stakeholders to be addressed. The literature emphasizes the broadening of the concept of value, which in the case of SBM includes costs and benefits not only for the company and its customers but also for two stakeholders that were not previously taken into account, namely the environment and society [7]. Several subcategories, or archetypes, of sustainable business models exist, e.g., product-service systems, base of the pyramid, and circular business models [20]. The relationship between SBM and CBM is summarized in Figure 1.

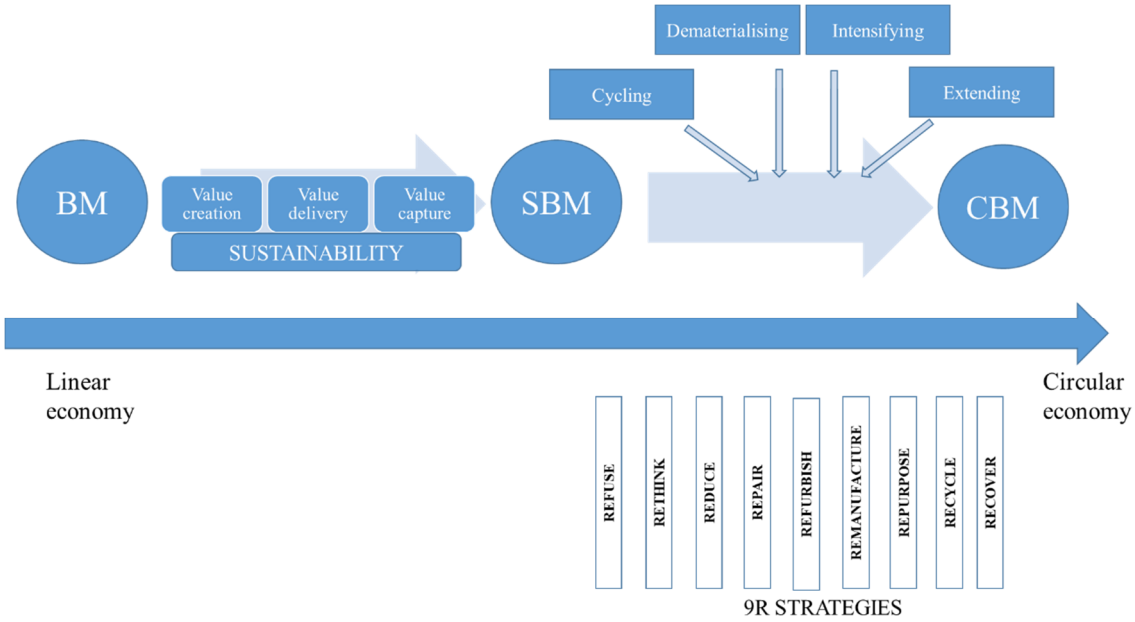

Figure 1. Traditional, sustainable and circular business models. Adapted from [5,21].

The circular business model (CBM) is a business model that is based on the principles of the circular economy. The circular economy is a production and consumption model that promotes the reuse, repair, recycling and reconditioning of materials and products in order to extend their life cycle as much as possible, helping to minimize waste. Once the product has completed the function for which it was designed, the materials that comprise it are reintroduced into the economic cycle, generating additional value. Circular business models can be defined as "business models that are cycling, extending, intensifying, and/or dematerialising material and energy loops to reduce the resource inputs into and the waste and emission leakage out of an organisational system. This comprises recycling measures (cycling), use phase extensions (extending), a more intense use phase (intensifying), and the substitution of products by service and software solutions (dematerialising)" [5] (p. 3). Fehrer and Wieland [22] identify four main logics for value creation through CBM: efficient material-technical loops, effective product-service loops, social-collaborative loops and symbiotic ecosystems. The idea behind efficient material-technical loops value creation is to close (i.e., reusing materials to maximize the production efficiency), slow (i.e., prolonging the use of materials and goods) or narrow (i.e., reducing the resources needed in the production process) the life cycle of materials and goods. Effective-product service loops

mechanisms create value by leveraging the concepts of leasing or renting. In this case, instead of promoting the individual purchase of goods and their disposal at the end of their life, the focus is on replacing product ownership with access to products through renting, leasing or pay-per-use policies. The concept of social-collaborative loops is the typical value creation approach of the sharing economy. The focus is on sharing, so consumption systems use the unused capacity of already produced goods or exploit the skills of individuals in their spare time. Finally, symbiotic ecosystems create value by closing resource loops through networking and collaboration.

2.2. Circular Business Model Innovation

Adopting a circular business model involves innovation. In fact, companies that want to resort to circular practices must adopt a perspective of innovation that is not limited to a change in the supply chain but that considers the existence of multiple cycles of value creation so as to minimize the need to dispose of products at the end of their life [7]. Business model innovation can take different forms: the design of a totally new business model from scratch, the transformation of an existing business model, the acquisition of a new business model and diversification through additional business models [5]. In most of the cases, it is an iterative process that involves several steps, including ideation, implementation and evaluation, and encompasses changes at different levels, such as at the conceptual level or in operational practices [23]. The ability to quickly innovate their business model is considered a fundamental requirement for companies that want to remain competitive on the market. Indeed, the role of business model has gradually changed over time: initially, it was mostly a tool for planning a company's activities, while in recent years it has shifted towards a more strategic function, focused on achieving a competitive advantage and improving firm performance [24,25]. Business model innovation, rather than product or process innovation, provides the company with a sustainable competitive advantage, which enables the achievement of social and environmental objectives without sacrificing high economic returns [26,27]. As far as circular business model innovation (CBMI) is concerned, it can be defined as "the conceptualisation and implementation of circular business models, which comprises the creation of circular start-ups, the diversification into circular business models, the acquisition of circular business models, or the transformation of a business model into a circular one" [5] (p. 8). It can be inferred from the definition of CBMI that a company can innovate its business model by incorporating circular economy elements either by irreversibly changing the existing business model or by adding a new business to the existing one. In general, CBMI takes different forms if we consider an incumbent firm or a start-up. The former tends to favor strategies that allow it to shift from a linear to a circular model by reconfiguring the existing business model, while the latter bases the creation of its business model on circular economy components [28]. CBMI has a high degree of complexity, because configuring a CBM involves decisions about how to recreate, redeliver and recapture value in every cycle the product goes through in its lifetime, without compromising the attractiveness of the value proposition to customers [29]. One way to address this difficulty is through experimentation, which means the company can draw on the contributions of external stakeholders, such as customers or suppliers, to explore different configurations of CBM and evaluate which is the best one to be implemented [30].

As far as the implementation process is concerned, there are many supporting tools available, but only a few of them are specifically tailored to CBMI. Most of the adopted tools and methods are rather generic, like the business model canvas approach [19], but due to their high flexibility they are applied also to CBMI. However, [31] highlights that the lack of focus on CBMI-specific approaches may distract attention from the sustainability and the circular economy dimensions. To fill this gap, in the last few years scholars have started to focus on tools specifically designed for business model innovation for circular economy practices. In [7], the authors propose a framework for classifying these tools on the basis of three dimensions, as shown in Table 2: tool type, tool nature and CBMI phase of application. Tool type refers to the form in which the tool appears, such as guidelines,

checklists or analytical tools to be applied to specific stages of the product development process. Tools can be qualitative or quantitative in nature, based on the information required to apply them (i.e., quantitative tools need numerical data or calculations with respect to qualitative ones). Finally the CBMI phase in which the tool is applied is required. Phases are derived from [23,32]; these works describe the process of CBMI as composed of three stages: the ideate and design phase, focused on the generation of ideas for potential new business models and their subsequent design; the implement and test phase, which involve investments to be made; and the evaluation and improvement phase, conducted after the BM is implemented with the aim to assess if any problems happened and to propose adjustments.

Table 2. Dimensions for CBMI tool classification. Adapted from [7].

Tool Type	Nature	CBMI Phase Application
Guidelines	Qualitative/Quantitative	Ideate and design
Checklists		Implement and test
Analytical Tools		Evaluate and improve

3. Methodology

The methodology adopted to conduct the research is a literature review in accordance with [6]. The authors proposed a framework, explained in detail in Section 3.1, aimed at investigating the state of the art of a given topic based on the authors' keywords. For the purpose of our study, the traditional systematic review proposed by [33] was not suitable. In fact, our aim is not only to identify the main research streams addressed by scholars, but also to understand their degree of relevance. Thanks to keywords analysis, it is possible to understand whether a concept is well established in the literature, becoming fundamental (core topic), whether it has captured an overwhelming interest from scholars (trendy topic) or whether it has recently appeared, representing a starting point for future research (emergent topic). These nuances cannot be grasped by applying a traditional systematic review.

3.1. Keywords Analysis

The framework in which our review is grounded is proposed by [6]. The authors suggest categorizing the literature on a specific topic on the basis of keywords. In fact, the keywords chosen by the authors to index their work rigorously synthesize the content, allowing them to catch the essence of the paper. Keywords are classified on the basis of two dimensions: dominance and persistence. The former measures the frequency with which a given keyword appears within the selected sample of articles. It is computed as the number of articles that chose such a keyword. The latter is a time-based measure that refers to the continuity of a given topic over time. It is calculated by considering the number of years a given keyword has been adopted to index the research. Combining the two dimensions, it is possible to determine a four-quadrant matrix, with each quadrant defining a homogeneous group of keywords. In particular, a keyword has high dominance if its value is higher than the average value (ADC, average dominance count) of the sample (calculated excluding keywords with dominance equal to one). Similarly, a keyword has high persistence if its value is higher than the average value of the sample (APC, average persistence count). As shown in Figure 2, the resulting quadrants refer to (1) core topics, with high persistence and dominance, (2) trendy topics, with high dominance and low persistence, (3) intermittent topics, with low dominance and high persistence and (4) emerging or phantom topics, with low dominance and persistence.

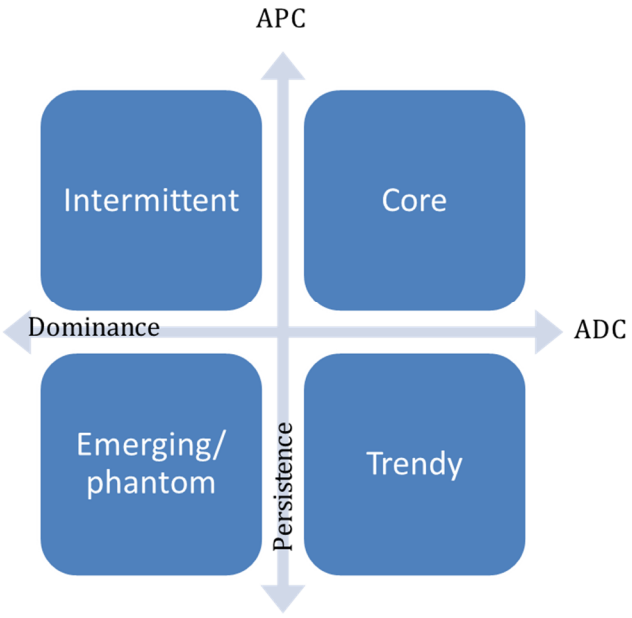

Figure 2. Reference framework. Adapted from [6].

Core topics are the fundamental ones upon which the literature on the topic is built. Trendy ones, in contrast, represent hot streams of research. Intermittent topics refer to issues that have been investigated in an on–off manner over the years, while emerging and phantom ones are characterized by a rising or a falling interest from scholars, respectively. The potential paths available for a keyword are highlighted in Figure 3. When a keyword first appears, it is considered emerging. In the case that it will no longer be adopted in forthcoming years, it is downgraded to phantom. However, if it is not completely abandoned but still appears in literature with discontinuity, it enters in the intermittent category. In the case that a keyword rapidly gains popularity, capturing the interest of many scholars, it is labeled as trendy. A trendy keyword may maintain the same degree of popularity over time, upgrading to a core one, or it may be totally (phantom) or partially (intermittent) abandoned.

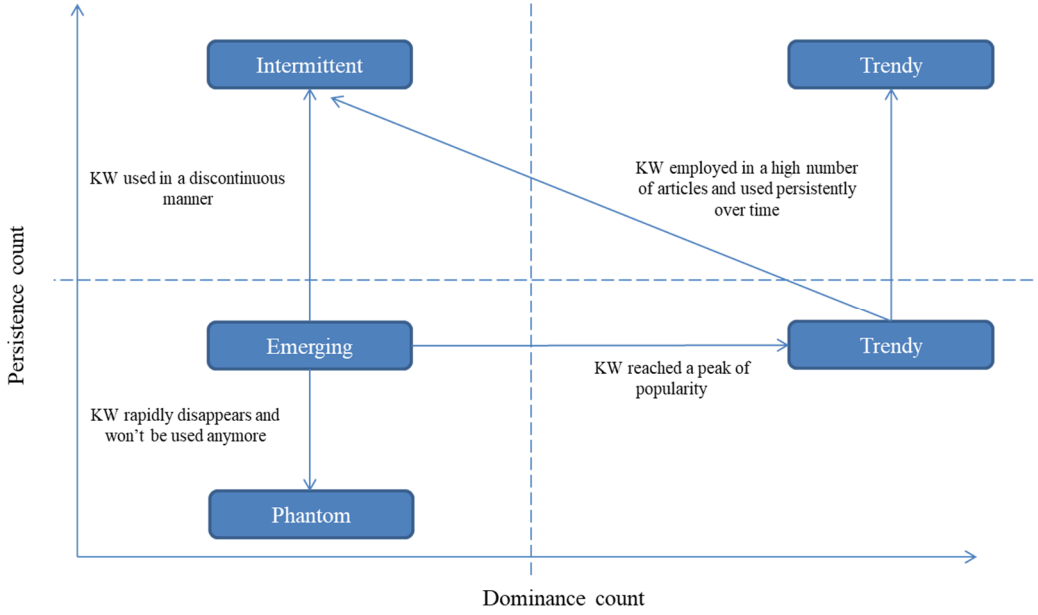

Figure 3. Keyword path over time, according to [6].

In order to reach the three-part objective of our paper, our discussion focused solely on the keywords belonging to the core, trendy and emerging topic quadrants. Intermittent quadrants showed no records, as the time span was too narrow to detect the intermittency of appearance. Moreover, the lower left quadrant was further divided into two clusters on the basis of keywords' years of appearance. For the sake of our review, only emerging topics should have been targeted; thus, we decided to distinguish between phantom and emerging keywords, considering as emerging only those ones that first appeared in 2020. In this way, we are likely to include in our review topics not already addressed in previous reviews.

3.1.1. Material Search

In order to select the sample of articles, a computerized search of two main databases, Scopus and Web of Science (WoS), was run at the beginning of February 2021, using the search following string: ("circular business model" AND "innovate*") OR ("business model innovation" AND "circular economy"). We chose to resort only to the two above-mentioned databases, since they are considered the most powerful search tools by the academic community, encompassing all the main peer-reviewed journals, conference proceedings and books [34]. No time span was set as inclusion criteria. The PRISMA guidelines [35] were followed to systematize the sample selection. They propose a checklist of items with the aim of guiding authors in making the reporting of literature reviews as effective as possible. According to these guidelines, before including studies in a literature review and giving reasons for excluding others, authors should carry out an exhaustive literature search. After that, once the results have been selected and eligibility criteria applied, a small number of citations will remain. In Figure 4 the entire study selection process is illustrated. Screening against the inclusion criteria resulted in a final set of 246 contributions. After removal of duplicates, papers without authors' keywords and non-relevant/not available contributions, 138 papers were left, and their keywords were analyzed.

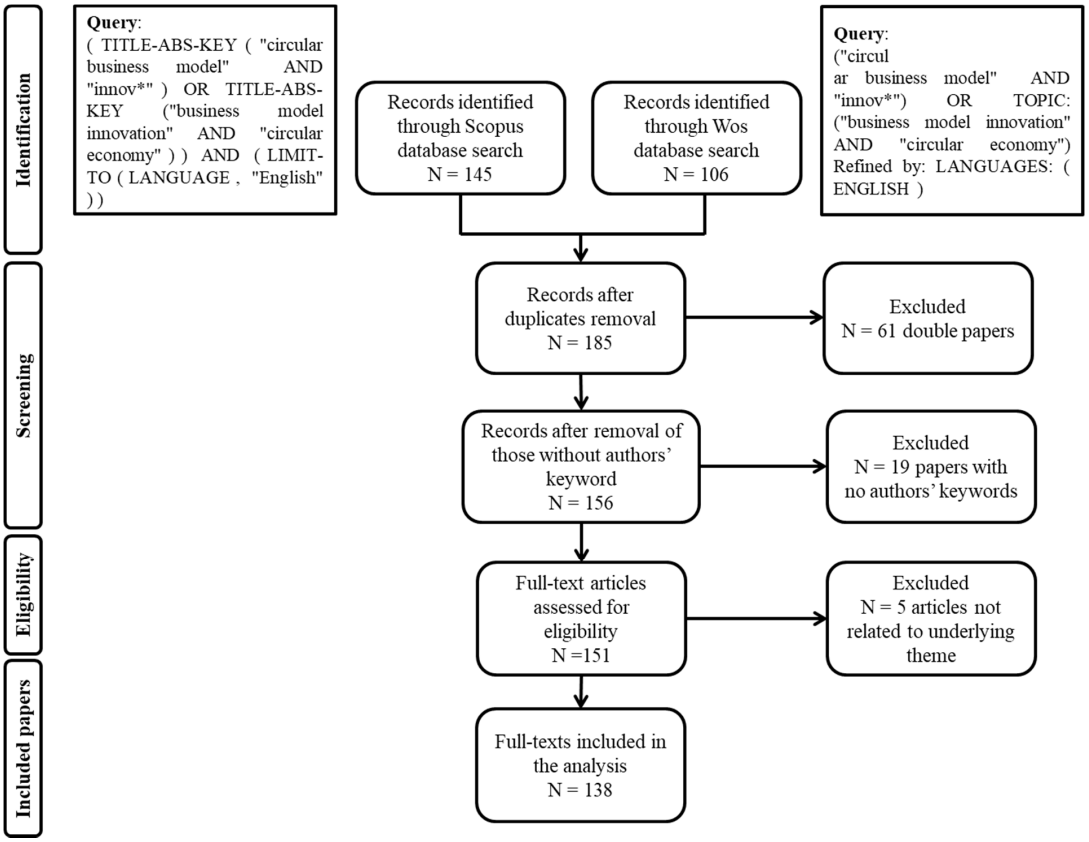

Figure 4. Methodology for article collection following PRISMA guidelines (as for the keyword "innov*", * is the truncation symbol, in the search innov* would find innovation, innovative, etc.).

3.1.2. Keywords Refinement

After a preliminary screening of the articles, manual adjustments were made in order to standardize words present in the singular and plural form, in British English and American English, in the abbreviated version (e.g., BM as business model), in different tenses (e.g., recycle and recycling) or with overlapping meanings (e.g., consumers and consumers). Circular business model innovation, circular business model, circular economy and innovation were not included in our keywords analysis as they were used as keywords in the Scopus search string. Their high values of dominance and persistence could have been misleading for our analysis.

4. Results

4.1. Initial Data Statisctics

In this section, we show some initial statistics related to the sample of articles analyzed, followed by a discussion of the results derived from the keyword analysis based on the framework of [6].

Figure 5 shows the trend of publications over time. The sample of articles resulting from the query was placed in a time horizon ranging from 2016 to 2021. This trend is consistent with that exhibited by [5], who conducted a review on circular business models, showing that since 2015 publications on this topic have grown exponentially. The scope of their review was limited to circular business models; thus, we can assume that the dimension of innovation had started to be explicitly taken into account in 2016, witnessing a strong boost in the last two years.

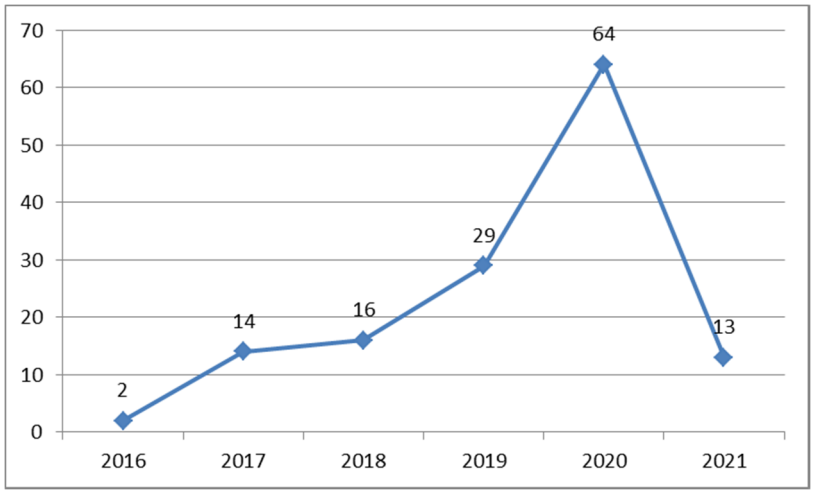

Figure 5. Publication trend.

Looking at Figure 6 it is noticeable that one journal, in particular, stands out for a high number of publications on this topic—Journal of Cleaner Production (56)—followed by Sustainability (Switzerland) (34) and Resources, Conservation and Recycling (18).

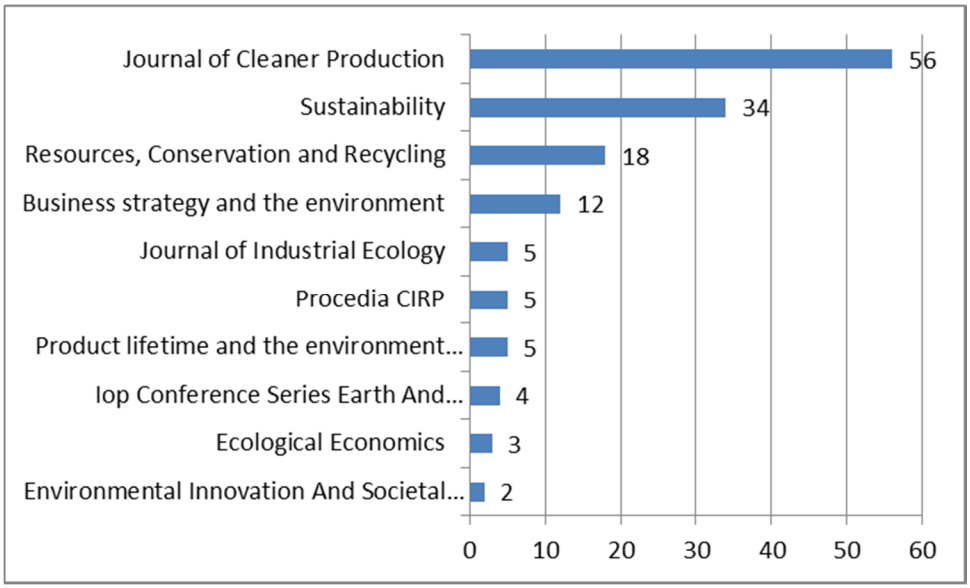

Figure 6. The ten journals with the majority of the publications.

It is interesting to observe the geographical distribution of the publications (Figure 7), proxied by the country of the paper's first author. Most of the contributions come from studies conducted in Sweden, Italy, the United Kingdom and the Netherlands. In particular, Sweden is the first country in terms of number of articles. A possible justification lies in the fact that Sweden is particularly sensitive to environmental policies, having been one of the first to adopt a green modernization approach to environmental and climate issues [36]. In addition, Sweden is one of the European countries at the forefront in promoting the circular economy at the national level, showing considerable efforts to promote circular economic flows through recycling [37].

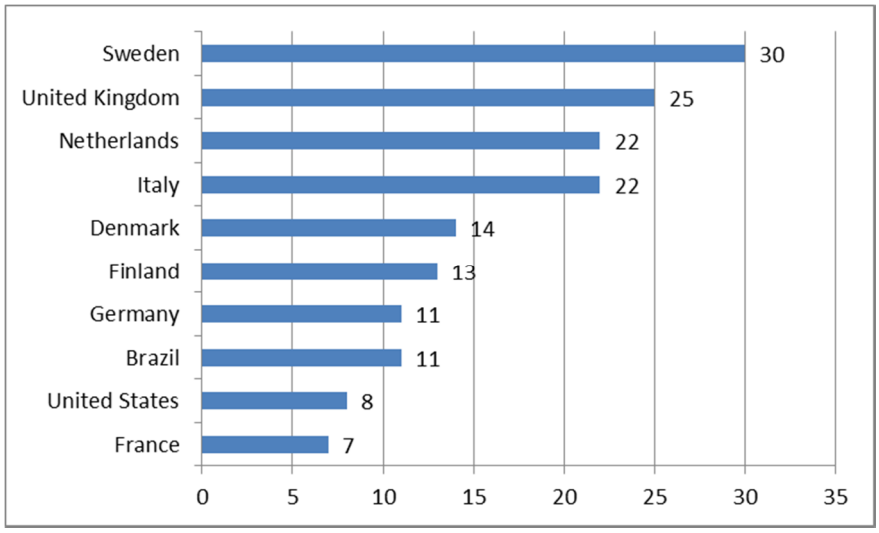

Figure 7. Ten most contributing countries.

Figure 8 shows the authors who appeared the most in the selected sample. The most active in this field appears to be Nancy Bocken, from the International Institute for Industrial Environmental Economics of Lund, Sweden. Consistent with the findings in Figure 5, she is affiliated with a Swedish institution, confirming the relevance of this country.

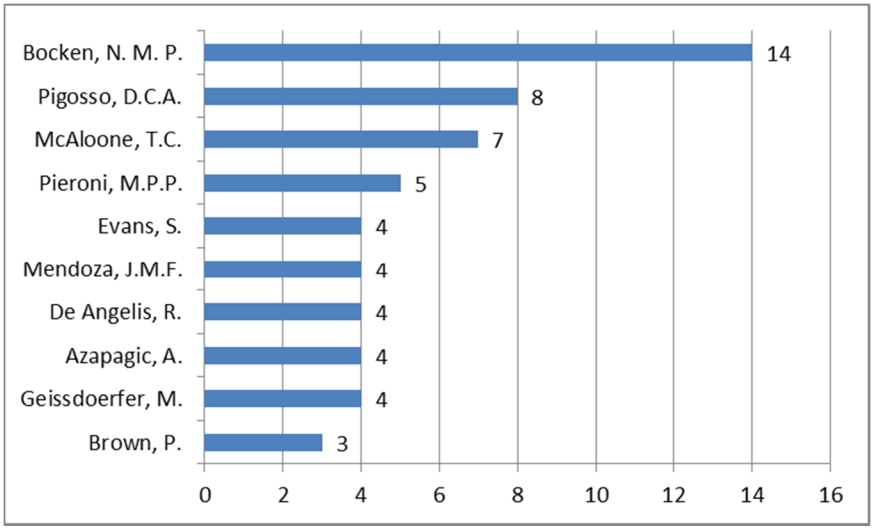

Figure 8. Ten most contributing authors.

Figure 9 shows the top 10 most popular keywords retrieved from the list of sample articles. As can be noticed, the most recurring keywords are those used in the search string to conduct the research, namely circular economy and business model innovation, followed by terms that refer to the same concepts, such as sustainable business model, innovation or business models.

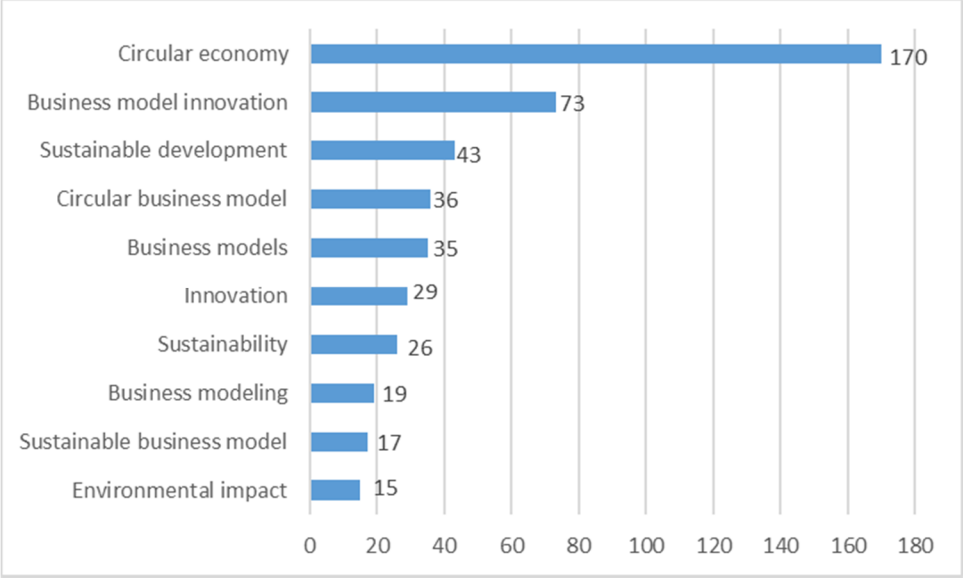

Figure 9. Ten most popular keywords.

4.2. Keywords Analysis Results

In Figure 10, the results from the keywords analysis are summarized. As can be seen, the quadrants that group most of the keywords are the emerging/phantom one and the core one, while the trendy quadrant shows only three records, and the intermittent has none. A possible explanation lies in the short time horizon considered. In fact, through the database search, only articles published from 2016 onwards emerged, highlighting the novelty of the underlying topic. By definition, a keyword can be labelled as trendy if it appears in a high number of contributions in a short time period. In our specific case, a trendy keyword is characterized by an appearance in at least five papers (ADC = 4.96) in less than three years (APC = 3.04). As the overall time period covered by the analysis is only

five years, the boundary between trendy and core (APC $\geq$ 3.04 and ADC $\geq$ 4.96) keywords is blurred. The narrowness of the time horizon also explains the absence of intermittent concepts: considering the few number of years, it is hard to assess the intermittency of appearance. Once we identified which quadrant each keyword belonged to, the discussion of topics was carried out by highlighting the relationships between the keywords belonging to the same quadrant.

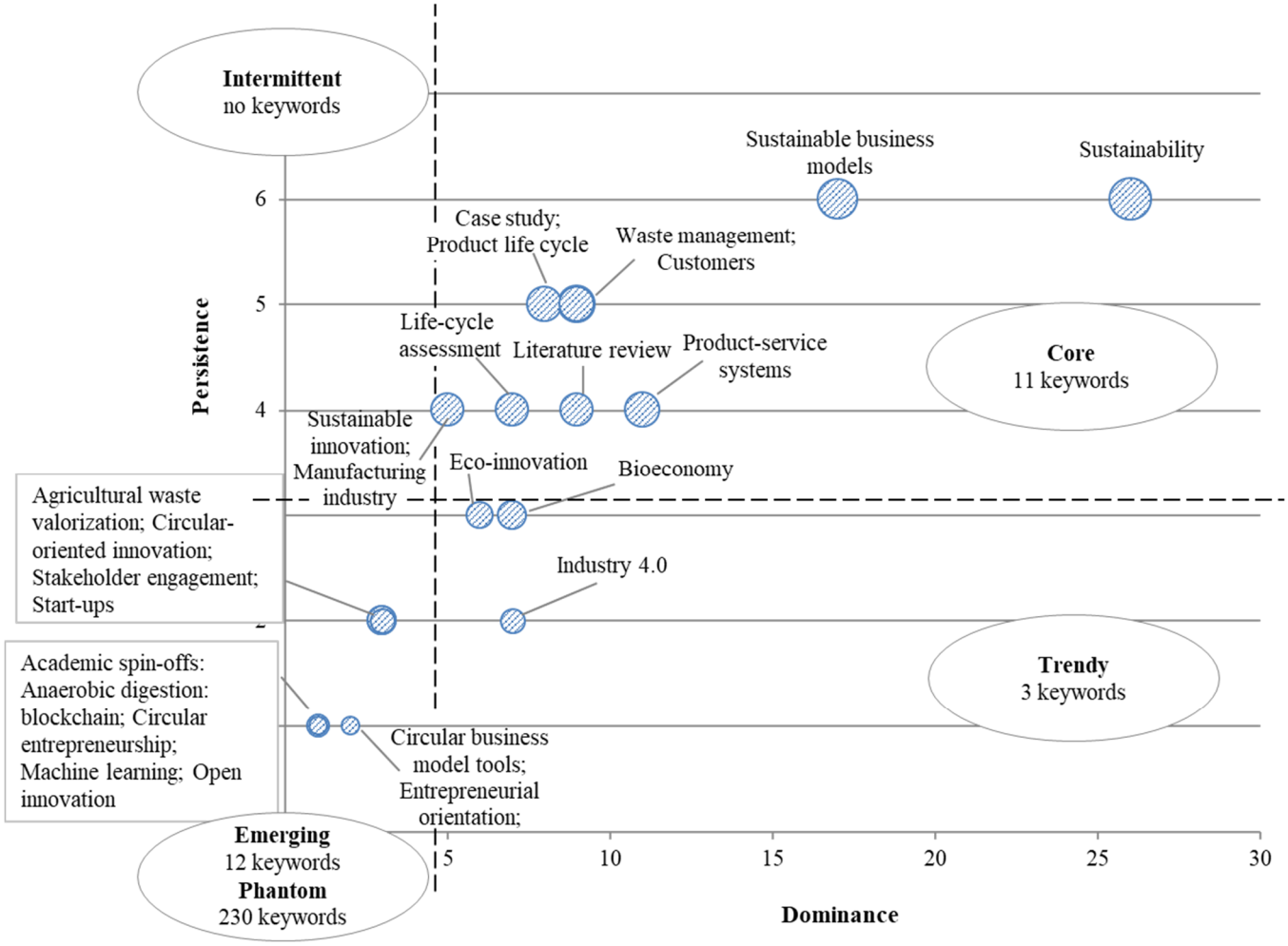

Figure 10. Persistence versus dominance of the keywords.

5. Discussion

This paper aims to investigate the field of circular business model innovation with a three-part objective in mind:

(a) understanding how the intellectual structure of CBMI is organized,
(b) understanding which are the trendy topics of research within the literature on CBMI, and
(c) understanding which are the emergent topics of research within the literature on CBMI.

Applying the model in [6], we classified the existing literature into four macro-categories through the study of authors' keywords, which were grouped by combining the two dimensions of dominance and persistence. The result is a framework able to give an idea of the CBMI intellectual structure. In particular, it is possible not only to identify consolidated research areas, highlighted by the core quadrant, but also to predict the most promising topics of research, which are detailed in the trendy and emerging quadrants. The discussion of each quadrant's content is reported below. We decided to describe in

detail the topics belonging to the trendy and emergent quadrants, because in the former there are the concepts on which scholars' attention is primarily focused, while in the latter there are concepts that will deserve more in-depth analysis in the future. The core topics quadrant, on the other hand, contains research topics that are well established in the CBMI literature, and therefore they do not require further analysis. For this reason we have chosen to describe them briefly using a table.

5.1. Core Topics

The top right quadrant includes keywords with high dominance and persistence; therefore, they represent the core concepts on which the literature on circular business model innovation is based. Table 3 shows these concepts, accompanied by a brief justification of their belonging to the core quadrant. It can be noticed that most of the core keywords refer to general concepts, such as sustainability, sustainable innovation and waste management.

Table 3. Core CBMI research topics.

Core Keywords	Reason
Case study, Literature review	CBMI is a relatively new and underinvestigated topic; consequently, many articles adopted the case study methodology to further explore it. In addition, literature review is also a widely used methodology, demonstrating scholars' interest in mapping the current state of the art in order to identify areas for future research.
Customers	Customers are key actors in the CBM process as their purchase intention is crucial for CBM implementation [38].
Manufacturing industry	The Manufacturing industry is the industry that CBMI-related studies have focused on the most.
Product life cycle, Life cycle assessment	The product life cycle is at the heart of the circular economy dynamics. Life cycle assessment is a technique used to evaluate the environmental impacts that occur in every stage of a product's life cycle [39].
Product-service systems (PSS)	Product-service systems are business models that involve the joint delivery of products and services. Different PSS types lead to different circular strategies, and most of them are considered as a typology of circular business models. In particular, use-oriented and result-oriented PSS are the most suitable for implementing circular strategies [40].
Sustainability	The essential concept around which the research revolves.
Sustainable business models	An umbrella concept that includes circular business models.
Sustainable innovation	Sustainable innovation is the creation of something new that improves performance in the three dimensions of sustainable development: social, environmental and economic [41].
Waste management	The concept of waste minimization, recovery and reuse is one of the focal points of the circular economy; hence, waste management is the basis of most circular business models.

5.2. Trendy Topics

The trendy concepts are characterized by high dominance but low persistence; they refer to topics covered in a large number of articles in a limited time span. The trendy keywords resulting from the analysis are bio-economy, eco-innovation and Industry 4.0. The inclusion of the term industry 4.0 in the trendy quadrant is justified by the high number of articles studying this concept associated with circular business models in a relatively small time horizon. Although it is popular, the Industry 4.0 concept is not classified as core because the novelty of the phenomenon makes it first appear in the sample of analyzed articles only in 2019. The expression Industry 4.0 indicates a wide range of digital technologies related to the use of data (further broken down into big data, cloud computing and Internet of Things issues), analytics, the interaction of man

and machine and the transition from digital to physical (e.g., 3D printing or robotics). Such technologies help to break down some of the main barriers to implementing circular economy practices, especially the lack of an adequate information flow. Indeed, in most cases, the scarcity of data, divergent data and the lack of trust on confidentiality discourage companies from adopting a circular economy model [42]. Numerous studies (e.g., [43–45]) agree that digital technologies, such as Internet of Things (IoT), big data, and 3D printing, enable the transition to circular business models, helping to generate value by increasing energy efficiency, extending the useful life of products, components, and materials, and recovering their value at the end of the cycle. Bressanelli et al. [46] argue that Industry 4.0 technologies intervene at every stage of the product lifecycle to enable the transition to more circular business models. At the initial stage, data collected through big data and IoT enable the product to be designed in such a way as to extend its useful life and facilitate its recovery at the end of its life. During the product's use phase, on the other hand, IoT allows constant monitoring, limiting the risk associated with a misuse of the product that would cause a reduction in its useful life. In addition, the combination of IoT, big data and analytics allows the optimization of resources and the introduction of predictive maintenance models, consequently extending the useful life of the product. Since digital technologies 4.0 make it possible to track the product, the knowledge of its location and status favors the procedures of recovery and re-introduction into the economic cycle through refurbishment, remanufacturing or recycling.

The concept of bioeconomy is closely related to that of circular economy. The idea behind the bioeconomy is similar to that underlying the circular economy, namely the compelling need to rely on renewable biological sources during the pursuit of economic growth [8]. Indeed, the bioeconomy can be defined as an economy based on the sustainable use of renewable natural resources and on their transformation into final or intermediate goods and services. Therefore, the bioeconomy includes not only traditional sectors such as agriculture, fisheries, aquaculture, and forestry, but also more modern economic sectors such as biotechnology and bioenergy [47]. To effectively make a transition to a bioeconomy, it is necessary to focus not only on technological innovations that can transform renewable resources into goods and services but also on the innovation of the company's business model. In fact, most products in the bioeconomy are not profitable, primarily because of their lack of attractiveness, so it is necessary to rethink how the company creates, delivers and captures value [48]. The use of circular business models represents a viable option for companies interested in moving to a bioeconomy as it allows them to totally rethink the value proposition, taking the circular perspective into account [49]. The enabling effect of the circular business model on the transition to a bioeconomy has been identified only recently, as the first studies to have related these two concepts date back to 2019. Nevertheless, interest in this dynamic has grown rapidly, making the keyword bioeconomy a trendy one.

In addition to the keyword bioeconomy, the term eco-innovation also refers to the environmental dimension that characterizes circular business models. The objective of this form of innovation is to address the environmental impact caused by the production and distribution of products, acting on the optimization of the necessary resources and the reduction of waste [50]. In fact, an increasing number of companies have become concerned about the environmental impact caused by their resource transformation processes, convincing them to use eco-innovation to simultaneously create economic and environmental value [51]. According to [52], eco-innovation is defined as any innovation, technological or non-technological, that fosters progress toward sustainable development by promoting the more efficient use of natural resources and reducing the impact of production methods on the environment. Specifically, [53] (p. 7) defines eco-innovation as "the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alterna-

tives". Eco-innovation plays an important role in the transition to the circular economy. Vence and Pereira [54] have identified six types of eco-innovation capable of fostering the implementation of a circular economy model: product design, process, organizational, marketing, social eco-innovation and system eco-innovation. In particular, [55] identifies organizational and process eco-innovations as enablers of the circular economy, as they enable the transition to a circular business model.

5.3. Emerging Topics

The emerging keywords we found are as follows: academic spin-offs, agricultural waste valorization, anaerobic digestion, blockchain, circular business model tools, circular entrepreneurship, circular oriented innovation, entrepreneurial orientation, machine learning, open innovation, start-ups and stakeholder engagement. They can be grouped in four main clusters, discussed below.

5.3.1. Collaboration

Circular oriented innovation (COI) figures among the emerging keywords, justified by the fact that it is a new and still under-investigated concept [56]. It represents a new strand of research within the circular economy literature; specifically, it consists of the study of combinations of product design, business model, and value network configurations to implement circular economy strategies [57]. The common goal of such strategies is to act on product obsolescence in order to preserve product characteristics for as long as possible or to restore their integrity, limiting the use of new resources and the disposal of obsolete goods [58]. However, the resources, capabilities and infrastructures to implement these goals in most cases are held by different actors, making collaboration among them necessary. For this reason, COI is closely related to the concept of collaboration and, more specifically, to collaborative innovation. In fact, collaboration means the voluntary interaction between two or more entities (individuals or organizations) in order to exchange information, expertise, data and resources to achieve a common goal or one that is impossible to achieve individually [59]. Collaborative innovation, instead, is the process through which new ideas, products, services or business models are created thanks to the shared contribution of different players [56]. Given that collaboration is essential to pursue circular oriented innovation, it is necessary to explore how this can be successfully carried out, as the management of collaborative networks is one of the main criticalities faced during CE strategies implementation [2]. The major critical issues experienced during collaboration between actors operating at different levels of a product's life cycle (and who traditionally do not work together) are mainly the difficulty of aligning on a common goal, the difficulty of including the right actors in the network, and the difficulty of developing circular-oriented governance and decision making [56]. The creation of a network of relationships aimed at promoting the implementation of circular economy practices in a company's business model implies inflows and outflows of knowledge across organizational boundaries [60]. These knowledge flows are at the basis of the paradigm of open innovation, theorized by Chesbrough in 2003 [61]. In fact, open innovation refers to the use of both internal and external ideas to produce innovation. Despite the fact that the concept of open innovation is not brand new, its intersection with the circular economy is still poorly investigated; for this reason the open innovation keyword appears among the emerging terms. Adopting an open innovation strategy in relation to circular business models means establishing a network of collaborative relationships with external partners, customers, or user communities in order to improve the implementation of circular practices [62]. Collaborating with a plurality of different actors allows the generation of different solutions on many issues underlying the circular business model, such as new re-uses of waste resources. Moreover, collaborating also means sharing resources for a common purpose, so open innovation helps to establish new ways to exploit the excess capacity of organizations [63]. Bocken and Ritala [64] identified three CBM strategies based on open innovation: open-narrowing, open-slowing and open-closing. In all three, collab-

oration represents the focal point. Open-narrowing is a strategy in which collaborations are vital to reduce the environmental impact of production processes. In most cases this takes the form of coopetition between companies operating in the same sector at the same level of the supply chain (e.g., manufacturers), which work together to optimize the use of resources [65]. Companies that adopt this approach create a value proposition that focuses on communicating their ecological practices to consumers, with an emphasis on reducing the use of raw materials. Open-slowing is a strategy in which the collaboration between different stakeholders has the function to extend the lifetime of a product through the proposal of innovative solutions, in order to delay as much as possible the moment of its disposal. The last one, open-closing, aims to reduce waste through the integration of an external ecosystem. For instance, in this case, a company decides to collaborate with a player who provides it with resources but who is also able to recover those resources after their use and inject them back into the system.

5.3.2. Circular Entrepreneurship

Another emerging concept is that of circular entrepreneurship; however, due to its novelty, it still lacks of a proper investigation [66]. The expression circular entrepreneurship indicates "the processes of exploration and exploitation of opportunities in the circular domain" [63] (p. 7), while the circular entrepreneur is an agent who aims to do business in accordance with the principles of circular economy [67]. In fact, circular economy and entrepreneurship are closely interlinked as, on one side, circular economy opens up a range of new business opportunities, while on the other side, entrepreneurs are crucial to implement circular business models [68]. Start-ups are receiving increasing attention in the circular entrepreneurship scene. A start-up is a newly created organization with a high degree of innovation, which is designed to grow rapidly according to a scalable and repeatable business model [69]. Since they are characterized by a high degree of flexibility and a high propensity to innovate, they are likely to adopt a circular business model from the very beginning. Henry et al. [70] identify five archetypes of circular business models adopted by start-ups: design-based, focused on the efficient use of resources; waste-based, focused on creating value from waste; platform-based, focused on resource sharing; service-based, focused on offering services that substitute products; and nature-based, focused on offering products that lower the input of natural resources. Like start-ups, spin-off companies are entrepreneurial initiatives well suited to the implementation of circular business models [28]. In fact, a spin-off is a type of venture that aims to give shape to an idea born in the context of another company or university, splitting off from the parent organization. In particular, the corporate spin-off generally arises from an existing enterprise to exploit innovations and knowledge that would otherwise not be usable, limiting the risk associated with the project to the new venture. The academic spin-off (ASO), on the other hand, stems from the decision to support, through an entrepreneurial strategy, an innovative idea born within a university in order to develop a marketable product or service [71]. ASOs are promoted by professors and/or researchers who leave their respective institutions to devote themselves entirely to the new company [72]. As such, academic spin-offs enable the transfer of knowledge and technology to the productive and commercial sectors, indirectly fostering local economic development. An emerging line of research is focused on the contribution of academic spin-offs to improving environmental and sustainability performance through their ability to generate innovation by promoting forms of change in business models [73]. Poponi et al. [73] conducted a study on a sample of 24 Italian academic spin-offs operating in the area of green economy Smart Specialization Strategy. They found that ASOs can be promoters of circular processes as long as they work on a high valorization of waste.

5.3.3. Agro-Waste Valorization

Agricultural waste valorization and anaerobic digestion are two trendy keywords that are part of the more general theme of waste valorization in the agro-food industry.

The principles of circular economy require that technical and biological materials flow in a continuous cycle and that wastes are preferably avoided, minimized or recycled. The concept of waste valorization is flanked by recycling and reuse technologies, as it is a process of transforming residues into products with a higher value. In particular, agro-industrial waste has a high potential to be valorized instead of disposed in landfills [74]. Circular business models represent an innovative solution that allows such agricultural wastes and byproducts to be used in a cyclical way, so that new products or applications can be developed based on natural resources [75]. De Corato et al. [76] highlight the possible uses of by-products from cereal crops, wine production and manure. Specifically, these co-products are used for the production of heat, biogas, first bio-material, food and feed. Kapoor et al. [77] provide an example of a circular business model based on waste valorization in order to obtain, produce and distribute natural biogas. In recent years, it has become popular to use biomass-related waste for clean energy production, with the specific goal of minimizing greenhouse gas emissions. For this purpose, agricultural waste has emerged as a potential source material for biogas production [78]. There are several technologies available to produce energy from such waste, applying the circular business model called waste-to-energy. The cheapest one is anaerobic digestion, which is a complex biological process in which, in the absence of oxygen, organic material is transformed into biogas thanks to the action of several types of specialized microorganisms [79]. In this way the organic matter is processed in a sustainable way and kept in a closed loop, solving the problems of both non-renewable energy usage and waste disposal [80].

5.3.4. Digital Technologies 4.0

It has to be noted that different aspects of Industry 4.0 (categorized as a trendy keyword), such as blockchain and machine learning, appear among the emerging topics, confirming the relevance of the relationship between Industry 4.0 and circular business model innovation.

Blockchain technology was introduced in 2008, associated with the emergence of Bitcoin. Its function was to ensure the tracking of transactions through the storage of data records. Subsequently, it also found application in areas other than cryptocurrencies, for example, in supply chain, value chain and business models. In general terms, in fact, the blockchain is configured as a decentralized network composed of economic agents that validate the state of shared data [81]. Openness is one of the characteristics that makes blockchain so widely applicable, as it allows facilitating intra-organizational collaboration [82]. Adopting this technology makes it possible to solve the problem of managing information flows within a company, ensuring their reliability. In fact, information about products and services plays a fundamental role in the organization of production and consumption cycles required to implement circular models. Some scholars (e.g., [83]) have found a positive feedback in using blockchain for a better management of waste materials. This use could play a pivotal role in integrating the circular economy into the business model of companies, as it would allow them to track the entire lifecycle of a product, certifying all stages from the sourcing of raw materials to the final stage of the product's life cycle. Constant certification at each stage acts as a guarantee of reliability, solving the problem of the perceived risk associated with the use of recycled, remanufactured or reused products [81].

Another branch of literature that has gained considerable popularity in recent years is grounded in the marketing concept of the consumer acceptance of new value propositions characterized by circularity. As already mentioned in Section 2, CBMI can occur by building a new fully, or almost completely, circular business model or by transforming the existing business model into a circular one. The first mode is more frequently adopted by start-ups or new companies, while incumbents tend to transform their business model or to diversify their value proposition through the juxtaposition of an acquired CBM to the existing one. Deciding to irreversibly change their business model to introduce circular principles represents a complex challenge for companies, which face the risk that the new

value proposition may not satisfy the current customer base. For this reason, the use of machine learning algorithms and simulation models is becoming increasingly popular [84]. An algorithm was developed, able to learn the behavior of a small group of consumers, established through a survey, and replicate it in a larger population [85]. By implementing the trained algorithm in a simulation model, it is possible to predict customer acceptance of a new circular value proposition.

6. Conclusions, Limitations and Future Research Directions

The main objective of this literature review is to map the intellectual structure of CBMI, focusing mainly on trendy and emerging issues. Although there are several literature reviews on the circular business model, ours differs in two main aspects. First, it was conducted with a methodology not adopted by anyone so far, which allowed us to reach the paper's objective through a detailed keyword analysis. Second, previous reviews were conducted on a sample of articles published by 2019 or early 2020. Although they are recent, interest in this topic has grown significantly over the past two years, resulting in an exponential growth in the number of published articles. One of the results of the keywords analysis is the identification of emerging research themes, summarized in Figure 11.

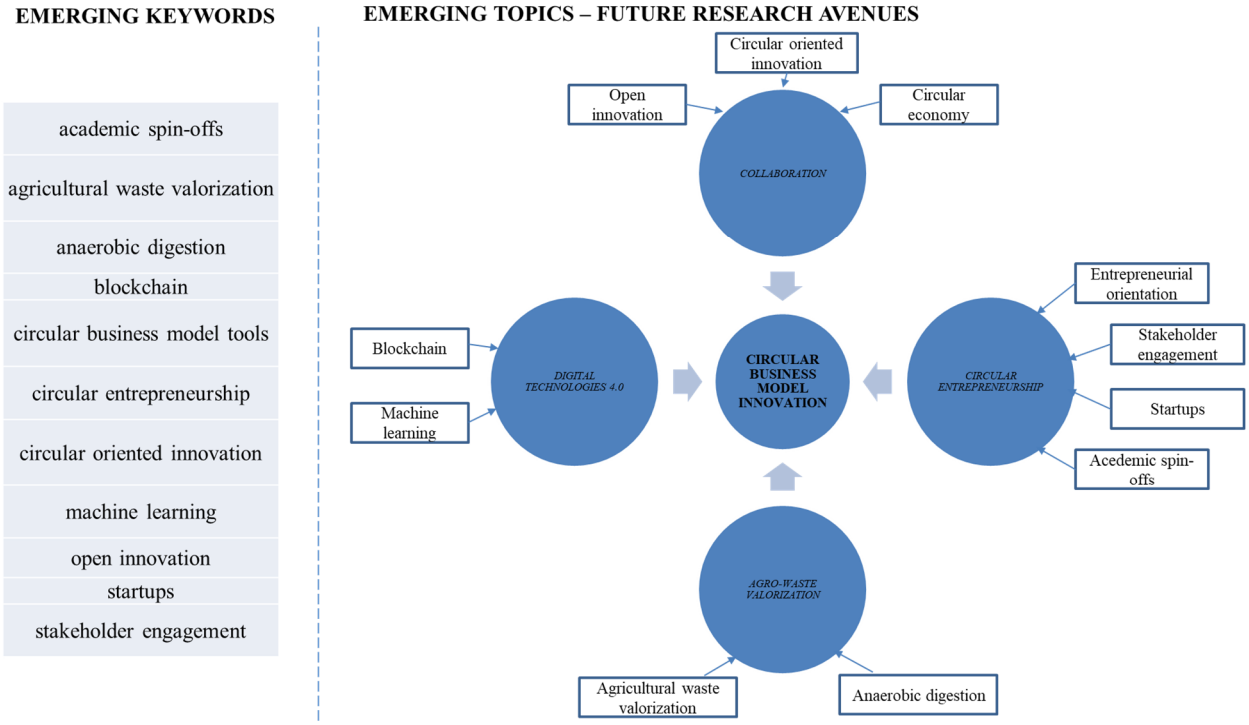

Figure 11. Future research avenues deriving from emerging keywords investigation.

In fact, through the mapping of keywords that appeared for the first time in 2019, it was possible to identify four main strands: the issues of collaboration, circular entrepreneurship, agro-waste valorization and digital technologies 4.0. They give a precise indication regarding the direction of future research. As far as the first issue is concerned, it emerged that the topic of collaboration is focal in the CBMI literature. Indeed, the concept of collaboration bridges the gap between circular oriented innovation and open innovation, two relatively recent themes that have captured the attention of scholars. Circular oriented innovation, which is among the emerging keywords, refers to a bundle of strategies that enable the implementation of circular practices by focusing on preserving the characteristics of a product for as long as possible. They include product design, business model modifications and different configurations of the value network. For such strategies to be put into practice, multiple actors are needed, making the issue of collaboration particularly

urgent. The creation of a dense network of relationships implies that the circulation of knowledge flows across organizational boundaries. Inflows and outflows of knowledge are the basis of open innovation. Although this paradigm has not emerged recently, its intersection with the circular economy and, more specifically, with circular business models is still poorly investigated. For this reason, it is necessary to further investigate the relationship between open innovation and the implementation of circular business models. In fact, the role of open innovation could be that of facilitator of the transition towards more circular business models. In this regard, the theme of collaboration is focal. In fact, open innovation is based on the collaboration among different players and on the building of a network of relationships. The second future research proposal also has a collaborative matrix. It deals with the role of academic spin-offs, traditionally involved in open innovation processes, in the development of circular business models. This issue is part of the broader topic of circular entrepreneurship, which is a concept that is still poorly explored. Entrepreneurship and the circular economy are closely linked, and their interaction has captured the attention of scholars, who have begun to investigate the role of start-ups as promoters of circular activities. Implementing circular practices in a mature company is far from straightforward due to organizational rigidities and difficulties in integrating new dynamics into the organization's status quo. The start-up, on the other hand, allows this problem to be overcome. In fact, since it is a completely new venture, its business model can be designed by including circular elements from the very beginning, thus precluding the need to integrate them later. Academic spin-offs are a particular type of start-up that leverages open innovation. Currently, only the study by [73] has explicitly investigated the effects of the role of academic spin-offs, but it is necessary to further explore the dynamics with which they are able to foster the creation of new circular business models based on innovation. Agro-waste valorization and digital technologies 4.0 represent two further avenues for future research. The former suggests a further investigation of the topic of waste valorization in the agro-food industry. While the issue of waste valorization is widely debated, little has yet been written about this topic with regard to agro-food. It is interesting to study the creation of innovative business models to put this into practice. The latter is based on Industry 4.0 technologies, in particular blockchain and machine learning. They can be used to foster the implementation of circular business models, since the first allows the product to be constantly tracked, facilitating its disposal, while the second allows the prediction of customer acceptance of new circular value propositions.

The paper has both theoretical and managerial implications.

As for theoretical contributions, the merit of this study is its having investigated a quite recent research field—circular business model innovation—in its multiple facets. Moreover, the findings of this review allow us to derive some considerations about possible future research activities. Indeed, looking at the sample papers reviewed, it emerges that various aspects of CBMI have been treated only marginally. Thus, attention should therefore be directed in particular to the research topics that were labelled as "emerging" and "trendy", for example, collaboration, circular entrepreneurship, agro-waste valorization and digital technologies 4.0 as for the emerging ones as well as bio-economy, eco-innovation and Industry 4.0 as for the trendy ones. These are the topics that should be investigated in greater detail in future research activities. The implications from findings, together with the limitations of this study, further open new research avenues for future studies.

From a managerial perspective, the paper provides several contributions. The literature has shown that the issue of collaboration is of considerable importance both for companies wishing to make a transition towards circular business models and for start-ups building their business model from scratch based on circular practices. Since the basis of collaboration is the exchange of information, the difficulty in transferring relevant information between different players represents a huge limitation to the success of CE initiatives. In particular, the lack of protocols to follow and platforms to facilitate the sharing of knowledge and resources between companies, organisations, academia and government can hinder the implementation of circular business models [86]. To facilitate the construction

of an effective network, in which there is an easy and direct exchange of information, the digital technologies of Industry 4.0 can be a solution for practitioners. In fact, the literature shows that digital 4.0 technologies are gaining ground in promoting, stimulating and enabling the transition to circular business models and their implementation in both start-ups and mature companies. Such tools can be used to facilitate the connection between the different players involved, creating value through the complementarity of knowledge.

However, like any other research paper, this study also presents some limitations. The first limitation refers to the fact that further analysis could be performed, including additional bibliometric tools; these include, for example, co-citation analysis, page rank analysis and data clustering. In addition, the definition of the sample of papers was made using only two databases, namely Scopus and Web of Science; thus we may have missed relevant contributions. Although these databases are considered to be comprehensive, it would be possible to gather further relevant studies by exploring other databases as well, such as Google Scholar. Finally, a cross-reference snowballing process could have added undetected papers.

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