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Original article

Economic geography's contribution to understanding the circular economy

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Abstract

This article explores the role of evolutionary economic geography in enhancing understanding and implementation of the circular economy (CE). By incorporating spatial and territorial dimensions into CE research, this study emphasizes the significant influence of geographical factors on achieving economic and environmental objectives. The research highlights the importance of localizing CE practices and emphasizes the contributions of proximity theory and territorial governance in promoting collaborative networks that are crucial for CE success. Furthermore, the article introduces the concept of Territorial Circular Ecosystems, which provides a framework for analyzing regional variations and the interplay between local actors, resources, and institutional support in the deployment of the CE. The findings offer fresh insights for policymakers and researchers, advocating for place-based policies to address CE challenges and optimize sustainability strategies.

Keywords: circular economy; path dependency; territorial governance; evolutionary economic geography; territorial circular ecosystems.

JEL classifications: Q50, Q57, Q58, R10, R12, R50.

1. Introduction

The transition to a sustainable economic model is at the heart of many current debates about how to address climate change (Coenen, Benneworth, and Trufferd 2012). Investing in the circular economy (CE) is emerging as a key solution, as evidenced by the European Commission's CE action plan adopted in 2020. This approach to production, which is defined in opposition to the traditional linear economy, promises to limit the waste of resources and reduce environmental impacts while increasing the performance of economic systems (Ellen MacArthur Foundation 2013). It thus claims to combine economic efficiency with environmental excellence, offering a pragmatic solution to the climate disruption and biodiversity loss that threaten the current model of production and consumption (Stahel 2016; Kirchherr 2022). Defined by its intent to minimize waste and make the most of resources, CE can be considered a resource-related concept for sustainable development (Cecchin et al. 2021).

However, to fully realize the ambitions of CE, it is essential to understand its economic and environmental implications. Economically, CE aims to create sustainable added value, optimize resource use, generate new jobs, encourage innovation, and promote both local and global competitiveness (Stahel 2019). From an environmental standpoint, CE seeks to significantly reduce waste, decrease the consumption of non-renewable resources, limit greenhouse gas emissions, and protect biodiversity

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(Ghisellini, Cialani, and Ulgiati 2016, Bourdin and Torre, 2020). With this in mind, we argue that the geographical and territorial dimensions of CE, often overlooked in previous studies, play a crucial role in achieving its economic and environmental ambitions.

Economic geography, a discipline that analyzes the spatial and geographical distribution of economic activities, offers a valuable lens for examining the extent to which the spatial dimension impacts the implementation of CE, while also expanding the knowledge produced on CE. Although economic geography was traditionally uninterested in sustainability, as the discipline has developed, it has become increasingly concerned with environmental issues (He et al. 2022). This evolution gave rise to a particular subfield known as environmental economic geography. This subfield concentrates on the evolutionary aspects of sustainable transition by analyzing the interaction between economic processes and the environment (Gibbs 2006; Hayter 2008). Environmental economic geography investigates the environmental constraints on economic activities, the environmental effects of these activities, and how environmental changes, in turn, impact economic activities (He et al. 2022).

Taking into consideration the evolutionary aspects of sustainable transition (Köhler et al. 2019), Evolutionary Economic Geography (EEG) provides a dynamic framework for understanding the spatial evolution of economic activities. EEG highlights the processes of change and adaptation over time. It draws upon principles from evolutionary economics, such as path dependency, innovation, and industrial dynamics, to explain how economic activities undergo transformation (Boschma & Frenken 2018). This approach is particularly relevant to the CE as it enables the analysis of how regions have specific capacities and develop unique trajectories for adopting CE practices. By focusing on historical contingencies and the cumulative nature of economic development, EEG facilitates the identification of factors that contribute to the success of certain regions in implementing circular initiatives. It also sheds light on the role of local institutions, technological lock-ins, and the diversity of industrial sectors in promoting or impeding the transition to a CE.

In this context, our article makes a significant contribution by applying a geographical lens to the study of CE, with particular emphasis on the dimensions of EEG. The aim of the article is twofold. First, we emphasize how integrating a territorial dimension into the definition of CE allows us to recognize the role that geography plays in achieving both its economic and environmental objectives. We theorize about the connections between economic geography and CE, highlighting how this integration can enhance the understanding of challenges and opportunities at the local level. Second, we explore how EEG provide new insights for studying CE. Specifically, we demonstrate how incorporating a geographical dimension expands our understanding of the regional dynamics in CE, a field that has received limited attention thus far. Third, we introduce the Territorial Circular Ecosystem (TCE) framework, which provides a framework for analyzing the specific interactions and synergies within a given territory that facilitate the effective implementation of CE. TCE emphasizes the significance of local collaborations, resource availability, and institutional support in fostering a CE. From this perspective, it offers a comprehensive approach to understanding how regional specificities and their evolution over time influence CE outcomes.

Our study begins by exploring the importance of the geographical dimension in enhancing the efficiency of CE. Next, we critique the existing definition of CE and suggest a more comprehensive understanding that includes economic geography. We then explore how EEG can enhance our comprehension of CE. Following these discussions, we introduce a new theoretical framework—the TCE—to understand the dynamic, interconnected network of economic players, institutions, policies, and practices within a specific territory that work together to optimize resource flows, reduce waste, and promote regeneration through CE principles. Lastly, we propose potential avenues for future research, emphasizing the substantial impact of geography on the economic and environmental outcomes of CE practices.

2. The geographical dimension: The missing link in defining CE

In this section, we show that understanding CE processes and their optimization cannot be achieved without considering the spatial dimensions that are at the heart of these operations. If these aspects are neglected, the definition of CE remains incomplete and often unclear.

2.1. Reviewing the definition of CE

2.1.1 A simple definition

CE has its roots in Boulding's idea of the Earth as a "spaceship," emphasizing that our planet has limited resources and, thus, the need for a holistic, cyclical approach to its management (Boulding 1966). In the second half of the 20th century, various ecological theories and movements emerged, such as energy and materials conservation with ecological economics or bioeconomy (Georgescu-Roegen 1971), industrial ecology (Allenby 1992), sustainable development (Brundtland 1987), or, later, cradle to cradle design, emphasizing the importance of designing products and systems that can be endlessly recycled or upcycled (McDonough and Braungart 2002). The idea of circularity is inspired, in particular, by the way natural ecosystems function, where the waste products of one species become the resources of another, creating a closed, self-sustaining system (Frosch and Gallopoulos 1989). In the 1970s, the Club of Rome drew attention to the limits of economic growth in a world of finite resources (Meadows et al. 1972), when some authors developed a theory to explain the relations between the economy and the environment on the basis of material balance sheets (Kneese, Ayres, and D'Arge 1970), resulting in the concept of industrial metabolism (Spash 2013). From this convergence of ecological and economic perspectives, the foundational principles of CE were delineated.

Many researchers have contributed to the development of CE, such as Pearce and Turner (1990), who proposed a CE model introducing the concepts of positive or negative amenity, depending on the impact of economic activity on resource stocks and, more generally, the environment. Nowadays, the essence of CE lies in the idea of moving from a linear "extract, produce, consume, throw away" economy to a more sustainable, circular model that integrates nature's cycles. It is thus a model that is simple to understand and grasp, with clear ambitions that are more limited than those of the concept of sustainability. Due to its more operational nature (Kirchherr et al. 2023), CE is gradually supplanting sustainable development, with its imprecise limits (Ruggiero 2021) and unclear implementation methods (Huesemann 2003).

CE seeks to create a *closed* system in which resources are reused, recycled, and recovered as much as possible, thus minimizing waste and the exploitation of natural resources (Ellen MacArthur Foundation 2015). Instead of creating products with a specific end of life, products are designed to be used for as long as possible, then disassembled and reused, and their waste is transformed into new resources. This practice helps to reduce the amount of waste generated and minimize the impact on the environment. CE can also help reduce dependence on non-renewable resources by promoting the use of renewable materials and increasing resource efficiency (Geissdoerfer et al. 2017). Finally, CE offers the opportunity to create a more inclusive and equitable economy by involving local populations in the production and recycling loop and shortening production circuits. By valuing waste as a resource and encouraging new forms of consumption, such as the sharing economy, CE can create new economic opportunities and reduce inequalities (Ghisellini, Cialani, and Ulgiati 2016).

CE is widely recognized by many companies and public authorities alike as a strategy for making the economy more sustainable by limiting resource consumption and waste (Bourdin, Galliano, and Gonçalves 2022). Stahel (2013) emphasized that by adopting the principles of CE, industries can increase their profitability while reducing their environmental footprints. Geissdoerfer et al. (2017) provided another perspective by defining CE as "a regenerative system by design aimed at conserving resources by minimizing waste, the emission of harmful substances, and the erosion of resource stocks." Thus, the EU has made it one of the major elements of its green deal policy (European Commission 2019), and the survey conducted in Flash Eurobarometer 441 (2016) highlights that the majority of companies in twenty-five-member states have undertaken CE activities, albeit at sometimes quite different levels of involvement (European Commission 2016).

2.1.2 A useful, but still unclear, model

Over the years, several attempts have been made to conceptualize CE. Among conceptualization efforts, the work of the Ellen MacArthur Foundation is often cited as the most significant. This organization defined CE as an economic model that aims to "conserve and enhance natural capital by controlling finite stocks and balancing renewable flows," "optimize resource use by circulating products, components, and materials at their highest level of utility at all times," and "promote system efficiency by minimizing negative externalities" (Ellen MacArthur Foundation 2013). Other researchers have also attempted to clarify this concept. Stahel (2019) highlighted the importance of maintaining the value of

products, materials, and resources in the economy for as long as possible while minimizing waste generation. Kirchherr, Reike, and Hekkert (2017), for example, analyzed over a hundred different definitions of CE and concluded that the CE is "an economic system that aims to eliminate waste and the continuous overuse of resources." They also pointed out that CE involves more than just technological improvements and requires a societal paradigm shift toward more sustainable consumption.

CE, while offering many potential environmental and economic benefits, has come under scrutiny due to some of its perceived limitations. Korhonen, Honkasalo, and Seppälä (2018) pointed out that CE encompasses a multitude of different ideas yet still lacks a clear, unified framework for implementation. This can lead to a diversity of understandings and interpretations of CE, making it difficult to implement coherent strategies at the policy, corporate, and local initiative levels. Nevertheless, a recent article by Kirchherr et al. (2023) explained that the concept has gained robustness and consistency over the last five years. Another frequently cited critique of CE is that it focuses primarily on environmental and economic efficiency, without taking social impact into account (Lazarevic and Valve 2017). For example, while CE is capable of creating new economic and labor opportunities, it can also lead to job losses in some traditional industries (Laubinger, Lanzi, and Chateau 2020), meaning that the labor balance remains unclear. It may prove difficult to distribute the benefits of CE evenly across society, with marginalized populations finding themselves less able to enjoy its advantages. Moreover, some critics have argued that CE could potentially perpetuate existing unsustainable consumption patterns. For example, Hobson (2016) argued that CE can be used to justify the continued consumption of goods by promoting the idea that it is sufficient simply to recycle or reuse these goods, without questioning the dominant economic model based on economic globalization, mass production, and consumption, and promoting a further increase in flows without any real reflection in terms of sustainability. In short, while CE offers significant opportunities for improving sustainability, it is also subject to significant criticism that should be recognized and addressed.

2.2. Highlighting the geographical dimension in the definition of the CE

2.2.1 Introducing the spatial dimension

The importance of geography in CE has been increasingly recognized by researchers and practitioners alike. CE is not only about minimizing waste and maximizing resource reuse; it is also deeply rooted in the spatial and territorial fabric of the economy (Niang, Torre, and Bourdin 2022). By *geographical dimension*, we refer to the deliberate emphasis on localizing resource flows and production–consumption systems within specific territorial boundaries, allowing regions or areas to have more direct control and influence over their economic activities. This move to relocalize flows aims to *close the loops* at a localized level, be it a region, a city, or a local community, and strives to promote greater territorial autonomy (e.g., the ability of a region or locality to operate independently without excessive reliance on external resources). Such autonomy can reduce the vulnerabilities associated with long and complex global supply chains. Furthermore, CE's localized approach minimizes the negative environmental externalities often associated with transportation and globalized production (Fischer and Pascucci 2017).

Indeed, a localized approach can significantly contribute to territorial resilience, that is, the capacity of a territorial unit to effectively adapt to and recover from various shocks, whether they are of an economic or environmental nature. Boschma (2015) provided a comprehensive explanation of how historical contingencies and regional specificities play a crucial role in determining the level of resilience. He particularly highlighted the importance of path-dependent processes and existing infrastructures in shaping regional economic trajectories. Within this framework, regions can attain both economic stability and resource security by adopting a CE model, which involves reducing reliance on external resources and establishing self-sustaining local systems. An illustrative example of this concept in action is the development of circular short food supply chains. These chains facilitate direct economic interactions between local producers and consumers within a confined geographical area, embodying the essence of geographical proximity and local system dynamics (Gallaud and Laperche 2016; Paciarotti and Torregiani 2021).

Furthermore, CE practices encourage the emergence of new businesses specializing in recycling, repairing, or reselling used objects, as demonstrated by the development of the second-hand economy (Bocken et al. 2016). Finally, resource recovery also contributes to local economic development. For example, organic waste is transformed into compost or energy through biogas. This process not only creates jobs in waste processing, but also supports the development of local activities, such as agriculture

and renewable energy production (Burg et al. 2023). By mapping value circuits and examining the role of social enterprises (SEs) in local development, especially those involved in CE, Lekan, Jonas, and Deutz (2021) underscored the feedback loops and tensions inherent in the (re)production, (re)circulation, exchange, and consumption of products and services within CE. They illustrated that CE not only generates economic value, but also fosters value in broader ways, emphasizing local and social inclusivity.

2.2.2 A new definition including the geographical component

Given this evidence, we propose to integrate the spatial dimension into the characterization of CE and retain this definition: "*CE is an economic system that aims to break with the linear economy by minimizing resource waste and environmental impact, while enhancing efficiency throughout the entire product life cycle. The ecological and economic efficiency of CE is linked to its geographical dimension, which promotes adaptive and locally-tailored resource management strategies. These strategies aim to maximize the sustainability and resilience of production methods while considering the specific geographical characteristics and trajectories of development of the territory where CE is implemented.*" This definition highlights that CE minimizes waste and maximizes product life and resource reuse, and also integrates a spatial and territorial dimension. CE aims to optimize resource cycles on a local scale, which can reduce greenhouse gas emissions and other environmental impacts associated with transporting resources and waste over long distances.

3. An EEG perspective on CE

3.1. Path dependency and sectoral variety

While the adoption of CE approaches is increasing, thanks, in particular, to the impetus of public policies at various scales (Arsova et al. 2021; Newsholme et al. 2022), a recent study shows that the geography of its deployment differs according to regions (Niang, Torre, and Bourdin 2022). This raises the central question of why implementation varies from one region to another, from one city to another, and even from one neighborhood to another. By analyzing regional differences in CE deployment, we can identify the local factors that influence the success or failure of CE initiatives. This allows us to move beyond a one-size-fits-all approach and recognize that the challenges and opportunities of the CE transition vary according to regional contexts. Some regions may have abundant natural resources to fuel CE loops, while others may face constraints, such as the availability of sufficient or appropriate natural resources, the availability of skilled labor, the level of infrastructure development, local business models, and environmental regulations (Rajaonson and Chembessi 2024).

Proposing an analytical framework helps to highlight the synergies and tensions between CE objectives and regional, territorial, and local priorities in terms of economic, social, and environmental development. While environmental imperatives, such as reducing greenhouse gas emissions and preserving natural resources, are essential to CE in all regions, the specific emphasis may vary. In some regions, CE initiatives may primarily be driven by economic goals, such as job creation or addressing the scarcity of human resources, due to local socio-economic conditions. In other regions, environmental concerns may take precedence, shaping CE practices to prioritize sustainability and ecological preservation. Thus, implementing CE is not about choosing between economic or environmental goals, but rather integrating these objectives in a way that aligns with the local context and challenges.

3.1.1 The theoretical framework

Analysis based on the theory of EEG provides a solid theoretical framework for comprehending spatial variations in CE deployment. This approach suggests the concept of path dependence, which asserts that a region's past economic paths have a substantial impact on its future development (Martin and Sunley 2006). Consequently, it can be hypothesized that the historical, economic, and institutional characteristics of each region will determine the approach it takes in adopting and implementing CE practices.

Several authors have emphasized the importance of this theoretical perspective in understanding economic geography and the evolution of local economic systems. Notably, studies by Boschma and Frenken (2006, 2018) have highlighted how historical events and previous decisions by local actors can shape economic development trajectories. For example, a region with a long industrial tradition

focused on specific sectors may be inclined to adopt CE practices related to these sectors and, therefore, base its sustainable territorial development on the sophistication and greening of these previous practices. Such an approach also exploits a region's competitive advantage due to the presence of specialized skills, existing capital and infrastructure, established supply networks, and favorable cultural norms.

Companies from various sectors (energy production, oil refining, chemical manufacturing, agriculture, etc) often work together to exchange resources. For example, thermal waste from a power plant is used to heat a fish farm, and organic waste from the fish farm is then used as fertilizer on neighboring farms (Jacobsen 2006). An article by Ehrenfeld and Gertler (1997) about Kalundborg Industrial Park (Denmark) is particularly enlightening; while the authors do not explicitly mention the concept of path dependency, the article highlights the historical evolution of Kalundborg's industry, in which interdependent relationships among different companies developed over time. These relationships often stem from industrial decisions and collaborative practices that go back several decades and have shaped current practices and influenced the choices of companies in the region. As Morales and Diemer (2019) demonstrated in their study of industrial symbiosis in Dunkirk, France, institutions, whether formal or informal, can also have persistent effects on firms' behaviors and foster continuity of collaboration and exchange practices. Finally, technological lock-ins can contribute to path dependency by limiting the options available to companies and reinforcing existing patterns. In the Kalundborg case, specific technologies and infrastructures were put in place to facilitate the exchange of materials and energy between companies, creating specific technological and industrial pathways that could be difficult to change once established (Valentine 2016).

3.1.2 *Economic diversity and complexity*

Economic diversity is crucial because it demonstrates how regions can use their diverse industries to drive innovation and sustainable regional development (Content, Frenken, and Jordaan 2019). It underlines the importance of the concept of related variety (Boschma and Iammarino 2009) in the implementation of CE processes and, consequently, reveals that regions that are good candidates for smart specialization policies because of their complementarity characteristics (Pinheiro et al. 2022; Bathelt and Storper 2023) are also good candidates for implementing CE strategies. In the context of CE, connected variety can facilitate synergies between different industries, enabling the implementation of industrial symbiosis. However, the setting and functioning of local industrial symbioses are possible only if the different nodes in the local value chain are not too far apart. The Kalundborg industrial park is an example of such practice, where waste from one process becomes input for another, highlighting the potential for sustainable resource management.

This framework helps us understand how the interconnectedness and economic complexity of a region's industries can significantly influence its ability to adapt to and adopt CE practices. Regions characterized by a dense network of related industries can more easily transition to circularity initiatives, leveraging their existing capabilities, such as technological expertise, skilled labor, and supporting institutions, to facilitate this change. By harnessing the inherent synergies between sectors, regions can effectively implement circular strategies, minimizing waste and improving resource efficiency through the establishment of industrial symbiosis networks (Kasmi 2021). Furthermore, the cross-sectoral flow of ideas and technologies enables the development of new solutions to environmental challenges, highlighting the importance of encouraging connected diversity as a key element in the pursuit of more sustainable economic development. By deliberately focusing on building and maintaining these cross-industry links, policymakers, and business leaders can unlock the full potential of CE and develop tailored sustainability strategies that capitalize on the strengths, available resources, and unique capabilities of their regions. This was demonstrated by Chembessi, Bourdin, and Torre (2024) in a comparative case study between France and Quebec, Canada.

3.2. Geographical and organized Proximity dynamics

Proximity theory, understood as a part of EEG, provides a comprehensive framework for understanding the factors involved in CE deployment. This approach emphasizes the significance of geographical and organized proximity, highlighting their role in promoting interactions, trust, and coordination among economic actors (Torre and Gallaud 2022).

The existing literature shows that geographical proximity allows for more frequent interactions among economic actors, enabling the exchange of information and knowledge (Boschma 2005). However, geographical proximity alone is not sufficient to ensure collaboration. Organized proximity, which refers to cooperative and coordinated relationships among economic players, is equally important (Torre and Rallet 2005). This form of proximity facilitates the sharing of essential information and knowledge for identifying and capitalizing on collaborative opportunities. Among the various approaches developed in economic geography, this analytical framework is the most commonly applied to CE, even if its use remains scarce.

3.2.1 *The essential but limited role of geographical proximity*

Geographical proximity can play an important role in understanding what drives collaborations between actors and how they collaborate in CE projects. Several studies have shown that CE can facilitate resource sharing, information exchange, and cooperation between companies. While this information is essential for the implementation of CE practices (Tapia et al. 2021; Bourdin, Galliano, and Gonçalves 2022; Niang, Torre, and Bourdin 2022; Veyssière, Laperche, and Blanquart 2022), these results have been known since the early 2000's in the context of the linear economy framework. More significant, however, is the finding that the development of CE initiatives at the local level induces a reduction in resource transport distances. This reduction has a significant impact on greenhouse gas emissions caused by the consumption of fossil fuels, and leads to a subsequent reduction in the consumption of local resources (Sorrell 2015; Bourdin, Galliano, and Gonçalves 2022). A study by Nasir et al. (2017) demonstrated that the adoption of CE in the construction sector reduced transportation distances for construction and demolition waste, leading to a significant reduction in CO2 emissions and air pollution. Therefore, proximity theory offers an appropriate framework to highlight the extent to which the CE practice needs to be local to be environmentally efficient. Otherwise, long-distance transport can also have significant local adverse effects, as demonstrated by the recycling of used clothing from Europe to Ghana and its harmful environmental consequences (St John James and Kent 2019).

However, geographical proximity is not in itself sufficient to ensure the success of CE (Niang, Torre, and Bourdin 2022). In the context of industrial CE, companies need to exchange information on available resources and waste so that they can be reused or recycled efficiently. In this sense, by using proximity theory, some researchers (Chembessi, Bourdin, and Torre 2024) have shown innovative results in the field of CE by demonstrating that communication is facilitated when companies have preexisting cooperative relationships prior to their CE exchanges. Second, organized proximity can help overcome some of the obstacles to CE. It facilitates the sharing of information and knowledge between companies, which is essential for identifying and exploiting opportunities to reuse and recycle resources. As several researchers have highlighted (Cerceau, Mat, and Junqua 2018), companies that collaborate closely may be better able to share information about their production processes and waste streams, which can identify potential synergies that might otherwise have been missed. Third, by studying organized proximity, some researchers have shown how strong relational structures between actors enable better coordination of economic activities. This is particularly important in the context of CE, which often involves complex coordination between different companies and economic activities (Veyssière, Laperche, and Blanquart 2022). For example, in an industrial symbiosis where one company's waste becomes another's resource, good coordination is needed to ensure that waste is transferred efficiently and at the right time (Chertow and Ehrenfeld 2012; Gallaud and Laperche 2016).

However, organized proximity, while essential to the effective implementation of a CE, is not automatic and presents challenges and limitations. Indeed, studies have shown that creating and maintaining cooperative and coordinative relationships between economic actors can be difficult (Boschma 2005). This is particularly true in the context of CE, which generally involves major changes in the way companies operate and interact with each other following a change in the production model. A study by Newsholme et al. (2022) analyzed the discrepancies in priorities and visions between regional authorities and businesses concerning CE in North Humberside, England. It revealed conflicting perspectives on CE implementation, emphasizing the challenges of aligning regional and business interests for sustainable growth. Moreover, one of the major challenges is mistrust between economic actors, which is likely to hamper the cooperation and information sharing required for CE (Pusz, Jonas, and Deutz 2023). This mistrust is based on various causes such as concerns about sharing sensitive

business information or the perceived risk of being dependent on other companies for critical resources (Ünal, Urbinati, and Chiaroni 2019). In addition, the coordination required for CE can be complex and costly in terms of time and resources. For example, in an industrial symbiosis, it is often difficult to coordinate the timing and logistics of waste transfer between companies due to differing agendas and constraints (Chertow and Ehrenfeld 2012; Zhu and Ruth 2014).

3.2.2 Organized proximity and the construction of cooperative relations

To overcome these challenges, several authors have argued that it is necessary for public authorities to design effective territorial governance frameworks (Niang, Torre, and Bourdin 2022). Concretely, this involves investing in the development of local cooperative and collaborative relationships, for example, by creating formal or informal collaborative structures, establishing norms of trust and transparency, or working with intermediaries to facilitate exchanges. Local actors should also be integrated into the governance process to mitigate and cope with potential opposition and conflict between local actors (Torre and Gallaud 2022). Thus, by utilizing proximity theory in conjunction with the concept of territorial intermediation, it is possible to illuminate the role local authorities can play in implementing CE.

Chembessi, Bourdin, and Torre (2024) showed that building trust, or at least cooperative relations, between CE players is facilitated by repeated interactions and long-term commitments, which can be considered under the heading of organized proximity. The building of such cooperation relies on methodologies for linking CE stakeholders proposed by territorial intermediary actors to facilitate the creation and development of CE approaches (Henriques, Ferrão, and Iten 2022). The actors in charge of these operations include economic development agencies, environmental organizations, local authorities, and even specialized companies that play a crucial role in facilitating the networking, coordination, and sharing of information required for CE. They act as *matchmakers* or brokers, identifying and connecting companies with potential synergies in terms of resources and waste. In this way, they help reveal opportunities for CE cooperation that might otherwise have gone unnoticed.

This strategy of creating local brokers and offering incentives for actors' cooperation is particularly important in cases where geographical proximity is insufficient to reveal ecological synergies, for example, when companies' production relies on complex processes or diversified waste flows (Herczeg, Akkerman, and Hauschild 2018). Territorial intermediary actors are, in this case, supposed to act as CE *orchestrators*, coordinating the activities of different companies and ensuring that resources and waste flow efficiently through the local economic system. This job involves coordinating production plans and delivery schedules, managing waste transport logistics, or even setting up resource tracking and traceability systems (De Angelis, Howard, and Miemczyk 2018), contributing to the development of local CE loops.

In short, proximity theory greatly enhances our understanding of CE dynamics by emphasizing the significance of the spatial and organizational arrangements of economic players. It provides a fresh perspective for analyzing CE initiatives, stressing that the success of these initiatives depends not only on environmental and economic factors, but also on the capacity of territories to mobilize and efficiently structure proximity relationships among the actors involved.

4. TCEs: Understanding the existence of fertile soil for CE

According to the Circular City Centre (C3), in 2022, fewer than 40 of the over 800 European cities with populations above 50,000 have developed CE strategies.[1] The slow and uneven progress in implementing CE across EU cities demonstrates the variable capacities of different territories to adopt CE practices. The concept of territorial absorption capacity (Schillaci, Romano, and Nicotra 2013) illustrates how different territories can integrate and transform CE practices based on their specific characteristics, such as public policies, density, and variety of the local economy, and the culture of innovation and collaboration among stakeholders. This concept highlights the importance of tailoring CE strategies to local realities by recognizing and appreciating the diversity of local capacities to absorb, innovate, and implement circular practices. Therefore, in this section, we emphasize, on the basis of our previous investigations, the essential properties of the implementation of CE by defining what we refer

[1] https://circular-cities-and-regions.ec.europa.eu/support-materials/papers-and-reports/circular-cities-declaration-report-2022

to as a TCE. The starting point for our proposal is recognizing that a region's economic history, and economic development trajectories are critical to understanding its capacity to adopt CE. However, this capacity is not only determined by past trajectories but also by how they interact with current dynamics between territorial actors, particularly their ability to foster collaborations through geographical and organized proximity. Therefore, the existence of an integrated TCE can determine whether a territory is fertile for CE implementation.

A TCE is a dynamic, interconnected set of economic players, institutions, policies, and practices within a specific territory. It works together to optimize resource flows, reduce waste, and promote regeneration through CE principles. Specifically, it is an integrated and dynamic network of actors (companies, public authorities, research organizations, non-governmental organizations (NGOs), citizens, etc) and processes (eco-design, recovery, recycling, reuse, etc) that promote the economic circularity rooted in the territory. This complex structure aims to reduce non-renewable resource consumption, minimize waste production, and promote sustainable product life cycles. It may be incomplete, but the objective in the medium term is that the territory has sufficient building components to foster a comprehensive circular approach, enhancing the reduction, reuse, and recycling of materials within the CE framework (Table 1; Figure 1).

4.1. Territorial governance and local action in favor of CE

Local policies play a crucial role in launching and developing circular initiatives. These policies leverage specific local resources (Bourdin, Galliano, and Gonçalves 2022) and provide a solid basis for adopting sustainable practices. Moreover, they effectively foster the adoption of a CE at the local level by taking into account the unique potential and challenges of each area (Neumark and Simpson 2015). However, in order to move away from one-size-fits-all strategies, it is evident that an effective CE approach requires tailored local interventions. Coordination among various stakeholders is a key factor. By emphasizing bottom-up approaches in CE implementation, it becomes clear that strategies should aim to remove institutional barriers and cultivate a CE-friendly environment through collaborative relationships among stakeholders (Deutz, Baxter, and Gibbs 2019). This transition necessitates focused efforts to improve coordination processes and provide targeted training for local authority personnel, known as capacity building, to establish a conducive environment for CE (Marjanović and Williams 2024). Furthermore, it requires a robust framework of institutional support and public policies to address the gaps identified in localized initiatives. In this regard, Chembessi, Bourdin, and Torre (2024) argue that local authorities can serve as territorial intermediaries to enhance connectivity and collaboration essential for the implementation of circular initiatives.

Thus, TCE requires close collaboration among actors of various types and levels (local, regional, national, and supranational) to link their actions and initiatives. This creates a coherent system that meets the territory's needs while preserving resources. Here again, the analytical framework of EEG helps. Geographical and organized proximities facilitate these collaborations. Direct and frequent interactions, facilitated by short distance, based on trust or reasonable defiance, mutual understanding and expectations, and shared objectives, is essential. In this dynamic, coordination between institutions at multiple levels and coordinated territorial governance are vital for the effective implementation of circular strategies.

Moreover, enhanced regulatory frameworks, comprehensive public policies, and strong institutional backing are vital for establishing a nurturing environment for CE. This includes providing incentives for sustainable practices, setting environmental standards, and investing in research and development (R&D) for new recycling technologies. Institutions such as governments, local authorities, NGOs, and regulatory agencies, have a major influence on shaping the economic landscape. For instance, support for CE can motivate businesses to transition through tax incentives, stricter waste management regulations, or financial assistance for research and development. This can also lead CE companies to adopt labor-intensive solutions that utilize local skills and the workforce, contributing to territorial development and the conservation of non-renewable resources.

A recent study on the UK's steel industry showed that environmental policies have a significant influence on resource recovery strategies, posing challenges for the companies that must adapt to new policy frameworks (Deutz, Baxter, and Gibbs 2019). As part of territorial governance processes, local and regional institutions can exert pressure on companies to adopt more sustainable practices by setting strict environmental standards, offering financial incentives for the adoption of green

Table 1. Components of a TCE.

	Components	Description
Territorial governance	Institutional support and PBPs	Regulatory frameworks, environmental standards, incentives for sustainable practices, and investments in research and development, highlighting the crucial role of governmental and regulatory bodies in fostering a conducive environment for CE.
	Geographical and organized proximity	Proximities facilitating close and collaborative interactions among ecosystem actors, and effective coordination necessary for CE practices through frequent, direct communication and shared objectives and expectations.
	Local collaborations	Networks of various stakeholders—companies, public authorities, research organizations, NGOs, citizens—working together across different levels to coherently link actions and initiatives.
Local resources and innovative behaviors	Human capital and labor market	The availability of a skilled, local workforce adept in CE practices, emphasizing the importance of training, education, and communication about circular job opportunities
	Resource mobilization and support	Financial resources, advisory services, and support for innovation and knowledge sharing that actors within the ecosystem need to implement and sustain CE initiatives.
	Effective resource and waste management networks	Industrial symbiosis systems and strategies for minimizing waste and maximizing resource efficiency, including the creation and facilitation of networks for exchanging resources and reducing waste throughout product life cycles.
	Innovation culture and knowledge sharing	The continuous innovation and the open exchange of best practices and technological advancements that keep the TCE vibrant and productive.

technologies, or strongly encouraging the implementation of CE practices (Moreau et al. 2017; Henrysson and Nuur 2021). The implementation of TCE can be hindered by a lack of coherence and coordination among different environmental policies and regulations (Gibbs and Deutz 2007; Gregson et al. 2015). Therefore, it is important to consider the local institutional context, harmonize regulations at different levels, and create an institutional environment that supports CE (Bahn-Walkowiak and Steger 2015).

4.2. Local resources and innovations

To implement CE at the local level, actors need various resources (Cerceau, Mat, and Junqua 2018; Chembessi, Bourdin, and Torre 2024), which can take different forms, including the support and advice of regional and national agencies, associations, and consultants. Financial resources are also important, whether in the form of direct aid to project promoters or support for organizations that assist them in mobilizing the necessary capital to implement policies and projects that promote circularity. Additionally, CE actors must be able to help project promoters adopt a lifecycle approach to products and services, encouraging reuse, recycling, and waste reduction from the design stage. Establishing effective resource and waste management networks is also important. Industrial symbiosis systems, where waste from one company becomes input for another, require the identification of waste production volumes and the encouragement of intermediary companies to facilitate resource exchange. Furthermore, a strong culture of innovation and a commitment to knowledge transfer and sharing best practices enable CE actors to discover and adopt new technologies, business models, and operational practices that support circularity. Therefore, CE actors must provide the means for stakeholders to innovate and share their knowledge and practices (Kasmi 2021).

Finally, a skilled local workforce is essential for CE as it helps stimulate job creation (Merli, Preziosi, and Acampora 2018). A pan-European study highlighted significant differences in labor intensity

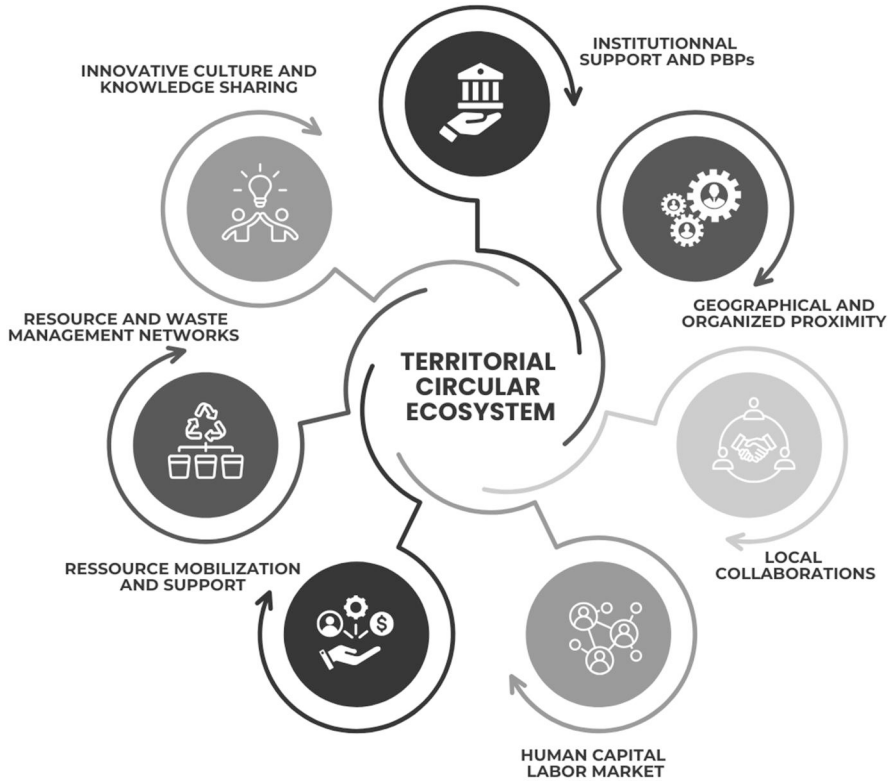

Figure 1. The territorial circular ecosystem.

between repair and reuse, on the one hand, and recycling on the other. It suggested that more attention should be given to improving competitiveness and working conditions in recycling activities, as they are not only ecologically beneficial but also have an inclusive dimension. The availability and quality of human capital are vital, including the existence of a skilled labor pool capable of supporting circular innovations and practices. A favorable labor market can also be achieved by offering training opportunities and providing information about circular employment prospects; in fact, recent literature has shown that the development of the CE requires new skills such as repair or eco-design (Burger et al. 2019). Therefore, it is crucial to address specific challenges, such as the lack of CE skills or knowledge, by investing in training and education, and promoting collaboration between local universities, research centers, and businesses to foster innovation and knowledge transfer.

Such knowledge resources, however, may not be available in all territories. To address this, McCann and Ortega-Argilés (2014) propose enhancing connectivity between stakeholders to strengthen links, at both the regional and extra-regional levels, which are increasingly important for expanding a region's knowledge pool and facilitating learning (Capello and Lenzi 2013). This approach, which combines local knowledge bases with external knowledge flows, or in other terms local ties with global pipelines (Bathelt, Malmberg, and Maskell 2004), can revitalize local industries and promote the implementation of TCE. Specifically, as demonstrated by Kampelmann (2020), who used the example of the urban forest value chain, local policies can proactively stimulate the development of CE by supporting local initiatives, building the capacity of local actors, and promoting innovation and territorial learning generated locally or from outside the territory, carefully using the power of value chains (Crescenzi and Harman 2023).

5. Conclusion and future research areas

This article emphasized the pivotal role of the often-overlooked geographical and territorial dimensions in realizing the economic and environmental ambitions of CE. Based on the EEG framework, we

demonstrated how a geographically informed perspective enhances both the theoretical conceptualizations of CE and the strategies employed to address the challenges it presents. We argued that to meet CE's ambitions, in terms of economic development and environmental impact, we must look beyond resource flows to understand how geographical and environmental dimensions interact with economic dynamics. Thus, we asserted that the geographical dimension is inseparable from the conceptualization of CE.

Overall, we demonstrated that the potential of CE can only be achieved by considering the specificities of the geographical context and territorial dynamics. With this in mind, we utilized the theoretical frameworks of EEG to show how this approach can explain regional variations in the implementation of CE. Based on this theory, we then proposed a conceptual framework to explain the presence of fertile soil for the deployment of circular initiatives. This framework clarifies the prerequisites for implementing CE at the local level and provides a guide for informing public decision-makers about the strategies they can employ to promote CE. Place-based policies should be adopted to effectively address the institutional and environmental challenges of CE. Implementing these policies necessitates a comprehensive understanding of territorial dynamics and the ability to coordinate various levels of public action. In this context, the significance of intermediary actors, such as local economic developers and local authorities, cannot be underestimated, as they play a crucial role in promoting alliances, coordinating networks, and facilitating exchanges.

Within this framework, we propose several avenues for future research in economic geography. First, greater attention should be paid to the interactions between CE and various geographical scales (local, regional, national, and global). Future research could explore how CE initiatives unfold and develop across these different scales, and how they are influenced by the specific contexts and the historical path dependency at each scale. In addition, studies could interrogate how policies at different scales effectively support CE. From this point of view, methods combining economic geography and institutionalist approaches would be particularly appropriate.

Second, understanding geographical variations in the implementation of CE enables policymakers to adapt their policies and programs to the specific needs and characteristics of each region. By identifying the factors that promote or hinder the adoption of CE practices in different cities and regions, decision-makers can design more effective and targeted policies to promote the transition to a more CE. Moreover, by gaining a better understanding of the explanatory factors and examining regions that have successfully implemented CE initiatives, researchers as well as practitioners can identify lessons and good practices that can be transferred to other territories. For example, we can identify the most effective collaborative mechanisms and best practices in participatory governance, by studying regions that have succeeded in establishing effective partnerships between the private sector, the public sector, and civil society to promote the CE. Similarly, by examining regions that have adopted innovative incentive policies, such as tax incentives or subsidies for businesses engaged in CE practices, we can determine the most effective approaches to encouraging the adoption of CE on a local scale.

Third, future research could also study how value creation is distributed in a CE context. In the linear, globalized economy, the stages of resource extraction, production, and consumption often occur in distinct places, resulting in value creation that is distributed across different regions. CE disrupts the linear global value chains and challenges these entrenched capitalist structures. Future research could further identify the entities and regions that primarily generate value in CE, and explore how this value goes beyond economic measures and encompasses more intangible dimensions (Chembessi, Bourdin, and Torre 2024).

Fourth, future research should focus on the role of intermediary actors in promoting CE, how they facilitate CE by building coalitions, orchestrating networks, and facilitating exchanges, and how their actions are shaped by the specific territorial context. Social network analysis (SNA), for example, has proven to be an effective method for unraveling the complex and dynamic interactions between different actors. Now, multiplex approach can bring more information and helps in identifying not only the different categories of actors, but also their mutual and various interests, for example, in terms of circulation of materials (physical dimension), business exchanges (economic dimension), and social relations (institutional dimension) (Snijders Lomi, and Torló 2013; Maghssudipour, Lazzeretti, and Capone 2020). By identifying the most central and influential actors, mapping the structure of relationships, and determining the modalities of exchange, SNA enables us to understand how coalitions are formed and how networks are orchestrated. Qualitative methods, such as case studies and semi-structured interviews, also offer an opportunity to explore in greater depth the roles, motivations, and strategic

approaches of intermediary actors, as well as the challenges and opportunities they encounter in the specific context of their territory when implementing CE projects. In addition, participant observation can provide valuable insights into the day-to-day actions and negotiation processes at work in such projects. Additionally, future research could interrogate the institutional and environmental challenges of CE and how these are addressed in the development of PBPs, including approaches to overcoming institutional barriers and promoting a supportive regulatory environment. Path dependence theory could be mobilized to examine the influence of a region's industrial and institutional past on its transition to a CE.

Fifth, based on the EEG theory of related variety (Frenken, Van Oort, and Verburg 2007), research studies could be conducted to ascertain how geographical and organized proximity at the sectoral level enhances or impedes the establishment of circular value chains, whereby waste from one industry becomes input for another (industrial symbiosis). This research could concentrate primarily on identifying crucial factors such as technological compatibility, the coordination of waste management policies, and the role of informal and formal networks in facilitating the exchange of information and resources. Through the examination of specific instances of both successful and less successful clusters, such studies would strive to develop strategic recommendations for urban planners and policy makers to optimize recycling and reuse infrastructure at the local level.

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