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CIRCULAR ECONOMY AND ITS RESTRICTION

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ABSTRACT: The paper discussed both the benefits and limitations of the circular economy. Furthermore, we discuss that this concept is ambiguously defined.. A circular economy seems to be a satisfactory remedy for expanding environmental pollution and waste overproduction The benefits of the circular economy are believed to ever exist. Surprisingly, there is some evidence to believe that rebound effects can diminish these types of social benefits addressed in current literature by leading to increased resource consumption. We want to check if the circular economy positively contributes to the business model. Therefore, we applied the method of systematic literature review. This paper's value is important since it argues that we must integrate circularity across supply chains rather than limiting them to waste management. Moreover, indicators of the Circular Economy are not yet commonly agreed upon, and data are limited to waste. The paper recommends for further review of the circular concept.

KEYWORDS: circular economy, benefits, industrial economy, rebound effects, sustainable development, waste management

Introduction

The previously existing "linear economy" concept was exemplified by permanently exhausting non renewable resources and then utilising them into products for sale through a series of physical transformation value-adding steps. The responsibility for waste utilisation of 'dead' products was transferred to the purchasing a-product customer. "Linear economy" is very regularly represented by the 'bigger-better-faster-safer' picture, which relates to the overconsumption pattern caused by excessive advertisement and mass media, together with fashion industry actions, emotions and progress. Biological processes of closing loops of biomass, water and nutrients, commonly existing in nature – assure resource availability for mankind. However, humans are becoming more environmentally aware, moving from grey to green consumers and willing to change old habits of "making, using, throwing away" into sustainable ones. Therefore, it appears crucial to introduce a new standard to divert from the old common practise of consuming and dumping into the direction of sustainable development by decreasing the excessive usage of resources and diminishing environmental impact while at the same time improving the life cycle of products. This principle is commonly referred to as the "circular economy" (CE), which consists of consumption and manufacturing according to the scheme based, e.g. on a multiple-"R": recycling, reuse, repair, remanufacturing, and additionally on product sharing, changing consumption patterns, and new business models and systems (European Commission, 2017). One mentioned example of that model could be the secondary use of bumpers, tires, cloth materials, shoes, and recycling plastic into pellets. The EU will continue to develop a circular economy globally to implement the Sustainable Development Goals (European Commission, 2020). In the past, Boulding (1966), cited by Wreglesworth (2020), was a pioneer who warned about remarkable outcomes of the "linear economy" and initiated a discussion on the consideration of the earth as a metaphor for space shuttle necessary for the survival of mankind. To date, however, no single definition of circular economy has emerged (Homrich et al., 2018; Korhonen et al., 2018). The CE concept is often treated rather as "an umbrella" concept incorporating various meanings (Moraga et al., 2019). Regardless of the ambiguous idea, some researchers try to transform CE into action plans supported by specific indicators. To enable recognition of what specific indicators measure, a classification framework to categorise indicators according to reasoning on what (CE strategies) and how (measurement scope) was suggested by Moraga et al. (2019). A paper by Kirchherr (2017) enumerated nearly 114 definitions related to this concept. The authors thus contend that, given the variety of formulated definitions, it is

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very challenging to provide one homogeneous definition of the circular economy. Some researchers confirmed that a single definition is merely unattainable (Korhonen et al., 2018; Prieto-Sandoval et al., 2018). They argued that by including only one CE definition, we may omit other possible meanings. Climate change contributes significantly to economic turnout.

On this basis, the work focuses more on the "substance" of the circular economy, in other words, on the different principles (3R) and methods (Ghisellini et al., 2016; Mongo et al., 2022), although the expression "circular economy" still remains broad, it must include at least the phrases of inputs reduction, reuse, and recycling waste (Su et al., 2013; Thomas et al., 2003; Yu et al., 2013; Yu et al., 2014). Paper by Homrich et al. (2018) and Gregson et al. (2015) demonstrated industrial symbiosis and extended product life. In turn, the concepts within industrial ecology, such as cradle-to-cradle, can be considered leading principles for eco-innovation, in which wastes are treated as raw materials for new products and applications, known as the term "zero waste economy" (Mirabella et al., 2014).

The research gap is the insufficient studies related to the circular economy and business models to date. Having considered the fact that there has not been verified proof that circular economy positively contributes to the business model. To prove that, the article is structured as follows. Section 2 is devoted to reviewing the existing narrative on the circular economy. Section 3 presents the data and methodology. Section 4 displays and discusses the empirical results. Section 5 draws conclusions.

An overview of the current knowledge

The term circular economy seems was introduced in the XX century (Pearce & Turner, 1990). Underlying that "everything could be an input to everything else'', the authors strongly criticised the old-fashioned approach of the linear economic model and developed a new "circular", which involves thermodynamical laws. The common interactions between the economy and the environment are protuberant in the circular model, which incorporates the basic economic functions of the ecosystems: resource supplier, waste assimilator and source of utility (Rizos et al., 2017). The common definition of tools and criteria for measuring the degree of circularity of products, companies or regions is still nebulous (Haas et al., 2015). Several authors shed light on this gap, pointing out the necessity of constructing high-quality and effective indicators in the transformation from a linear to a circular model of the economy. Elia et al. (2017) provided a review of selected methodologies and indicators according to five CE characteristics taken from the European Environmental Agency data (EMEP/EEA, 2016). The authors demonstrated

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that defined indicators and methodologies alone are not able to monitor all the CE features. Furthermore, Iacvideou (2017) analysed the existing methods to evaluate resource recovery from waste to promote CE. Their results indicated similarly that none of the methods alone could account for the retention of value in waste resources, and a rather holistic approach is crucial as necessary to encompass all the environmental, economic, social, and technical dimensions of CE. Moreover, a paper by (Pauliuk, 2018) offered a set of indicators with the BS 8001:2017. This standard aims to help the CE implementation in businesses, organisations, and production systems. One of the problems is the omitting of that standard compliance requirements. The proposed dashboard used existing indicators to assess five characteristics promoted by the BSI standard (restore, regenerate, maintain utility, maintain financial value, and maintain nonfinancial value) and existing indicators for complementary characteristics (resource efficiency, climate, energy, and sufficiency) (Pauliuk, 2018).

According to other Scholars' definitions: "circular economy is an effective approach that would transform the function of resources in the economy" (Preston, 2012). For example, the existing technology enables the use of wastes from one company as a material input to the next process at another one (cradle to cradle) since products after their life cycle could be repaired, reused or upgraded instead of thrown away' (Rizos et al., 2017). This is depicted as an industrial symbiosis – the process by which by-products of one industry or process become the raw materials for another process. We can give an example of brewery wastewater that contains valuable materials such as sugars, soluble starches, ethanol, volatile fatty acids and suspended solids, which can be reused by Amoriello and Ciccoritti (2021). Application of this idea allows to diminish material consumption and enables the formation of a circular economy. In line with this idea, (Signals 2014, n.d.) claimed that the circular economy "refers mainly to physical and material resource aspects of the economy – it focuses on recycling, limiting and re-using the physical inputs to the economy, and using waste as a resource leading to reduced primary resource consumption.

Circular economy (CE) is described as an SD solution that is being proposed to tackle the challenges of environmental pollution and resource availability. It is incorporating CE's 3-R philosophy (reduce, reuse and recycle materials). The basic rules depend on a circular system where each material can be recycled, energy originates from renewable sources, activities support and rebuild the ecosystem and support a healthy society, and resources are properly used to generate value (Heshmati, n.d.). The circular economy is, furthermore, a presentation of models that create new business possibilities where linear processes are replaced by cycles. It is revitalising and regenerative by project and aims to keep products, components, and materials at their

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highest utility and value at all times, for Kirchherr et al. (2017) the common point of all CE definitions is that circular economy is mostly a combination of three principles, namely the reduction, reuse, and recycling of activities (also called the 3Rs) (Mongo et al., 2022). These principles are further elaborated in the remainder of this section.

One of CE's targets is to decrease energy-intensive activities, raw materials, and water and, furthermore, minimise waste amount or air pollution. The cleaner production concept as a proactive strategy enables us to achieve that target. Moreover, another concept can be helpful, Eco-efficiency, which focuses on the economic and environmental dimensions. It is focused on increasing productivity and reducing the use of resources. Eco-efficiency is largely induced by (green-innovation) (Cainelli & Mazzanti, 2013), which allows companies in their production activity to take into account, throughout the life cycle of a product/process, all the environmental damage caused (Kemp & Pearson, 2007). For its part, resource efficiency implies both a reduction in the use of resources and an increase in economic and social well-being (Ness, 2008).

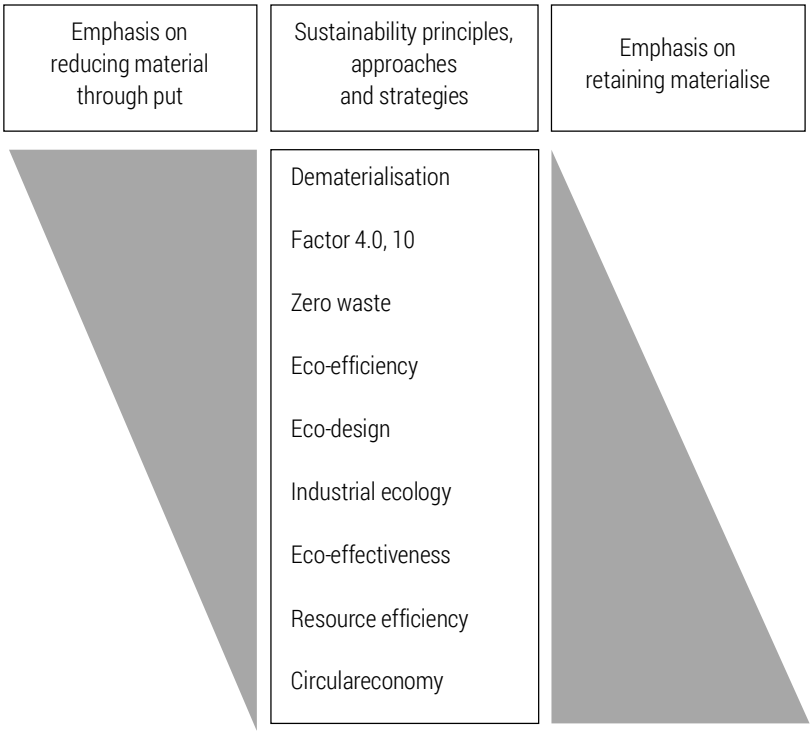

Figure 1. Evolution of the circular economy concept

Source: author's work based on (Iacovidou et al., 2017).

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The European Commission, which supports circularity, estimated that the CE revolution could even bring 600 billion euros in annual economic profit for the EU manufacturing sector alone (European Comission, 2017; Khan et al., 2022), and the global economy would benefit 1000 billion US dollars annually. Similarly, Japan passed a law called "promotion of efficient utilisation of resources" in 2000 and made it mandatory for manufacturers to run disassembly plants to recover products (Abubakar, 2018).

The circular economy concept evolution is presented in Figure 1.

Companies make money by low-cost strategy, trading high volumes of inexpensive products. There is an alternative. A 'circular economy' would turn goods that are at the end of their service life cycle into resources for others, closing loops in industrial ecosystems and minimising waste (Stahel, 2016), which is presented in Figure 2. It would change economic logic because it replaces production with sufficiency: reuse what you can recycle what cannot be reused, repair what is broken, and remanufacture what cannot be repaired.

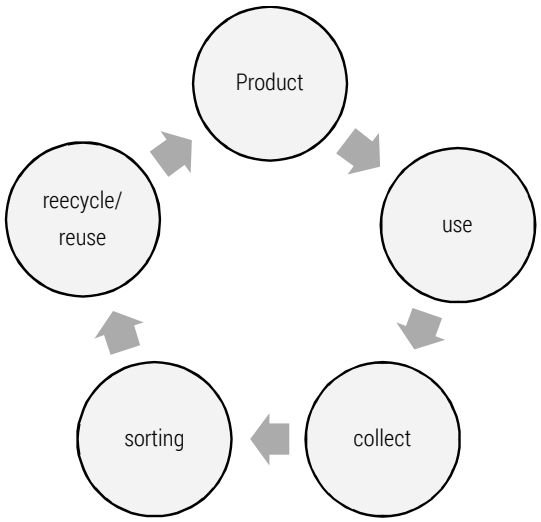

Figure 2. The circular economy concept illustration

Source: author's work based on Ezeudu and Ezeudu (2019).

One of the illustrations of the emerging problem of CE implementation is the fact that even 30 percent of plastic waste is neither collected nor managed at all (OECD, 2022). Despite the commonly accepted significant benefits of CE, the intended outcomes are not always achieved due to the occurrence of rebound effects. The industrial economy can be divided into both linear and circular (Stahel, 2016).

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Research methods

The systematic literature review method (SLR) was applied to find current articles most relevant to circular economy to pics and business models. In addition, the literature and documents review enabled us to identify the research gaps and assess the most significant documents. We analysed reuse, which is one of the basic circular economy ideas which involves all physical activities that allow waste to be used a second time to prolong its life by asimilar or completely different application. The reuse implies operations, which may contain maintenance, repair or reconditioning. We have tounder line the meaning of "reuse", mainly no change in the functionality or the use for which it was designed. Represented as a combination of all three bases, specifically the reduction, reuse, and recycling of activities (shortcut- 3Rs). These principles are further developed in the remainder of this section.

A systematic literature review (SLR) method critically reviews previous examinations in order to answer a research question (Dewey & Drahota, 2016). The systematic review should follow a clearly defined protocol or plan where the criteria are clearly stated. We constructed a search query using the Web of Science databases to elaborate on the field of our research study. We applied the Social Science Citation Index of Clarivate Analytics Web of Science (WoS SSCI) since its thoroughly selected publications prepared readers with the most important research information. Web of Science is the biggest database of peer-reviewed literature – scientific articles, books and conference materials. To safeguard the consistency of that research, the full texts of the selected articles were manually coded. We analysed articles to exclude those not relevant or under scientific-level publication. The overall search process resulted in a sample of bibliographic records achieved through queries (Table 1).

Table 1. Syntaxes used in query calibration for database exploration

No	Query Syntax	No of results
1	Results for circular economy (All Fields) AND benefits (All Fields) and 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 (Publication Years) and Management or Business (Web of Science Categories) and Article (Document Types)	168
2	Results for circular economy (All Fields) AND business models (All Fields) and 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 (Publication Years) and Management or Business (Web of Science Categories) and Article (Document Types)	548
3	Results for circular economy (All Fields) AND business models (All Fields) AND benefits (All Fields) and 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 (Publication Years) and Management or Business (Web of Science Categories) and Article (Document Types)	91

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Limiting references to Circular economy, business models, and benefits allows the identification of several clusters. The four clusters (green, white, green, red, and blue) were automatically identified and coloured by the VOSviewer software and next presented as the bibliometric map in Figure 3.

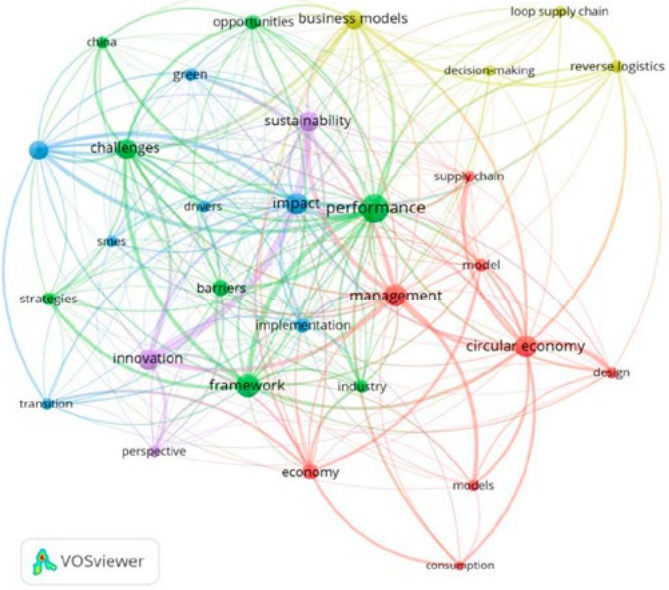

Figure 3. Visualisation of results for circular economy and business models from years 2017-2023 in Voswiever software https://www.vosviewer.com/

Source: author's work in Voswiever software.

The red cluster in Figure 3 connects the circular economy, models, consumption, design and innovation, together with supply chain competitiveness, circular economy, consumption, industrial performance, and competitive advantage. The blue cluster connects impact, drivers, transition, and supply green management. The green cluster connects performance, challenges, framework, barriers, and strategy. The white green connects business models with circular economy, total supply chain models, reverse logistics, alternate energy, and renewable energy.

Circular-economy business models are usually classified into two groups: (1) those that foster reuse and extend service life through repair, remanufacture, and upgrades and (2) those that turn old goods into as-new resources by recycling the materials. People's behaviour is crucial to the model (Webster et al., 2017). Ownership gives way to stewardship; consumers become

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users and creators. The remanufacturing and repair of old goods, buildings and infrastructure creates skilled jobs in local workshops.

Results of the research

We analysed literature to date and proved that a transformation to a circular economy would bring substantial benefits in the reduction of the country's greenhouse gas emissions by up to 70% and increase its employment by about 4% (Khanna et al., 2022). Nevertheless, an interesting, reducing benefits effect called as Circular Economy Rebound (CER) was identified, which may be striking in some circumstances (Zink & Geyer, 2017). The original, more thoroughly researched 'classic' rebound effect typically occurs when beginning boosts in production/consumption efficiency are lost out due to absolute increases in production/consumption (Barker et al., 2009; Brookes, 1990; Jevons & Flux, 1965) also recognised as Jevons' Paradox (Siderius & Poldner, 2021). The concept has also been named as the 'backfire' (Broberg et al., 2015). The total effect incorporates the direct effect and the influence of (1) the lower energy price on energy demand in the three broad sectors as well as of (2) the extra consumers' expenditure from higher (implicit) real income, and (3) the extra energy-efficiency investments (Barker et al., 2009).

Table 2. Indicators of circular economy with trends for country-example of Poland

Indicator	Value (year)	Trend
Recycling rate of municipal waste [%]	38,7(2020)	increasing
Recycling rate of all waste excluding major mineral waste [%]	58 (2018)	increasing
Recycling rate of overall packaging [%]	55,5 (2019)	decreasing
Recycling rate of plastic packaging [%]	31,5 (2019)	decreasing
Recycling rate of wooden packaging waste [%]	27,3 (2019)	decreasing
Recycling rate of e-waste [%]	39,1(2018)	increasing
Recycling rate of biowaste [kg per capita]	42 (2020)	increasing
Recovery rate of construction and demolition waste[%]	74 (2020)	decreasing

Sources: author's work based on Eurostat (2021).

The available data on the circular economy with the trend is presented in Table 2. However, data are scarce and limited only to waste, as they present reliability, and we observe a deficit of other resources. Contrary to a strong belief that sales of used products will eliminate sales of new ones, some scholars to date proved such an idea can be misleading (Frota Neto et al.,

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2016; Gutowski et al., 2011; Makov & Font Vivanco, 2018; Thomas et al., 2003). As a result, the production of new units is only partly displaced by reused or recycled products, and thus, the total production even increases (Thomas et al., 2003). A commonly referred literature example is the case of a "driver who replaces a car with a fuel-efficient model, only to take advantage of its cheaper running costs to drive further and more often" (Druckman et al., 2011; Warmington-Lundström & Laurenti, 2020).

Nevertheless, that concept has been highly supported by the EU, which spent €650 million on its package to transition to a Circular Economy, and China is the first country to adopt a law for the Circular Economy Commission (European Commission, 2017; EEA, 2014). In parallel, there has also been growing uptake of the Circular Economy amongst businesses with foundations such as the Ellen MacArthur Foundation (2017) promoting its benefits to its "CE100 companies" including Dell, Coca-Cola and IKEA although the extent to which these companies have done so is unclear.

Discussion, limitation and future research

The article highlighted numerous problems concerning the ambiguous definition of the circular economy and the round about effects of economic growth and implementation that inhibit the application of the Circular Economy as a tool for environmental improvement. The arguments presented in this article are limited in scope andoverlook details regarding the distinct but co-evolving scientific and practice discourses. To date, inconsistencies exist regarding how the Circular Economy influence social equity, enables economic growth, and limits the rate of extraction of raw materials depletion. Further intensive work should be conducted, particularly related to the closed-loop solution' costs. In the conducted research, we faced numerous difficulties related to the Eurostat countries' data scarcity. We have to underline further that, as Allwood (2014) argued, secondary production can notfully substitute primary production. In an in-depth analysis concerning the life-extension of the major material classes, the researchers underlined that today, no technology is able to break down some garbage structures or clean some fluids. This paper recognises that there may be many other aspects of the Circular Economy relating to Sustainable Development that have not been yet discussed. This paper critically evaluated the concept of CE with a specific focus on rebound effects. From a literature review on CE, significant barriers exist, which governments should be familiar with to complete a transition that seems still far from being achieved. In particular, according to several authors, CE has shown a lack of attention on the basis of the CE concept, i.e., social and environmental sustainability.

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Conclusions

We conclude this research from the theoretical, practical point of view by confirming that available indicators to date from the 'CE monitoring framework' are vague and limited to waste statistics as a result of the limited statistics and reliability only on some data and deficit of other resources. On the one hand, the indirect CE indicators are based on waste and materials data; on the other, the direct CE indicators based on recycling data use waste statistics to analyse information on the possible approaches to reuse materials. The recycling rates from the 'CE monitoring framework' are a promise that a fraction of waste will be upgraded as a secondary material in the context of the literature review. Circular business models transform product and material flows through the economy. In that way, they can mitigate or eliminate environmental side-effects coming from the resource extraction, use, and eventual disposal of waste. Finally, shifting to a more circular and resource-effective economy will require more widespread penetration of circular business models. The policy can address the market failures, policy problems, and present circumstances and biases that currently impede the competitiveness of these business models. The classification framework shows the preservation of functions as an open question for CE indicators. However, the less clear boundary of preservation functions (compared to products or materials) may also raise uncertainty in CE concept evaluation. The pessimistic conclusion is that in some areas, the recycling rate of packing is decreasing. However, it requires elaborate research. Particularly, the European Commission calls for a transition to bio-based, biodegradable and compostable plastics.

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