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Entrepreneurship as a transition to the circular economy

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Abstract
Given the challenges facing businesses and society in mitigating climate change, creating and supporting sustainable entrepreneurship is critical. However, the influence of National Systems of Entrepreneurship (NSEs) on the circular economy has not yet been studied. Our research studies the impact of NSEs on countries' circular economies while assessing the impact of the digital transition on this relationship. Using dynamic panel econometric techniques and by using various international databases, it was possible to assess the effect of NSEs on the circular economy. Furthermore, our analysis also allowed us to research how the impact of the digital transition may influence the relationship between NSEs and the circular economy. We achieve that countries with advanced NSEs achieve superior grades in their circular economy. We intend to add to the theoretical field by extending the knowledge of the relationship between NSEs and the circular economy. We also intend that the various actors in the surrounding environment who enhance entrepreneurial activities, realize that entrepreneurship is a fundamental component, within the system to which it belongs, for achieving the circular economy.

Keywords National Systems of Entrepreneurship · Circular economy · Digital transition

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1 Introduction

A wide range of researchers have increasingly paid care to the link among circular economy and entrepreneurship (O'Neill et al., 2006; Fernandes et al., 2021; Trischler and Ying, 2022; Emani et al, 2022). In this movement of research, the conception of sustainable entrepreneurship is by Fellnhofer et al. (2014). And so, sustainable entrepreneurs are understood as vehicles of modification dedicated to continually obtaining a equilibrium among economic capability, social well-being and environmental defense (Youssef et al., 2018). Here the difference between necessity and opportunity entrepreneurship inevitably arises. Since Baumol (1990), it has been clear that Schumpeterian innovative entrepreneurs cohabit through protective and necessity entrepreneurs. In this sense, it is also argued that less developed countries are more prone to the emergence of entrepreneurship out of necessity, thus verifying that the level of economic development of a country contributed to the explanation of sustainable entrepreneurial activity (Terán-Yépez et al., 2020; Wheeler, et al., 2005). In parallel with this relationship (entrepreneurship vs economic performance), North's institutional theory () corroborates the influence of institutions to economic development. It constitutes a basic pillar for the study of entrepreneurship (Aparicio et al, 2016). The entrepreneurs are, beyond all, the promoters for national competitiveness and economic growth (Acs et al, 2016) and emerge as a crucial contribution to economic development (Ferreira et al., 2023) and the sustainability of countries (Ferreira et al., 2020). Several authors have shown that entrepreneurial activity can fluctuate between different countries over time, given that the existence of an economic, social and political climate is as important as the predisposition of individuals to open new businesses (Raposo et al, 2020; Stiglitz, 2016). Understanding the different modes in which formal and informal institutions are organized, the different values, cultures, attitudes and norms are fundamental to understanding the different levels of entrepreneurial performance from country to country (Acs et al., 2016). And so, Acs et al. (2014) created the NSEs, this being the first approach to entrepreneurship at the national level. This index assimilates the importance of agency and the knowledge spillover theory of entrepreneurship and institutions. This approach argues that different institutional conditions bring about different forms of entrepreneurship (Aparicio et al., 2016), thus demonstrating that individuals' choices depend on the institutional context and the models and tools that it provides them (Valdez & Richardson, 2013), thus leading to the relationship between NSEs (Acs et al., 2014) and its impact on sustainability (Raposo et al, 2020). We also find that the study of the influence of entrepreneurship on the economy at all its levels, specifically in the circular economy, has prevailed in the literature more at the microlevel (company) or mesolevel (sector or region) to the detriment of analysis at the macrolevel (nations) (Rahdari et al, 2016). In this sense, several researchers (Dhahri & Omri, 2018; Hall et al., 2010) concluded that entrepreneurship should be seen as a solution to environmental degradation, rather than its opposite. Thus, in order to guarantee the development of society, it is essential that entrepreneurship and the circular economy are observed together. And so, there has been an increasing interest in the study and application of new business models that allow the combination of environmental issues while not losing sight of financial and social objectives (Ferreira et al, 2022; Raposo et al, 2020). All these new business models inevitably need to observe the relationship between digital transition and entrepreneurial activity (Zaheer et al., 2019). Despite this relationship being a challenge, the action of entrepreneurs that enable the use of digital technologies shows us that we are facing a digital revolution (Kraus et al., 2019). However, it is still difficult to measure the connection among entrepreneurship, the circular

economy and digital transformation at the national level (Ferreira et al., 2022) and thus arises our investigation objective: to study the relationship between NSEs and the circular economy, considering the effect of digital transformation in this relationship. Specifically, given the importance of NSEs, because, as Acs et al. (2014) argue, entrepreneurship at the country level should be treated as a systemic phenomenon, we found that no research considers the effect of NSEs on the circular economy. Thus, our research questions arise: *what is the effect of NSEs on the circular economy, and what is the impact of the digital transition on the connection between NSEs and the circular economy?*

Our empirical evidence provides several contributions. The first contribution has to do with the link between the NSE and the circular economy. With this consideration, we were able to identify a stream of research that is still underdeveloped: NSE—digital transition—circular economy. Our results add important inputs to the theory by demonstrating that SES (entrepreneurial attitudes, skills and aspirations) have a positive impact on the circular economy. Our second contribution is precisely the construction of new knowledge about the relationship of an index determining entrepreneurship at the national level (NSEs) with the circular economy, given that this is the first study to evaluate this relationship, in a dynamic approach in panel data. Numerous scholars have advocated for increased research into the relationship between entrepreneurship and various economic and social challenges, with a particular focus on understanding its impact on the circular economy (Raposo et al., 2020; Tiba et al. 2020; Zaheer et al., 2019). Our investigation brings important contributions in this orientation. Finally, we refer that both managers and policy makers must recognize that entrepreneurship must obey a systemic analysis. It is in this systemic approach that entrepreneurship should be seen as the core force for the circular economy.

2 Theoretical framework

2.1 Institutional approach

Soto (1989) and North (1991) constructed the institutional approach as we know it today. North presents us with two kinds of institutions: formal (policies, rules, etc.) and informal (culture, behaviors, etc.). Following this approach, there are authors who argue that it is the laws, regulations and policies issued by these institutions that influence the intention of companies to innovate (Ferreira et al., 2023; Santos et al, 2020). It is the institutions that by providing possibilities for various investments, enabling various motivations and encouragement, and providing a unchanging atmosphere that contribute to reducing the uncertainty of companies (Aparicio et al., 2016). Institutional factors such as schooling, robust legal protection and the political and economic situation itself constitute the specific circumstances rooted in the institutional and economic environment and are strongly related to individuals' decisions to undertake high-value creation activities (Varsakelis, 2006; Urbano & Aparicio, 2019). Bruton et al. (2010) go even further and argue that institutions are antecedents of entrepreneurial activity. And thus, institutions are responsible for stimulating (creating a suitable environment) or retracting (creating barriers) entrepreneurship. It is the institutions that by providing possibilities for various investments, enabling various motivations and support, and providing a stable environment that contributes to reducing the uncertainty of companies. It is from this diversity of investigations on entrepreneurship, but which seem to forget that its study is fundamental, considering a set of factors and more specifically considering it in a systemic approach, that the study by Acs

et al. (2014) emerges. These authors created an index that allows overcoming the dilemma between "institutions x individual." From a systemic perspective, Acs et al. (2014) proposed that it is essential to give importance to the resource mobilization aspect of entrepreneurial action, and thus NESs emerged that focus on the relationships among institutional circumstances and entrepreneurial action. Any definition of NES must recognize that entrepreneurship is an individual attitude, which moves resources toward the search for opportunities through the creation of new companies (Acs et al., 2014, 2016)

2.2 NSEs and circular economy

The urgency and need to understand how entrepreneurship can facilitate the emergence of the circularity is undeniable (Suchek et al., 2021; Alonso-Almeida et al., 2021). The current concern with environmental protection and climate change has attracted increasing attention from governments, companies, citizens and other organizations (de Jesus & Mendonça, 2018). In this way, the institutional entrepreneur is a key element in promoting the change from the conventional economy to the circularity. Only entrepreneurs are capable of applying strategies oriented toward resource efficiency, extending the useful life of products (Morseletto, 2020). To achieve circular economy targets, changes in entrepreneurial activity need to be implemented, changes those institutions should initiate (Suchek, et al., 2021; Alonso-Almeida et al., 2021; Ferasso et al., 2020). Thus, mobilizing resources by institutions to drive the change to a circular economy is strictly key, given that companies may not have precisely the financial resources, knowledge or conviction to approve a circular economy model (Rubio-Andrés et al., 2022). Thus, some researchers have recommended positions to encourage circularity: subsidies, capital support, subsidized loans, incentives for research on the topic or support for sustainable innovation models (Brown et al., 2019; Alonso-Almeida and Rodriguez-Anton, 2021). Thus, the institutions on which national entrepreneurship systems are based play a important function in the change to the circular economy.

The research hypothesis thus arises:

H1 NSEs have a positive influence on the circular economy

2.3 Impact of the digital transition

The only way companies can generate disruption and compete in the twenty-first century is through digital transition (Anderson, 2014; Ramadani et al., 2022). Nevertheless, knowing the necessity for transformation and knowing its design of it are two different things, and legacy companies often have problems from the start (Nowiński and Haddoud, 2019). A common misconception about digital transformation is the belief that everything is solved in a company by injecting technology at all levels, and this is not the process at all. Technology is an enabler of novel modes of conducting business, but digital transformation contains rethinking all facets of a company's operations (Endres et al, 2020; Fichter & Tiemann, 2018). Thus, before any company starts the digital transformation journey, it is essential to rethink the business model (Hornuf et al., 2020). One important successful factors are the mindset of the people within your organization. If staff think of the firm as a digital business, they can help reconstruct the tactic based on digital transformation (Palmié et al., 2020). Conversely, suppose the company has a team of people who are fixed in their mindset. In that case, the company needs to help guide them in achieving a growth

mindset so that they become open and able to change, specifically that they can change to the circular economy (Hornuf et al., 2020).

We can thus say that in the process of building sustainable entrepreneurship, the digital transition plays a completely modifying role in the world economy (Anderson, 2014). Digital technologies make new business occasions available to entrepreneurs through the dissemination of their products and services around the world, while companies are also concerned with mitigating climate change (Elia et al., 2016). The virtualization of business is succeeding in removing extreme expenses and barriers to entry for new firms while offering new occasions to a new production of sustainable entrepreneurs (Youssef et al., 2022). Instead, the wide dissemination and use of digital technologies similarly generate new wishes, requiring new businesses then a novel kind of entrepreneur that can make the transition from the traditional economy to the circular economy (Ferreira et al, 2022)

The research hypothesis thus arises:

H2 The digital transition positively impacts the interaction between NSEs and the circular economy.

In Fig. 1 is presented the conceptual model.

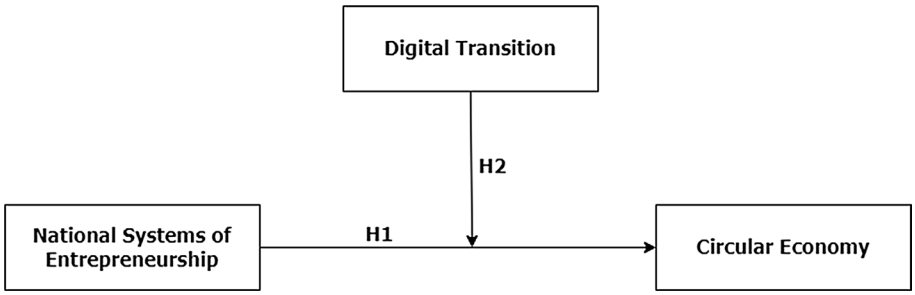

Fig. 1 Research model

3 Research methodology

3.1 Data

The data used were collected from some different sources (World Bank (WB), United Nations (UN), Eurostat, World Economic Forum (WEF), Global Entrepreneurship Monitor (GEM), and Food and Agriculture Organization (FAO)). These sources provided aggregated data at the national level, which we utilized in our analysis. Our analysis focuses on the 27 countries that comprise the European Union, and the time frame of interest spans from 2016 to 2020 (5 years with available data).

Our research covers the 27 countries of the European Union for the years 2016 to 2020. In our study, we excluded data from the UK for two main reasons. Firstly, the country departed from the European Union in 2020, rendering its inclusion in the analysis potentially misleading. Secondly, the Brexit referendum, which took place in 2016, may have introduced significant changes and created political and economic uncertainty that could

have affected the outcomes of the UK when compared to other EU member states during the period between 2016 and 2020.We used the country average variable whenever countries had missing variables.

3.2 Measures

We present the measures and variables under study in Table 1.

3.3 Data analysis

To validate our hypothesis, we used econometric approach based on dynamic panels that capture differences over time. We applied the two-step approach developed by Arellano–Bond based on moment conditions and generalized method of moments (GMM) estimators (Arellano and Bond 1991; Bond 2002). This approach allowed us to incorporate lagged levels of the dependent variable (circularity rate) and independent variables (National Systems of Entrepreneurship and Digital Transition) in our model (Ferreira et al., 2022; Raposo et al., 2020). To validate our hypotheses, we employed the follow econometric specification. This specification has been chosen based on its ability to capture the dynamic relationships between our variables of interest and to account for potential endogeneity issues.

$$CR_i = \alpha + \beta_1 CR_{it!1} + \beta_2 Control_{it} + \beta_3 NEE_{it} + \beta_4 NEE_{it!1} + \beta_5 DTI_{it} + \beta_6 DTI_{it!1} + \beta_7 DTI_{it} \times NEE_{it}$$

Due to the use of a dynamic model, our estimates are limited to the period between 2016 and 2020, spanning five years. We have developed two distinct models to estimate the relationships of interest. In Model I, the control variables and the autoregressive circularity rate are employed as the predictive variables. In Model II, the control variables will be used as the predictive control variables and the autoregressive circularity rate in conjunction with two additional variables related to national entrepreneurship systems (both the contemporaneous and autoregressive values), two variables for digital transformation (both the contemporaneous and autoregressive values) and the interaction term between National Systems of Entrepreneurship and Digital Transformation. By utilizing these two models, we aim to better understand the complex relationships between the national entrepreneurship systems and the digital transformation and their impact on the circular economy.

4 Analysis of results

For the ongoing correlation levels between the different variables, the results are shown in Table 2. All independent variables showed a statistically significant correlation with the circularity rate.

The findings of our research are presented in Table 3, which reports the results of our dynamic panel models that were used to test our hypotheses. In Model I, the results revealed a statistically significant positive impact of GDP growth (β=0.51; p<0.05) on the circularity rate.

Considering our results for *H1: NSEs have a positive influence on the circular economy*, it is observed that both contemporary (β = 0.07; p < 0.05) and previous year NSEs (β = 0.08; p < 0.01) have a statistically significant positive impact on the circularity rate. With these results, it was possible to confirm hypothesis H1. Thus, we support the perspective of several authors who argue that entrepreneurship can positively impact the circular

Table 1 Measures and variables

Measures	Dimension	Description	Authors
Independent variables	NSEs	Entrepreneurial: (1) Attitudes; (2) Skills (3) Aspirations	Acs et al. (2014), Acs and Szerb (2016)
Moderator variable	Digital transition	(1) Digital Economy and Society Index (DTI) (scores range from 0 to 100)	Ferreira et al. (2022)
Dependent variables	Circular economy	(1) Circularity rate (CR)	Raposo et al. (2020)
Control variables		(1) GDP per capita (2) GDP growth rate (3) Population size (millions) (4) Population growth rate	Ferreira et al. (2019), Raposo et al. (2020)

Table 2 Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) CR	1						
(2) GDP per capita, PPP (constant 2015 international $)	0.229**	1					
(3) GDP growth (annual %)	0.153*	0.277**	1				
(4) Population, total	0.362**	-0.021	-0.084	1			
(5) Population growth (annual %)	0.284**	0.809**	00.127	0.057	1		
(6) NSE	0.250**	0.585**	0.351**	−0.026	0.498**	1	
(7) DESI	0.239**	0.488**	0.284**	−0.184*	0.355**	0.599**	1

*$p < 0.05$; **$p < 0.01$

Table 3 Models estimated

	Circularity rate	
	Model I	Model II
CR(-1)	0.85 (0.35)*	0.09 (0.04)*
GDP_pc	−0.46 (0.36)	−0.07 (0.08)
GDP_growth	0.51 (0.25)*	0.01 (0.05)
Pop	−0.32 (0.29)	−0.04 (0.06)
Pop_growth	−0.26 (1.08)	−0.53 (0.30)
SNE		0.07 (0.04)*
SNE(-1)		0.08 (0.03)**
DTI		0.08 (0.15)
DTI(-1)		0.05 (0.02)*
SNE x DEGI		0.02 (0.01)

*$p < 0.05$; **$p < 0.01$

economy (Aghelie et al., 2016; Ferreira et al., 2022). Assumed the rising awareness that changes are needed to mitigate climate change generated by unsustainable entrepreneurial performs (Raposo et al, 2020), our results show that countries with high ranks of NSEs also show a greater capacity to shift toward the circular economy. In other words, entrepreneurship as a system enables high levels of entrepreneurship and contributes to mitigating climate changes. Therefore, entrepreneurship can be projected as a mainly active for sustainable and more complete growth (Ferreira et al, (2022). Entrepreneurship is therefore tasked with promoting sustainability objectives and addressing the challenges of climate change (Ferreira et al., 2020). Despite the observation that the previous year's digital transition levels ($\beta = 0.05$; $p < 0.05$) have a statistically significant positive impact on the circularity rate, it was not possible to support hypothesis *H2: Digital transition has a positive impact on the interaction between NSEs and the circular economy* ($\beta = 0.02$; $p = 0.324$). That is, no effect of digital transition is observed on the interaction between NSEs and the circular economy ($\beta = 0.02$; $p = 0.324$). Contrary to several researchers who demonstrate how important the relationship among entrepreneurship and the digital transition is, our results do not allow us to draw such considerations (Ferreira et al., 2022).

Figure 2 presents the confirmed conceptual model

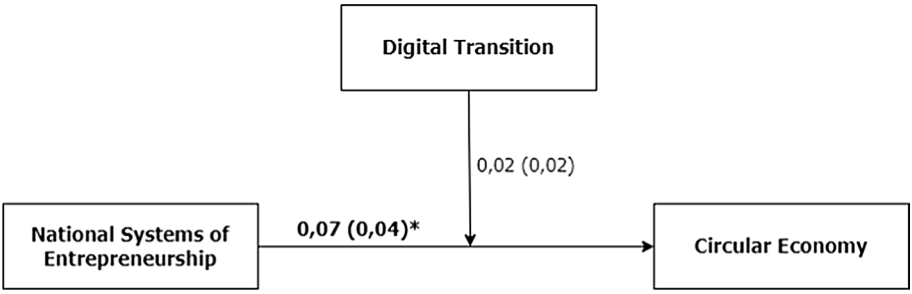

Fig. 2 Confirmed conceptual model

5 Implications

Our aims, with this investigation, are to measure the effect of NSE levels on countries' circular economies, which we believe is an important step for nations to improve their entrepreneurial activities (Ferreira et al., 2020). Simultaneously, we also aim to see whether digital transition impacts the connection between NSEs and the circular economy, given the importance that digitalization has for this relationship (Le Dinh et al., 2018).

We found that higher levels of circularity are influenced by higher levels of NES. In this way, our results allow us to overcome a limitation existing in previous investigations on the connection among entrepreneurship and circularity (Raposo et al., 2020; Youssef et al., 2018).

We found that higher levels of circularity are influenced by higher levels of SES. In this way, our results allow us to overcome a limitation existing in previous investigations on the link among entrepreneurship and the circular economy (Raposo et al, 2020; Suchek et al, 2021). Sustainable entrepreneurship faces several challenges, in establishing its legitimacy, starting with the uncertainty in obtaining revenue compared to traditional businesses, whose revenues are taken almost for granted (Neumeyer & Santos, 2018). And so sustainable entrepreneurship is clearly undervalued in today's reality (Ferreira et al, 2023). Thus, our results bring an implication to this research field by showing the advantages of not looking at sustainability as a liability, but as a competitive advantage that can allow companies to overcome more adverse times. Illiteracy and absence of knowledge about sustainability and circularity pose an even greater challenge in orienting toward circularity (Munoz & Dimov, 2015).

Of our implications, we highlight as the most significant for the practice of management, the fact that the leaders of the most diverse companies and organizations (governmental, non-governmental) cannot ignore the challenges they face in mitigating climate change. They should not see sustainability as something that will deprive them of competitiveness or even the creation of wealth. With our research it is proven that entrepreneurship, if observed from a systemic perspective, affords high ranks of circularity. That is, if we have high ranks of entrepreneurship and at the same time we achieve high levels of circularity, we can infer that these countries and companies have by no means lost competitiveness. Thus, in our view, one of the ways to study the relationship between the circular economy and entrepreneurship is precisely how we observe entrepreneurship as a national system. Sustainable entrepreneurial orientation is undoubtedly the biggest challenge for all agents within the NSE.

6 Conclusions

Our research aims to study the connection among NSEs and the circularity and the effect of the digital transition on this relationship. Our results, which highlight the connection among entrepreneurship and the circular economy, are of high importance essentially for two causes: First, entrepreneurs must be aware that it is crucial to adopt businesses that manage to mitigate climate change, and the second reason, which is to break with the "commonplace" of "either we have entrepreneurial activity or we have environmental sustainability."

Regarding our research questions—what is the effect of NSEs on the circular economy? And what is the impact of the digital transition on the relationship between NSEs and the circular economy? Although we were not able to prove the impact of the digital transition on the connection among NSEs and the circular economy, the results (positive impact of NSEs on the circular economy) obtained are in line with several studies (Dhahri & Omri, 2018; Rahdari, et al., 2016). These studies argue that entrepreneurship is a path to sustainability and circularity. Indeed concerns about the planet's sustainability have emerged as an increasingly pressing issue in business and academic practice (Munoz & Dimov, 2015; Neumeyer & Santos, 2018). The fact that we do not have a "planet B" has brought to the light of theory several investigations that intend to demonstrate how entrepreneurship can be a fundamental factor in the pursuit of sustainability goals (Terán-Yépez et al., 2020; Youssef et al, 2018).

Our empirical evidence offers relevant evidence on the role of entrepreneurship as a driver in the transition from the traditional economy to the circular economy. We also found that if we look at entrepreneurship as a systemic national phenomenon, it is possible to verify its positive effects on the sustainability of countries.

Because there are no fully complete investigations, our investigation also found limitations. The fact that we used that we used the measure of entrepreneurship as an index (NESs), and we did not test which of the three pillars (attitudes, skills and aspirations) has the most impact on the circular economy, constitutes our first limitation. The second limitation is that we did not use the level of economic development or inequality as a way to verify differences between countries. From these limitations we propose future investigations. Investigations should be carried out that focus on the exploration of NES and specifically on the differences in results in their three pillars: aspirations, skills and attitudes, and which ones have the greatest impact on the circular economy. In general, we expect our research to motivate efforts to improve and understand the impact of NSE on the circular economy, so that it encourages additional work on this important research topic, but with so much need for additional studies.

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Data availability Our data do not violate the protection of human subjects, or other valid ethical, privacy or security concerns.

Declarations

Conflict of interest The authors declare that they have no conflict of interest, and all data are available from the respective organizations referred to in the paper.

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