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How does it pay to be circular in production processes? Eco-innovativeness and green jobs as moderators of a cost-efficiency advantage in European small and medium enterprises

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Abstract

This study investigates whether circularity in production processes generates a reduction of firms' production costs and the conditions that determine the intensity of this reduction. It explores the role of two moderators for this cost-efficiency advantage to emerge, namely, eco-innovativeness (investments dedicated to the adequate implementation of circular practices in current production processes) and green jobs (human resources dedicated to circular practices). Using data on 13,117 small and medium enterprises (SMEs) from the Flash Eurobarometer 2017, a cluster analysis revealed that there is a gradual path towards Circular Economy among European SMEs, with the implementation of increasingly more circular practices. Four ordered probit models confirmed that a higher level of circularity in processes achieved by European SMEs is related to a reduction in their production costs. Moreover, eco-innovativeness positively moderates this relation. In contrast, the relative share of green jobs in SMEs' workforce mitigates the impact of circularity on production costs. In practice, by engaging in circularity, SMEs can contribute to the United Nations goals for Sustainable Development while reducing production costs; although the level of this reduction depends on how circularity is implemented.

KEYWORDS

Circular Economy, economic performance, green jobs, Porter Hypothesis, process-related eco-innovations, small and medium enterprises (SMEs), sustainable development goals

1 | INTRODUCTION

Does it pay to be green? When does it pay to be green? For whom does it pay to be green? How does it pay to be green? These questions demonstrate the strong interest of researchers in understanding whether and how implementing environmental practices can improve firms' economic performance (Boiral et al., 2012; Ghisetti & Rennings, 2014; Hart & Ahuja, 1996; Klassen & McLaughlin, 1996;

Russo & Fouts, 1997). Although this debate originated in the field of Environmental Management in the nineties, within the framework of the so-called Porter Hypothesis (Porter, 1991; Porter & van der Linde, 1995), research is still expanding our knowledge about the ways, factors and conditions that mediate or moderate the economic consequences of environmental protection, especially in the area of Circular Economy (CE). Research framed in this area attempts to generate new theoretical and empirical evidence on the still open '*It pays to be green*' debate. Our paper contributes to this debate by analysing whether reinforcing circularity of production processes can improve firms' economic performance through a cost-efficiency advantage. We also analyse whether this advantage is moderated by an eco-innovative conduct, that is, eco-innovativeness, and by the dedication of human resources to the adequate implementation of circular practices, that is, green jobs.

CE represents an alternative model of growth to the linear economic model, and is potentially capable of achieving a sustainable development (Prieto-Sandoval et al., 2018). In 2015, the United Nations set an Agenda for 2030 in which it defined 17 sustainable development goals addressing global issues and requiring urgent action from governments, civil society and firms (United Nations, 2015). Consequently, a growing number of researchers are exploring how firms can participate in these goals, and what the outcomes resulting from firms' contribution are (Provin et al., 2021; Udemba et al., 2021; van der Waal et al., 2021). At the European level, guidance on how to achieve sustainability is conveyed by the European Union's (EU) agenda for a sustainable development, '*The European Green Deal*'. More precisely, the EU has been promoting a sustainable development through the adoption of CE principles in business creation and practices, as illustrated by its New Circular Economy Action Plan (European Commission, 2020). Companies are proactive in circularity when they extensively apply traditional green practices that contribute to the achievement of sustainable development to their products, processes and management systems.

The circular practices analysed in the current study contribute directly to sustainable development by tackling climate change, and offer a concrete example of how firms, especially SMEs, can contribute to the international goals. SMEs are of particular interest in the study of circular practices as they represent 99% of European firms, and employ two thirds of the European workforce (European Commission & Centre for Strategy and Evaluation Services, 2012). They also play a crucial role in economic growth, innovation and job creation, placing them at the centre of interest of the European Commission (European Commission & Centre for Strategy and Evaluation Services, 2012). Therefore, changes in their practices are critical to achieve the goals of a sustainable development using CE as a path (Prieto-Sandoval et al., 2018).

The operationalisation of CE sheds light on eco-innovation (EI) as the main instrument to achieve sustainability (European Commission, 2020; Ghisellini et al., 2016). Eco-innovativeness represents the intention of continuous improvement in circularity as, based on Kemp and Pearson (2007), EI refers to a set of practices, technological or otherwise, that are new to the organisation and that lead to an improvement in its environmental performance. At the same time, EI appears to be a relevant indicator (Smol et al., 2017) and a key enabler of the transition towards CE (de Jesus et al., 2018). Simply put, EI guarantees the implementation in companies of appropriate circular practices for their current production processes.

Another indicator of circular practices within the company to which this investigation dedicates attention is the creation of green jobs and the assignment of green tasks. The European Commission defines a green job within the Flash Eurobarometer Survey 456 as '*one that directly deals with information, technologies, or materials that preserves or restores environmental quality. This requires specialized skills, knowledge, training, or experience (e.g., verifying compliance with environmental legislation, monitoring resource efficiency within the company, promoting and selling green products and services)*' (European Commission, 2018; Moreno-Mondéjar et al., 2021). Precise forecasts are lacking on the extent to which green jobs are created today in companies, but they are expected to grow considerably with the implementation of CE (Moreno-Mondéjar et al., 2021). Previous literature has indicated that organisational resources supporting the adoption of environmental practices make it easier to obtain higher economic results (Ferrón Vílchez & Darnall, 2016; López-Fernández & Serrano-Bedia, 2007; Rivera-Torres et al., 2015). In this regard, green jobs contribute to enhancing firms' environmental results (Norton et al., 2015). The improvement in environmental proactivity and performance can in turn facilitate the accomplishment of economic benefits (Rivera-Torres et al., 2015). This is consistent with the estimates of job creation when implementing CE, because of a shift from greater intensity in resources to greater intensity in labour (Drakulevski & Boshkov, 2019), or because of the creation of a competitive advantage and an increase in demand (Horbach & Rennings, 2013).

The debate on the economic consequences of pro-environmental practices, or today's circular practices, is still an open debate (Alshehhi et al., 2018; Cañón-de-Francia & Garcés-Ayerbe, 2019). According to this debate, reaching a win-win situation in which both environmental and economic performance improve depends on internal as well as external factors (Cañón-de-Francia & Garcés-Ayerbe, 2019). But in the right conditions and contexts, the benefits of circularity are expected to flow within the company (Deineko et al., 2019). This theoretical grounding is consistent with the Porter Hypothesis which states that, when incentivised by properly designed environmental regulation, firms innovate more and, as a result, may experience improved environmental performance and in some cases, improved economic performance (Porter, 1991; Porter & van der Linde, 1995). In this paper, we do not review the first premise of the Porter Hypothesis—the fact that environmental regulation triggers firms' innovative behaviour. Rather, we focus on a part of the second premise, suggesting that improved environmental performance, and in our case through greater circularity, can contribute to enhancing firms' economic performance.

The literature that supports the Porter Hypothesis acknowledges two types of benefits derived from circular practices: cost savings and market gains (Ambec et al., 2013; Ambec & Lanoie, 2008; Hang et al., 2019; Klassen & McLaughlin, 1996; Schaltegger & Synnestvedt, 2002). Despite the little evidence that exists, the advantages in terms of cost savings and market gains have been associated with the adoption of circular practices in processes and products, respectively (Ormazabal et al., 2016; Silchenko et al., 2019; Triguero et al., 2013; Usubiaga et al., 2018). In this study, we focus our attention on the adoption of circular practices in processes only.

Our first objective is to provide information on the profile of European SMEs in terms of circularity in processes and, thus, on the state of CE in Europe. Our second objective is to conduct an empirical study on the relation between circularity in production processes and the reduction in production costs. Our third objective is to test the effects of two possible moderators on this relation, namely eco-innovativeness in processes and green jobs dedicated to circular practices and tasks.

One argument put forward is that when circular measures are adopted, EI enhances firm environmental performance by boosting more effectively circularity in processes (Kemp & Pearson, 2007). This can in turn increase economic performance through greater cost reduction (Ghisetti & Rennings, 2014; Klassen & McLaughlin, 1996). Furthermore, these improvements can lead to the formation of a competitive advantage (Arundel & Kemp, 2009; Horbach & Rennings, 2013). On the other hand, the additional efforts necessary to increase processes' circularity may require the dedication of specific human resources (Norton et al., 2015; Rivera-Torres et al., 2015). These arguments, related to the *How does it pay to be circular in processes* question, have been little studied in the literature. In sum, although the literature on CE has flourished over the past few years, the question of how going green or going circular can lead to higher economic performance remains a fundamental question. It is to this research gap that our research tries to make contributions.

The remainder of this paper is organised as follows. In the second section, we develop the theoretical background and build our hypotheses. In the third section, we present the data, methods, and results of our empirical study. In the fourth section, we discuss our results. Conclusions follow in the last section.

2 | THEORETICAL FRAMEWORK

2.1 | From a linear to a Circular Economy

The twentieth century has witnessed an unprecedented development of human activities according to a linear economic model. The core of this model is captured as '*take, make, and dispose*' (Ghisellini et al., 2016). Yet, more recently, the international community has raised the alarm on the threats posed by this model of development (Intergovernmental Panel on Climate Change [IPCC], 2014; World Commission on Environment and Development, 1987). The surge in the number of international meetings to re-think this model of development has resulted in promoting Sustainable Development as a priority on the agenda of most countries around the world. A sustainable development is one that grants equal importance to the social, economic and environmental needs of present and future generations and harmonises them so that sustainability is ensured in the long run (World Commission on Environment and Development, 1987). In 2015, the United Nations set an Agenda for 2030, defined 17 clearer goals to achieve a sustainable development, and called governments, the civil society, as well as businesses to actively contribute to these goals (Provin et al., 2021; Udemba et al., 2021; United Nations, 2015; van der Waal et al., 2021).

Only recently has CE emerged as a viable path towards a sustainable development (Prieto-Sandoval et al., 2018). First implemented, albeit in different ways, in China, Japan and Europe (Ghisellini et al., 2016), research on CE flourished significantly after the first report of the Ellen MacArthur Foundation (EMAF) in 2012 (Kirchherr et al., 2017). CE copies natural ecosystems and cycles in which flows of materials follow a closed loop scheme (Murray et al., 2017). Resources are used efficiently and energies are renewable (Ghisellini et al., 2016). Industrial symbiosis allows connections and synergies to develop between different production processes of traditionally separated industries (Chertow, 2008). The environmental impact is at least restorative, and at best regenerative (EMAF, 2012; Morseletto, 2020). Thus, CE can be defined as an '*economic system that represents a change of paradigm in the way that human society is interrelated with nature and aims to prevent the depletion of resources, close energy and materials loops, and facilitate sustainable development through its implementation at the micro (enterprises and consumers), meso (economic agents integrated in symbiosis) and macro (city, regions and governments) levels*' (Prieto-Sandoval et al., 2018, p. 610). Implementing this circular model requires environmental innovations in the way Society legislates, produces and consumes (Prieto-Sandoval et al., 2018).

The path towards CE is gradual. In a study of 7843 European SMEs, a cluster analysis drew five groups depending on the number of circular practices and the barriers that SMEs faced (Garcés-Ayerbe et al., 2019). This analysis evidenced that for European SMEs, the first practices implemented tackled issues related to pollution control, while the latest practices implemented call for a proactive environmental strategy of pollution prevention (Garcés-Ayerbe et al., 2019; Henriques & Sadorsky, 1999; Roome, 1992). Depending on the intensity of circularity, the barriers that SMEs were facing varied. For example, most proactive firms were constrained by administrative barriers, difficult access to capital, lack of Human Resources or the costs of meeting regulation standards. Conversely, less proactive firms were mainly restrained by economic barriers, from implementation costs to uncertain return on investments (Garcés-Ayerbe et al., 2019). SMEs are often under pressure because of a lack of resources (Del Río et al., 2010; Wielgórka & Szczepaniak, 2019). Later, other barriers become more salient as operational challenges arise in the path towards CE, such as lack of Human Resources for these new activities. Innovation and other internal capabilities, such as the creation of green jobs, appear to be at the heart of CE, since they contribute to overcoming some of the main barriers to engaging in circularity.

2.2 | Hypothesis development

2.2.1 | Circularity in processes and consequences on firm's production costs

The first authors to address this issue (Hart & Ahuja, 1996) claimed that pollution prevention costs could be reduced by using inputs more efficiently, reducing waste disposal and end-of-pipe costs, avoiding liability costs by anticipating and being proactive regarding legal requirements. Their key finding may rest in the notion of anticipation and proactivity. Indeed, environmental management strategies range from reactive to proactive. They reflect firms' behaviour regarding compliance with legal environmental requirements and preventive actions that go beyond regulation standards (Henriques & Sadorsky, 1999; Hofmann et al., 2012; Roome, 1992). Higher commitment towards environmental performance, anticipation and avoidance of environmental harm are presumed to be reflected in firms' economic performance (Boiral et al., 2012; King & Lenox, 2002; Klassen & Whybark, 1999; Majumdar & Marcus, 2001; Porter & van der Linde, 1995; Przychodzen & Przychodzen, 2015; Russo & Fouts, 1997). It is important to note that a time lag may be necessary before seeing the results on firms' economic performance (Hang et al., 2019; Hart & Ahuja, 1996).

Research in the CE framework has inherited the idea of an incremental environmental proactivity aligned with an incremental economic performance. Overall, borrowing the expression from the literature on Environmental Management, it appears that '*it pays to be circular*'. However, the mechanisms of the effect of circularity on firm performance are rarely studied in depth, and economic benefits are often a secondary objective and outcome in the studies on circular practices. Creative examples of circular practices raise the question of whether engaging further in circularity has positive impacts on economic performance. More intensity in circular practices, especially in the case of selling scrap, could represent a larger potential of positive economic spillovers.

The EMAF suggests four sources of value creation that underlie the core principles of CE. Value can be created from the inner circle of production through cost reduction, from lengthening products' lifetime, from a cascading use of materials in which waste becomes inputs, or from closing the loop of materials that remain uncontaminated all along their different cycles (Murray et al., 2017). Hence, by definition, the implementation of circular practices in processes should lead to a reduction in production costs. In sum, a primary motivation of firms when implementing circular practices in their processes is cost reduction (Bonzanini Bossle et al., 2016; Prieto-Sandoval et al., 2018), which is also an expected consequence of CE (Murray et al., 2017).

The valorisation of materials, a characteristic of CE, can considerably reduce the ecological impact of their disposal, create local employment and generate value through the three dimensions of sustainable development, namely economic, social and environmental (Mahmoudi et al., 2020). In Italy, only waste management firms that separate waste before reusing, recycling and recovering were found to experience economies of scale, illustrating the compatibility between environmental and economic sustainability (Bartolacci et al., 2019).

In the nascent literature on circular practices within firms, Ormazabal et al. (2016) confirmed these arguments empirically. The authors showed that when SMEs in the Basque Country had a mature environmental management, they benefited from a growth in prestige, cost reduction and permanence of the company in time. Conversely, companies with an immature environmental management did not obtain such benefits (Ormazabal et al., 2016).

There are clear examples from the food industry of how circularity in processes allows the reduction and reuse of materials. The European Commission pinpointed this sector for its alarming environmental impact, with food waste amounting to 88 million tons annually in the EU (European Commission, 2016). The regulatory response of the EU led researchers to analyse whether a transition towards CE offers this sector any economic benefit. If well implemented, circular practices could lead to a 10% to 11% decrease in inputs along the whole food value chain (Usubiaga et al., 2018).

Another example from the Italian Food Bank showed that the reorientation of food waste, from traditional food supply chains to non-governmental organisations, optimised existing resources, created new economic value and tackled the social issues of food insecurity and food waste (Silchenko et al., 2019). A kilo of food started at a cost of 0.2 to 2 euros and ended up creating a new shared value of 2.5 to 6.5 euros per kilo, connecting and satisfying the needs of several stakeholders through synergies (Porter & Kramer, 2011). Business operators obtained economic benefits from the reduction in food waste storage and disposal costs, besides strategic benefits like the improvement of their reputation (Silchenko et al., 2019).

From these arguments and empirical evidence, we can infer that the benefit of cost reduction may also be gradual and depend, at least partially, upon firms' level of circularity in processes. Thus, we hypothesise the following:

> **Hypothesis 1.** A higher level of circularity in processes is positively associated with a larger reduction in production costs.

Nevertheless, the idea of a gradual path towards CE through circularity in processes and its relation to the reduction in production costs requires further refinement.

2.2.2 | The moderating effect of eco-innovativeness in processes

Kemp and Pearson defined EI as '*the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organisation (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives*' (Kemp & Pearson, 2007,

p. 7). It is important to note that EI may not bring any novelty or be new to the industry. It just need to be more resource efficient than '*relevant alternatives*', and new only to the organisation (Kemp & Pearson, 2007). It differs from traditional innovations by reducing environmental burdens, which contributes to a sustainable development (Rennings, 2000).

There is a relative consensus on the typology of EI in the literature. The first type concerns organisational methods (Przychodzen & Przychodzen, 2015) and is also the most widely studied (de Jesus et al., 2018). The other two types relate to products and processes (Horbach & Rammer, 2020). Process-related EI aims at reducing environmental harm and enhancing operational efficiency, by focusing on internal capabilities through greener internal processes (Grekova et al., 2013). In contrast, eco-design is the main instrument of product-related EI that aims at increasing product environmental attractiveness and differentiation, enhancing the firm's image and thus increasing revenues (Christmann, 2000; González-Benito & González-Benito, 2006; Horbach & Rammer, 2020; Klassen & McLaughlin, 1996; Rivera-Torres et al., 2015; Triguero et al., 2013).

As our focus is on reducing firms' production costs, a motive driving process-related EI (Horbach, 2008; Triguero et al., 2013), we will target only this type of EI. Cost reduction is a primary motivation to engage in circularity, that is in practices increasing processes' efficiency consistent with a sustainable development (Prieto-Sandoval et al., 2018). But it is also a primary motive to engage in process-related EI, that is in environmental practices in processes that are novel to the company and more efficient than relevant alternatives. Our argument is that EI guarantees that circular practices are more innovative and appropriate for the current production processes of the company; thus, causing relatively greater cost savings. Triguero et al. (2013) confirmed that the implementation of process-related EI was significantly driven by cost-related motives, a relation not found for product- and organisational process-related EI (Triguero et al., 2013). In line with this finding, and despite the numerous drivers identified in the literature (Cai & Li, 2018; Kesidou & Demirel, 2012), other authors have confirmed that the primary motivation to eco-innovate in processes is cost reduction (Bonzanini Bossle et al., 2016; Hroncová Vicianová et al., 2017). Earlier, Christmann found evidence that internal capabilities fostering process-related innovation and implementation acted as a moderator of the relationship between environmental best practices and cost reduction (Christmann, 2000).

Regarding the outcomes, process-related EI is also found to be the only type of EI related to cost reduction. In a Slovakian sample of SMEs, process-related EI was associated to an overall reduction in costs, increased savings, reduction in material costs and improved production efficiency; product-related EI was not (Hroncová Vicianová et al., 2017). In line with this argument, the Resource-Based View of the firm expects production efficiency to reduce costs (Christmann, 2000). In a Brazilian sample, investments in EI coupled with the existence of an Environmental Management System were found to moderate a firm's growth (Barbieri & Santos, 2020). In a German sample, Ghisetti and Rennings (2014) confirmed that companies implementing energy and resource efficiency innovations reduced production costs, and built a competitive advantage through a better use of scarce resources in their production process (Ghisetti & Rennings, 2014). The exclusive link between process-related EI and a cost-reduction outcome was mitigated by another German study. German companies that conducted process- and product-related EI from 2012 to 2014 enjoyed a significantly better financial standing in 2016 (Horbach & Rammer, 2020).

EI in processes enhancing water conservation and circularity can reduce water usage by up to 45% (Sartal et al., 2020), thereby contributing to reducing operational costs. Process-related EI also generates positive results by improving recycling. Mahmoudi et al. (2020) demonstrated that the local recycling of photovoltaic panels in Australia can yield large economic and environmental benefits. Finally, EI in waste recovery allows the loop of these materials to be closed, either by selling the recovered waste to other industries (Ferri et al., 2020), or by upcycling within the industry (Gigli et al., 2019).

In sum, engaging in circularity can increase cost efficiency. But investing in process-related EI can serve as an indicator of continuous improvement in circularity. Consistent with the Porter Hypothesis, well-designed environmental regulation can incentivise firms to enter a virtuous circle of continuous learning and greater improvement of their production efficiency. This efficiency can in turn lead to a distinctive competitive advantage and greater business performance (Ambec et al., 2013; Ambec & Lanoie, 2008). A recent finding suggest that firms that reinforce their existing EI experience greater business performance (Leyva-de la Hiz et al., 2019), possibly because of increased efficiency and continuous improvement benefits. Thus, we suggest that eco-innovativeness may boost rather than initially trigger firms' efforts in continuous improvement, indirectly impacting firm economic performance. Such role has been overlooked in past research.

Our assumption is also supported by the path dependency hypothesis. Having been innovative in the past increases the likelihood of innovating in the future because firms have been able to build a stock of human capital and knowledge (Horbach, 2008; Kesidou & Demirel, 2012). Consequently, this path dependency was found to predict product and process-related EI, whereas past economic performance per se did not (Horbach, 2008).

Our assumption echoes how environmental performance was found in the past to mediate the effects of environmental management practices and firms' financial performance (Klassen & McLaughlin, 1996). More precisely, process-related EI moderates the relation between environmental management and cost efficiency advantage (Grekova et al., 2013). Consequently, and based on all the previous arguments, we hypothesise that

> **Hypothesis 2.** Eco-innovativeness in processes moderates the relationship between circularity in processes and production costs, such that firms that eco-innovate in processes experience larger reductions in production costs.

2.2.3 | The moderating effect of green jobs

Environmental changes in companies are usually '*preceded, accompanied, or followed by changes in organisational design*' (Rivera-Torres et al., 2015, p. 311). The authors found that environmental changes related to products, processes, and supply and distribution practices directly impact short- to mid-term economic performance. Also, changes in organisational design, that is, in coordination systems and employees' motivation, indirectly mediated this relationship, except for product-related practices. The authors explained this difference by the fact that companies have a relatively higher control over practices related to processes and supply and distribution, whereas product-related practices are more market-dependent (Rivera-Torres et al., 2015).

In another study, changes in organisational structure were associated with the implementation of environmental practices (Horbach, 2008). Expected growth in employment increased the likelihood that a firm would innovate, which is consistent with the demand pull determinants of EI (Horbach, 2008). Similarly, process- and product-related EI were followed by a change in organisational design, although process-related EI was more frequent in the sample (Horbach & Rammer, 2020). The change in organisational design, namely, a growth in employment, emerged because environmental change provided firms with a competitive advantage, and consequently a growth in sales, that compensated for a decrease in labour due to the modernisation of processes (Horbach & Rammer, 2020; Horbach & Rennings, 2013).

Organisational flexibility, or '*discretionary slack*', is related to higher environmental proactivity (Sharma, 2000), but less significantly to Corporate Sustainable Development (Bansal, 2005). Green products and services positively affect demand in green jobs (Cecere & Mazzanti, 2017). More precisely, the interaction between an Environmental Management System coupled with the offer of green products explains demand in green jobs (Cecere & Mazzanti, 2017). Similarly, European SMEs that are more proactive in the implementation of circular practices face the common barrier of a lack of Human Resources to perform such practices, a barrier not yet experienced by less proactive SMEs (Garcés-Ayerbe et al., 2019).

In contrast to these positive relations, whether German firms belonged to the environmental sector was a better predictor of the link between green products and green jobs than firms' level of innovation (Horbach & Janser, 2016). Other results have suggested that organisational capabilities, along with Human Resources policies, are important internal drivers and could improve efficiency through cost reduction (Bonzanini Bossle et al., 2016). Our argument refers again to the question of how does it pay to be circular in processes. More specifically, our argument points out that the dedication of green jobs can guarantee the adequate selection and implementation of circular practices in processes, thus leading to a greater reduction in costs.

Green jobs have already been identified as a possible tool for increasing firms' environmental performance in the past (Norton et al., 2015). Even in the absence of green jobs, green training and environmental awareness of collaborators were found to moderate the intensity of the implementation of an Environmental Management System (López-Fernández & Serrano-Bedia, 2007). The environmental profile of collaborators is of great interest in the literature on Employee Green Behaviour, especially when environmental tasks are not part of their job description (Boiral, 2009), challenging the success of environmental sustainability within firms (Ones & Dilchert, 2012). The recent development of Green Human Resource Management (GHRM) confirms the key role of HR in the success of a firm's ecological transition, and is strongly linked to both employee green behaviour (Masri & Jaaron, 2017; Paillé et al., 2016; Pham et al., 2018) and firm environmental performance (Masri & Jaaron, 2017).

The link between organisational capabilities—particularly green jobs—and circularity and economic performance appears to be promising. Nonetheless a more precise understanding of this relationship is needed. Horbach and Rammer (2020) found an indirect relation, but Rivera-Torres et al. (2015) presented evidence of a partial mediating effect, and López-Fernández and Serrano-Bedia (2007) observed a moderating effect of GHRM. In addition, our data do not allow us to know whether circular effort was preceded or followed by a change in organisational design, specifically in green jobs. Yet the relative number of green jobs in European SMEs can reflect their efforts to move towards circularity. Given the links between GHRM and environmental performance, organisational capabilities and economic performance, and between environmental and economic performance, we hypothesise the following:

> **Hypothesis 3.** Green jobs impact the relation between circularity in processes and production costs, such that firms with a higher percentage of green jobs over the total number of employees experience a larger reduction in production costs.

3 | EMPIRICAL STUDY

3.1 | Data

We have used data from the survey Flash Eurobarometer 456 '*SMEs, resource efficiency and green markets*', commissioned by the European Commission (European Commission, 2018). This survey was carried out by the TNS Political & Social network in September 2017 in the 28 member states of the European Union (EU), as well as in Albania, Iceland, Macedonia, Moldavia, Montenegro, Norway, Serbia, Turkey, and the United States. However, only EU members were included in our analysis so that we could focus on countries with similar environmental regulation. The unit of analysis was the firm (with at least one employee). This resulted in a sample comprising 13,117 SMEs (out of the 15,019 SMEs included in the survey). Note that the United Kingdom was part of the sample as its separation from the EU was officialised on 31 January 2020, after the fieldwork of this survey had been carried out.

The distribution of firms that responded to the survey across countries, economic sectors (NACE classification on a first level)

TABLE 1 Descriptive analysis of key variables

	N	%
Country[a]		
France/Belgium/The Netherlands/Germany/Italy/Denmark/Ireland/United Kingdom/Greece/Spain/Portugal/Finland/Sweden/Austria/Czech	12,518	95.4%
Republic/Estonia/Hungary/Latvia/Lithuania/Poland/Slovakia/Slovenia/Bulgaria/Romania/Croatia/Luxembourg/Malta/Republic of Cyprus	599	4.6%
Total	**13,117**	**100.0%**
Sector (NACE)		
B—Mining and quarrying	75	0.6%
C—Manufacturing	3015	23.0%
D—Electricity, gas, steam and air conditioning supply	98	0.7%
E—Water supply; sewerage, waste management and remediation activities	237	1.8%
F—Construction	1979	15.1%
G—Wholesale and retail trade; repair of motor vehicles and motorcycles	3887	29.6%
H—Transportation and storage	746	5.7%
I—Accommodation and food service activities	745	5.7%
J—Information and communication	474	3.6%
K—Financial and insurance activities	365	2.8%
L—Real estate activities	272	2.1%
M—Professional, scientific, and technical activities	1224	9.3%
Total	**13,117**	**100.0%**
Size—Number of employees		
Between 1 and 9 employees (Microenterprises)	5158	40.1%
Between 10 and 49 employees (Small enterprises)	4320	33.5%
Between 50 and 249 employees (Medium-sized enterprises)	2592	20.1%
250 employees or more (Large enterprises)	808	6.3%
Total	**12,878**	**100.0%**
Circular process-related practices implemented		
Saving energy	8460	64.5%
Saving materials	7582	57.8%
Using predominantly renewable energy	2191	16.7%
Saving water	6047	46.1%
Minimising waste	8041	61.3%
Selling your scrap material to another company	4368	33.3%
Recycling, by reusing material or waste within the company	5457	41.6%

TABLE 1 (Continued)

	N	%
Total	**13,117**	
Production costs		
Significantly increased	335	3.35%
Slightly increased	1411	14.09%
Not changed	2649	26.46%
Slightly decreased	5069	50.63%
Significantly decreased	547	5.46%
Total	**10,011**	**100%**
Investment in resource efficiency		
No	2367	23.55%
Yes	7684	76.45%
Total	**10,051**	**100%**
Number of green jobs		
None at all	6421	53.7%
Between 1 and 5 employees	3708	31.0%
Between 6 and 9 employees	397	3.3%
Between 10 and 50 employees	1086	9.1%
Between 50 and 100 employees	180	1.5%
101 employees or more	166	1.4%
Total	**11,958**	**100%**

[a]Each country is represented by about 500 observations, except for smaller countries—Luxembourg, Malta and Cyprus.

and size is presented in Table 1. On average, each country is represented by about 500 observations, except for smaller countries—Luxembourg, Malta and Cyprus. Overall, 29.6% of the interviewed firms operated in the wholesale and retail trade sector, 23% operated in manufacturing; 15.1% operated in the construction sector, and 9.3% in the professional, scientific, and technical industries. Each of the remaining economic activities represented less than 6% of the sample. Finally, the sample consisted mainly of micro-enterprises (40.1%) while large enterprises accounted only for 6.3% of the total. It is important to highlight the heterogeneity of the sample, which is essential as each sector faces its own barriers to circularity. Besides, firm size can influence the ability to develop unique capabilities and invest in resource efficiency, which are expected to have an impact on the intensity of eco-innovations and the construction of a competitive advantage (Horbach, 2008; Triguero et al., 2013).

3.2 | Variables

Although the survey Flash Eurobarometer 456 was not designed for the purpose of our study, four questions utilised in the survey were well-suited for our investigation. These four questions are reported in Table 1 (for a better understanding of the variables, see the original items of the survey).

3.2.1 | Dependent variable: Reduction in production costs

The respondents to the Flash Barometer survey were asked: '*What impact have the undertaken resource efficiency actions had on the production costs over the past two years?*' We recoded the answers in the following way: 'Significantly increased' was assigned the value 1; '*Slightly increased*' the value 2; '*Not changed*' the value 3; '*Slightly decreased*' the value 4; '*Significantly decreased*' the value 5.

3.2.2 | Independent variable: Circularity in processes

This variable was built is two steps. In the first step, we used information of the Eurobarometer to perform a cluster analysis. The respondents to the Flash Eurobarometer survey were asked: '*What actions is your company undertaking to be more resource efficient?*' Seven practices were to be rated: '*Saving water*', '*Saving energy*', '*Using predominantly renewable energy (e.g., including own production through solar panels, etc.)*', '*Saving materials*', '*Minimising waste*', '*Selling your scrap material to another company*' and '*Recycling, by reusing material or waste within the company*'. We recoded the answers so that each possible practice became a dummy variable with a value of 1 if the firm had implemented the practice, or 0 otherwise. In the second step, the results of the cluster analysis (i.e., belonging to one of the 4 cluster groups) allowed us to create the independent variable '*Circularity in processes*'. We explain the cluster analysis in the section *3.4. Circularity in processes within European SMEs*.

3.2.3 | Moderating variable 1: Eco-innovativeness in processes

The respondents to the Flash Barometer survey were asked about the investments made over the past 2 years with the aim of becoming more resource efficient. We constructed a dummy variable taking the value of 1 when the firm had invested during the past 2 years, and 0 otherwise. The time lapse of 2 years makes it possible to focus on the willingness of firms to improve continuously resource efficiency, that is, their eco-innovativeness. This measure is consistent with past research (Horbach, 2008, 2016; Hroncová Vicianová et al., 2017; Lee & Min, 2015).

3.2.4 | Moderating variable 2: Green jobs

The respondents to the Flash Barometer survey were asked: '*In your company, how many of your full time employees, including yourself, work in green jobs some or all of the time?*' We constructed a continuous variable capturing the percentage of green jobs over total employment. Past literature supports the idea that current levels and not variations in an organisational capability can affect environmental performance (Bansal, 2005; Sharma, 2000) and drive cost reduction (Bonzanini Bossle et al., 2016).

3.2.5 | Control variables

Firm's size was measured as a continuous variable reflecting the number of employees. Dummy variables were used for country and sector.

3.3 | Methodology

The empirical analysis was divided into two stages. In the first stage, we conducted a cluster analysis to identify a typology of European SMEs based on their circular practices. In the second stage, we used the results from the cluster analysis to build the variable '*Circularity in processes*' that we utilised to test our hypotheses. We chose to perform ordered probit models because of the nature of the dependent variable '*Reduction in production costs*', that is, an ordinal variable with five modalities. The cluster analysis was performed with the SPSS26 software package, and the ordered probit models with the STATA16 software application.

3.4 | Circularity in processes within European small and medium enterprisess

The cluster analysis was performed using available information on the type and number of circular practices in processes implemented by SMEs in order to be more resource efficient (Table 1). Additionally, we constructed a summary variable, *Intensity of circularity in processes*, depending on the number of practices performed by SMEs. Its scale ranges from 0, no practice implemented, to 7, where all seven possible practices are implemented.

TABLE 2 Descriptive analysis: Circularity in processes

	Low CE $\bar{x}_{GR1}$ 30.9% (4048)	Medium CE $\bar{x}_{GR2}$ 22.7% (2979)	High CE $\bar{x}_{GR3}$ 31% (4067)	CE champions $\bar{x}_{GR4}$ 15.4% (2023)	Total $\bar{x}$ 100% (13,117)	ANOVA
Circular process-related practices implemented[a]						
Using predominantly renewable energy	4.8%	6.0%	17.6%	54.2%	**16.7%**	1136***
Selling your scrap material to another company	6.2%	27.3%	40.3%	82.4%	**33.3%**	1703***
Recycling, by reusing material or waste within the company	11.1%	35.9%	50.7%	92.5%	**41.6%**	1837***
Saving water	4.3%	38.6%	69.3%	93.9%	**46.1%**	3321***
Saving materials	17.3%	49.2%	87.5%	91.6%	**57.8%**	2899***
Minimising waste	16.4%	57.4%	90.0%	99.2%	**61.3%**	3788***
Saving energy	15.5%	64.3%	95.6%	100.0%	**64.5%**	5104***
Intensity of circularity in processes[b]	0.76	2.79	4.51	6.14	**3.21**	44786***

Note: ANOVA: Rejection of H0: '$\bar{x}_{GR1} = \bar{x}_{GR2} = \bar{x}_{GR3} = \bar{x}_{GR4}$' for p value < .00. Duncan Test: Rejection of H0 '$\bar{x}_I = \bar{x}_J$', for all $i \neq j$, p value < .00; except for '*Using predominantly renewable energy* (e.g., *including own production through solar panels*, etc.)' between GR1 and GR2 (4.8% and 6.0%).
[a]Dummy variable: 1 = Practice implemented; 0 otherwise; means are expressed as a percentage.
[b]The scale was from 0 to 7 (0 = No practice implemented and 7 = seven practices implemented).
*p < .10. **p < .05. ***p < .01.

We applied hierarchical agglomerative cluster analysis to gather firms into homogeneous groups based on the 7 possible practices implemented in order to be more resource efficient, and the intensity of circularity in the practices implemented. Four homogeneous groups emerged from the cluster analysis (see Table 2).

Firms in group 1 implemented on average less than one practice, as illustrated by the variable *Intensity of circularity in processes*. Saving materials, minimising waste and saving energy are their most frequently performed practices. This group only relied on one 'R' principle to act for the environment, namely, that of reducing its environmental impact through an increased efficiency in the use of resources (Kirchherr et al., 2017). We called SMEs in this group 'low CE performers'. Group 1 accounted for 30.9% of the sample.

SMEs belonging to Group 2 implemented an average of two to three practices. Beyond activities aimed at reducing the consumption of resources, this group further engaged in recycling. We called SMEs in this group 'medium CE performers'. It accounted for 22.7% of the sample.

SMEs belonging to group 3 implemented an average of four to five practices. In this group, 40.3% of the SMEs took steps to sell their scrap material to another company. Within the framework of industrial symbiosis and network management, this can demonstrate a

TABLE 3 Descriptive analysis: Circularity in processes per country

	Low CE performers Group 1		Medium CE performers Group 2		High CE performers Group 3		CE champions Group 4		Total	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%
France	68	13.5%***	119	23.7%	220	**43.8%** ***	95	18.9%**	502	100.0%
Belgium	96	19.1%***	108	21.5%	178	**35.5%** **	120	23.9%***	502	100.0%
The Netherlands	110	22.0%***	113	22.6%	191	**38.2%** ***	86	17.2%	500	100.0%
Germany	109	21.8%***	102	20.4%	202	**40.4%** ***	87	17.4%	500	100.0%
Italy	151	**30.2%**	114	22.8%	141	28.2%	94	18.8%**	500	100.0%
Luxembourg	71	**35.3%**	38	18.9%	65	32.3%	27	13.4%	201	100.0%
Denmark	145	28.9%	107	21.3%	181	**36.1%** **	69	13.7%	502	100.0%
Ireland	60	12.0%***	107	21.4%	184	**36.8%** ***	149	29.8%***	500	100.0%
United Kingdom	70	14.0%***	101	20.2%	188	**37.5%** ***	142	28.3%***	501	100.0%
Greece	222	**44.3%** ***	94	18.8%**	134	26.7%**	51	10.2%***	501	100.0%
Spain	94	18.8%***	95	19.0%**	221	**44.1%** ***	91	18.2%*	501	100.0%
Portugal	71	14.2%***	99	19.8%	207	**41.4%** ***	123	24.6%***	500	100.0%
Finland	159	31.8%	101	20.2%	172	**34.4%** *	68	13.6%	500	100.0%
Sweden	66	13.2%***	122	24.4%	169	**33.8%**	143	28.6%***	500	100.0%
Austria	88	17.6%***	125	25.0%	182	**36.4%** ***	105	21.0%***	500	100.0%
Republic of Cyprus	106	**53.0%** ***	47	23.5%	31	15.5%***	16	8.0%***	200	100.0%
Czech Republic	126	25.1%***	124	24.8%	175	**34.9%** *	76	15.2%	501	100.0%
Estonia	373	**74.6%** ***	86	17.2%***	28	5.6%***	13	2.6%***	500	100.0%
Hungary	187	**37.3%** ***	119	23.7%	145	28.9%	51	10.2%***	502	100.0%
Latvia	187	**37.3%** ***	145	28.9%***	128	25.5%***	42	8.4%***	502	100.0%
Lithuania	249	**49.8%** ***	121	24.2%	100	20.0%***	30	6.0%***	500	100.0%
Malta	48	24.2%**	61	**30.8%** ***	60	30.3%	29	14.6%	198	100.0%
Poland	129	25.8%**	114	22.8%	202	**40.4%** ***	55	11.0%***	500	100.0%
Slovakia	183	**36.6%** ***	121	24.2%	141	28.2%	55	11.0%***	500	100.0%
Slovenia	177	**35.2%** **	119	23.7%	119	23.7%***	88	17.5%	503	100.0%
Bulgaria	274	**54.8%** ***	139	27.8%***	64	12.8%***	23	4.6%***	500	100.0%
Romania	316	**63.2%** ***	107	21.4%	48	9.6%***	29	5.8%***	500	100.0%
Croatia	113	22.6%***	131	26.1%*	191	**38.1%** ***	66	13.2%	501	100.0%
Total	**4048**	**30.9%**	**2979**	**22.7%**	**4067**	**31.0%**	**2023**	**15.4%**	**13,117**	**100.0%**
$\chi^2_{[81]}$: 2030***										

Note: Numbers highlighted in grey reflect a lower level of circularity for the countries in Groups 1 and 2, and a higher level for the countries in Groups 3 and 4, as compared to the European mean.
**p* < .10. ***p* < .05. ****p* < .01.

greater involvement towards CE by extending the lifespan of products (Chertow, 2008; Kirchherr et al., 2017) and a more complex management of stakeholders. We called SMEs in this group 'high CE performers'. It accounted for 31% of the sample.

Finally, in group 4, the rates of completion of each CE practice as particularly high, from 54.2% for the least performed practice (the use of renewable energy) to 100% for the most performed practice (saving energy). We called SMEs in this group 'CE champions'. It should be noted that group 4, although the smallest, nevertheless accounted for 15.4% of the total sample.

This typology of European SMEs reflects differing levels of circularity practices, ranging from group 1 (low) to 4 (high). It seems that firms first opt for a mix of preventive (reducing) and corrective (recycling) practices to increase resource efficiency, and then progress towards costlier practices that require interactions with other actors to connect production cycles or larger investments to switch to renewable energy. Our results are consistent with an earlier study of European SMEs (Garcés-Ayerbe et al., 2019) and reinforce the idea of a gradual implementation of circular practices in firms evolving towards CE. In the Environmental Management literature, the accumulation of knowledge and investments in specific domains of resources are also expected to induce firms to move from reactive or end-of-pipe strategies to more proactive or preventive strategies (Hart, 1995; Roome, 1992).

To test whether there is a gradual path towards CE practices, we performed an analysis of variance (ANOVA). Results strongly support the fact that belonging to one of the groups is statistically related to a particular level of circularity, and groups' means were significantly different (p value < .00). Besides, the Duncan Test confirms the rejection of the null hypothesis: Groups were significantly different ($\bar{x}_{GR1} < \bar{x}_{GR2} < \bar{x}_{GR3} < \bar{x}_{GR4}$ and p value < .00). The results mean that all groups performed circular practices at different levels of intensity, and that differences between groups were significant for each type of practice.

Cross-tabulating the results with the SMEs' country of origin added more details to this broad picture (see Table 3).

Twelve countries had a majority of SMEs belonging to group 1 (***Low CE performers***): Italy, Luxembourg, Greece, the Republic of Cyprus, Estonia, Hungary, Latvia, Lithuania, Slovakia, Slovenia, Bulgaria and Romania. Fifteen countries had the greater part of their SMEs belonging to group 3 (***High CE performers***): France, Belgium, the Netherlands, Germany, Denmark, Ireland, the United Kingdom, Spain,

TABLE 4 Descriptive analysis: Circularity in processes per sector

	Low CE performers Group 1		Medium CE performers Group 2		High CE performers Group 3		CE champions Group 4		Total	
	N	%	N	%	N	%	N	%	N	%
B—Mining and quarrying	19	25.3%	17	22.7%	29	**38.7%**	10	13.3%	75	100.0%
C—Manufacturing	628	20.8%***	642	21.3%**	1067	**35.4% *****	678	22.5%***	3015	100.0%
D—Electricity, gas, steam and air conditioning supply	24	24.5%	23	23.5%	30	**30.6%**	21	21.4%*	98	100.0%
E—Water supply; sewerage, waste management and remediation activities	44	18.6%***	61	25.7%	52	21.9%***	80	**33.8% *****	237	100.0%
F—Construction	695	**35.1% *****	465	23.5%	539	27.2%***	280	14.1%*	1979	100.0%
G—Wholesale and retail trade; repair of motor vehicles and motorcycles	1218	31.3%	922	23.7%*	1244	**32.0%**	503	12.9%***	3887	100.0%
H—Transportation and storage	319	**42.8% *****	152	20.4%	185	24.8%***	90	12.1%***	746	100.0%
I—Accommodation and food service activities	166	22.3%***	154	20.7%	287	**38.5% *****	138	18.5%**	745	100.0%
J—Information and communication	214	**45.1% *****	106	22.4%	125	26.4%**	29	6.1%***	474	100.0%
K—Financial and insurance activities	126	**34.5%**	76	20.8%	111	30.4%	52	14.2%	365	100.0%
L—Real estate activities	105	**38.6% *****	72	26.5%	70	25.7%*	25	9.2%***	272	100.0%
M—Professional, scientific, and technical activities	490	**40.0% *****	289	23.6%	328	26.8%***	117	9.6%***	1224	100.0%
Total	**4048**	**30.9%**	**2979**	**22.7%**	**4067**	**31.0%**	**2023**	**15.4%**	**13,117**	**100.0%**
$\chi^2_{[33]}$: 572***										

Note: Numbers highlighted in grey reflect a lower level of circularity for the countries in Groups 1 and 2, and a higher level for the countries in Groups 3 and 4, as compared to the European mean.
*p < .10. **p < .05. ***p < .01.

Portugal, Finland, Sweden, Austria, the Czech Republic, Poland and Croatia. Only Malta had more SMEs in Group 2 (***Medium CE performers***) and none of them had a majority of firms in Group 4 (**CE champions**). This result is consistent with recent findings (Llorente González, 2019).

The predominance of Groups 1 and 3 was still valid when we cross-tabulated the data with the sectors (see Table 4). No sector was predominantly associated with Group 2. SMEs in Group 4 carried out their activity principally in the sector '*E - Water supply; sewerage, waste management and remediation activities*' (33.8%). Although this result is intuitive, we expected more firms from this sector to be CE champions. In general, economic activities based on services were low CE performers, whereas economic activities related to physical goods were high CE performers, including the two activities with the largest samples, namely, '*C - Manufacturing*' and '*G - Wholesale and retail trade; repair of motor vehicles and motorcycles*'.

3.5 | Hypotheses testing

In order to test our hypotheses, we specified four ordered probit models (see Figure 1):

$$\text{Prob}\,(Y_i = j) = F(\delta_{11}\text{Circularity in processes}_i + \beta X_i) \quad (\text{Model 1})$$

where firms are indexed by *i*, Y_i indicates the levels of *Reduction in production costs* with $j \in \{1;5\}$, and X_i is a vector of the control variables (firm's size, country of origin and sector of activity).The results of the cluster analysis allowed for the creation of the variable *Circularity in processes*; possible grades for this variable ranged from 1 to 4, depending on which of the four groups of the cluster analysis the firm belonged to.

SMEs achieving a higher level of circularity in processes experience a larger reduction in their production costs: $\delta_{11} = 0.148$, *p* value < .00.

Eco-innovativeness is added as an explanatory variable in Model 2. Results show that these types of investments are positively associated with a reduction in production costs ($\delta_{22} = 0.117$, *p* value < .10), suggesting that firms that eco-innovate in processes are more cost-efficient than their counterparts. Results also support Hypothesis 2 that suggests that eco-innovativeness in processes moderates the relation between circularity in processes and the reduction in production costs ($\gamma_{22} = 0.051$, *p* value < .10). The effect of circularity on production costs is still robust at this stage ($\delta_{21} = 0.088$, *p* value < .00). Overall, these results are not at odds with previous evidence that SMEs need to invest at least the equivalent of 10% of their revenues to get returns from their investments in circular practices (Demirel & Danisman, 2019).

Model 3 shows the impact of *Green-jobs*. In this model, circularity in processes is still positively associated with the reduction in production costs ($\delta_{31} = 0.182$, *p* value < .00). *Green-jobs* are also positively associated with the reduction in production costs ($\delta_{33} = 0.315$, *p* value < .00). This result is not at odds with the notion that SMEs that show a higher proportion of green jobs in their workforce are more cost-efficient than their counterparts. However, contrary to Hypothesis 3 that suggests that *Green-jobs* positively moderate the relation between circularity in processes and the reduction in production costs, we obtain a negative coefficient for the interaction term ($\gamma_{33} = -0.118$, *p value* < .00). This result means that the joint effect of green jobs and circularity in processes on firms' production costs is smaller than the effect of circularity alone. That is, the cost reduction derived from circularity in processes is smaller when SMEs need to dedicate more green jobs to circular activities. This lower reduction in production costs can be justified by the increase in the cost of human resources that simply leads to a lower reduction in total production costs.

$$\text{Prob}\,(Y_i = j) = F(\delta_{21}\text{Circularity in processes}_i + \delta_{22}\text{Eco-innovativeness}_i + \gamma_{22}\,\text{Circularity in processes}_i \times \text{Eco-innovativeness}_i + \beta X_i) \quad (\text{Model 2})$$

$$\text{Prob}\,(Y_i = j) = F(\delta_{31}\text{Circularity in processes}_i + \delta_{33}\text{Green-jobs}_i + \gamma_{33}\,\text{Circularity in processes}_i \times \text{Green-jobs}_i + \beta X_i) \quad (\text{Model 3})$$

$$\text{Prob}\,(Y_i = j) = F(\delta_{41}\text{Circularity in processes}_i + \delta_{42}\text{Eco-innovativeness}_i + \delta_{43}\,\text{Green-jobs}_i + +\gamma_{42}\text{Circularity in processes}_i \times \text{Eco-innovativeness}_i + \gamma_{43}\,\text{Circularity in processes}_i \times \text{Green-jobs}_i + \beta X_i) \quad (\text{Model 4})$$

Our results from the probit models are displayed in Table 5. In Model 1, we loaded *Circularity in processes* as an independent variable to analyse its impact on the dependent variable *Reduction in production costs*. Results support Hypothesis 1 that suggests that European

Model 4 shows the impact of adding simultaneously *Eco-innovativeness* and *Green-jobs* as explanatory variables to the base regression that includes *Circularity in processes*. Hypothesis 1 is still supported ($\delta_{41} = 0.108$, *p* value < .00) as well as Hypothesis 2 ($\gamma_{42} = 0.071$,

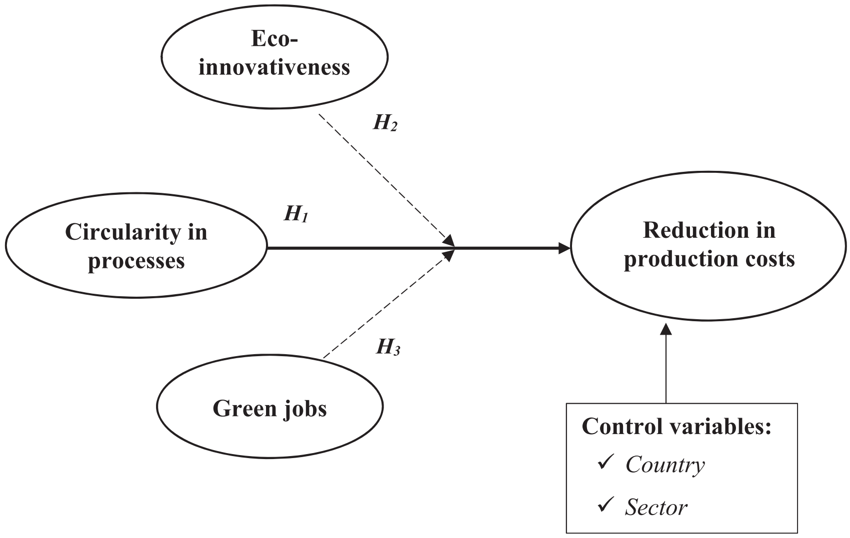

FIGURE 1 Conceptual framework

p value < .05). Hypothesis 3 is again rejected ($\gamma_{43} = -0.127$, *p value* < .00). Also note that, in this model, *Eco-innovativeness* is not significantly associated with a *Reduction in production costs* ($\delta_{42} = 0.075$, *p* value > .10). This finding suggests that it was not enough to take the decision to invest, that is, to demonstrate eco-innovativeness. Investments could reduce production costs only if firms combined it with an appropriate implementation of circular practices.

4 | DISCUSSION

In this work, we analysed data from the Flash Eurobarometer Survey 456 to empirically test the impact of European SMEs' level of circularity, eco-innovativeness in processes and allocation of green jobs on their cost structure. We first conducted a cluster analysis that revealed how the path towards CE in European SMEs is gradual regarding process-related practices. This path starts with practices related to reducing their environmental impact through savings in resource consumption and waste generation. It continues with recycling or corrective actions, and goes on with preventive practices that allow firms to reuse materials and waste. We then built and tested four models in which the level of circularity in processes achieved by European SMEs leads to a reduction in production costs, providing support for H1. This reduction is positively moderated by SMEs' eco-innovativeness in processes to the extent that these investments are aligned with the implementation of novel and appropriate circular practices, thus supporting H2. However, this reduction is not improved, but mitigated, by the relative share of green jobs as evidenced by the negative coefficient for the interaction term. Thus, H3 is rejected.

Our results support the idea that, overall, it pays to be circular in processes, through a reduction in production costs. But they also provide more evidence on how it pays to be circular, as production costs are further reduced when the circularity achieved within the firm is greater, and especially when it is coupled with eco-innovativeness in processes. These results are in line with past research on the effects of process-related EI on firms' cost structure (Grekova et al., 2013; Hroncová Vicianová et al., 2017; Triguero et al., 2013), and with the 'win-win paradigm' of the Porter Hypothesis (Ambec et al., 2013; Ambec & Lanoie, 2008; Garcés-Ayerbe & Cañón-de-Francia, 2017). Moreover, they complement past research as there is, to our knowledge, no previous evidence on the moderating role of eco-innovativeness on the relation between circularity in processes and reduction in production costs.

It is important to note that, contrary to our expectations, a higher relative proportion of green jobs in European SMEs' workforce did not positively moderate the relation between circularity and reduction in production costs. Our results show that firms with green jobs are more cost efficient. But there is no evidence that increasing this green workforce will further reduce production costs. It might simply give rise to a mechanical increase in production costs, with no evidence of economies of scale—for example, with more sales or the improvement of internal processes offsetting the costs of the change in the workforce. Crossing our results with past literature shows that product-related circularity may be more sensitive to effects related to green jobs, especially for firms belonging to the environmental sector (Horbach & Janser, 2016). Through the lenses of the Porther Hypothesis, green jobs seem to be related to the increased revenues benefit of environmental innovation in products, and not to the reduced costs path (Ambec & Lanoie, 2008; Horbach & Rennings, 2013). Process-related circularity leads to cost efficiency by modernising internal processes, which in turn generates a competitive advantage for the firm (Triguero et al., 2013). Once the competitive advantage has been built and is yielding higher sales, the employment rate adjusts to this new demand, but these costs do not seem to be absorbed by increased efficiency (Horbach & Rammer, 2020; Horbach & Rennings, 2013). Thus, green jobs might in fact be indirect outcomes of the decision to

TABLE 5 Ordered probit estimation: Reduction in production costs

	Model 1			Model 2			Model 3			Model 4		
	Coef.	Std.Err.		Coef.	Std.Err.		Coef.	Std.Err.		Coef.	Std.Err.	
Circularity in processes	0.148	(0.012)	***	0.088	(0.026)	***	0.182	(0.014)	***	0.108	(0.028)	***
Eco-innovativeness				0.117	(0.069)	*				0.075	(0.072)	
Green-jobs							0.315	(0.086)	***	0.327	(0.090)	***
Circularity in processes* × *Eco-innovativeness				0.051	(0.029)	*				0.071	(0.030)	**
Circularity in processes* × *Green-jobs							−0.118	(0.031)	***	−0.127	(0.033)	***
Size	0.002	(0.000)	***	0.002	(0.000)	***	0.002	(0.000)	***	0.000	(0.000)	***
Sector												
• B—Mining and quarrying	0.265	(0.166)		0.273	(0.176)	*	0.241	(0.175)		0.237	(0.187)	
• C—Manufacturing	0.129	(0.082)		0.190	(0.088)	**	0.135	(0.085)		0.196	(0.091)	**
• D—Electricity, gas	0.276	(0.153)	*	0.326	(0.164)	***	0.327	(0.159)	**	0.370	(0.169)	**
• F—Construction	−0.057	(0.084)		0.027	(0.090)		−0.061	(0.087)		0.023	(0.093)	
• G—Wholesale, retail trade	0.025	(0.082)		0.085	(0.088)		0.032	(0.085)		0.092	(0.091)	
• H—Transportation	0.056	(0.093)		0.084	(0.099)		0.056	(0.096)		0.080	(0.103)	
• I—Accommodation and food	0.120	(0.091)		0.178	(0.098)	*	0.133	(0.095)		0.189	(0.101)	*
• J—Information	0.114	(0.100)		0.253	(0.108)	**	0.135	(0.103)		0.273	(0.111)	**
• K—Financial and insurance	0.172	(0.106)		0.240	(0.113)	**	0.166	(0.110)		0.230	(0.118)	*
• L—Real estate activities	0.184	(0.112)		0.263	(0.120)	**	0.149	(0.116)		0.204	(0.123)	*
• M—Professional, scientific	0.054	(0.088)		0.145	(0.094)		0.057	(0.091)		0.149	(0.097)	
$\chi^2_{(11)}$	42.5***			38.77***			42.09***			37.65***		
Country[a]												
• France	−0.262	(0.074)	***	−0.281	(0.077)	***	−0.241	(0.075)	***	−0.250	(0.079)	***
• Belgium	−0.167	(0.075)	***	−0.190	(0.079)	**	−0.157	(0.077)	**	−0.172	(0.081)	**
• The Netherlands	−0.168	(0.075)	***	−0.205	(0.077)	***	−0.151	(0.077)	*	−0.184	(0.080)	**
• Germany	0.034	(0.075)		−0.013	(0.079)		0.048	(0.078)		0.006	(0.081)	
• Italy	−0.127	(0.075)	*	−0.109	(0.080)		−0.117	(0.077)		−0.086	(0.081)	
• Luxembourg	−0.330	(0.104)	***	−0.357	(0.109)	***	−0.302	(0.107)	***	−0.310	(0.112)	***
• Denmark	0.077	(0.075)		0.062	(0.079)		0.094	(0.077)		0.086	(0.080)	
• Ireland	−0.206	(0.075)	***	−0.198	(0.079)	**	−0.215	(0.079)	***	−0.198	(0.083)	**
• United Kingdom	−0.447	(0.076)	***	−0.460	(0.082)		−0.426	(0.080)	***	−0.429	(0.085)	***
• Greece	0.221	(0.078)	***	0.218	(0.081)	***	0.254	(0.081)	***	0.245	(0.084)	***
• Spain	0.038	(0.073)		0.020	(0.077)		0.046	(0.076)		0.022	(0.079)	
• Finland	0.235	(0.075)	***	0.190	(0.078)	**	0.262	(0.077)	***	0.226	(0.080)	***
• Sweden	−0.121	(0.075)		−0.136	(0.078)	*	−0.089	(0.077)		−0.094	(0.080)	
• Austria	−0.027	(0.074)		−0.061	(0.077)		0.012	(0.076)		−0.019	(0.080)	
• Republic of Cyprus	−0.004	(0.108)		0.076	(0.118)		0.027	(0.111)		0.107	(0.120)	
• Czech Republic	−0.031	(0.076)		−0.004	(0.081)		−0.041	(0.080)		0.004	(0.085)	
• Estonia	−0.028	(0.085)		−0.034	(0.090)		0.012	(0.088)		−0.011	(0.091)	
• Hungary	0.102	(0.076)		0.114	(0.080)		0.113	(0.080)		0.137	(0.084)	
• Latvia	−0.088	(0.076)		−0.090	(0.079)		−0.083	(0.079)		−0.077	(0.082)	
• Lithuania	0.217	(0.079)	***	0.227	(0.083)	***	0.244	(0.082)	***	0.258	(0.085)	***
• Poland	−0.268	(0.077)	***	−0.264	(0.080)	***	−0.258	(0.082)	***	−0.256	(0.085)	***

(Continues)

TABLE 5 (Continued)

	Model 1			Model 2			Model 3			Model 4		
	Coef.	Std.Err.		Coef.	Std.Err.		Coef.	Std.Err.		Coef.	Std.Err.	
• Slovakia	−0.079	(0.077)		−0.106	(0.082)		−0.051	(0.081)		−0.063	(0.086)	
• Slovenia	0.246	(0.076)	**	0.214	(0.080)	***	0.265	(0.079)	***	0.232	(0.082)	***
• Bulgaria	0.261	(0.081)	**	0.243	(0.085)	***	0.291	(0.088)	***	0.275	(0.093)	***
• Romania	0.172	(0.081)	**	0.148	(0.084)	*	0.209	(0.085)	**	0.198	(0.087)	**
• Croatia	0.213	(0.076)	**	0.233	(0.082)	***	0.236	(0.079)	***	0.258	(0.085)	***
$\chi^2_{(26)}$	*268.9****			*242.67****			*255.54****			*186.21****		
Number of observations	9819			8958			9034			8302		
LR χ^2	480.5			522.6***			477.6***			519.55***		
Log likelihood	−11,950			−10,819			−10,984			−10,016		
Pseudo R^2	0.020			0.024			0.021			0.026		

Note: Sector base category: E—Water supply; sewerage, waste management and remediation activities. Country base category: Portugal.
[a]Malta was discarded because of insufficient valid cases in the variables.
****p* < .00. ***p* < .05. **p* < .10.

invest in circularity and eco-innovate in processes, and not a moderator, that is a necessary tool to guide the process towards greater circularity.

The positive results of CE in processes at the European level should not erase the disparities that have been revealed between sectors and countries, and which past studies have also experienced (Horbach, 2008; Horbach & Janser, 2016; Triguero et al., 2013). The differences in circularity among sectors are not surprising, as numerous variables not considered in this study may come into play, such as the nature of the products, characteristics of the inputs, suppliers, markets, Environmental Management Systems, regulation and so on. Despite these forces, the differences in levels of circularity between the economic activities are consistent with past literature or EU targets.

For example, the fact that the manufacturing sector has a majority of high CE performers may find explanations in its long history of implementing efficient management practices and certifications, for example, ISO norms. Such practices helped companies develop internal capabilities and build competitive advantage, often leading to a twin benefit of cost reduction and mitigation of environmental impact (Hart, 1995; Porter & van der Linde, 1995). It has also been suggested that pollution prevention practices could be integrated in Total Quality Management (Hart & Ahuja, 1996; Molina-Azorín et al., 2009). Similarly, the implementation of a quality management system (ISO 9001) has an impact on the intensity of implementation of an Environmental Management System (ISO 14001) (López-Fernández & Serrano-Bedia, 2007).

In accommodation and food services, most SMEs are high CE performers, which may be a consequence of being targeted by the European Commission for poor environmental performance and high rates of food waste all along the value chain. Stricter regulation and plans to tackle this issue may have led the sector to climb the ladder towards more circularity.

Disparities in circularity and eco-innovativeness between countries may, however, reveal deeper inequalities between European countries. In this respect, our results are consistent with Llorente González's conclusions, which indicated that different levels of development, technological intensity, and labour cost structures have in turn given rise to different levels of CE within Europe (Llorente González, 2019). It is interesting to note that the countries with a majority of high CE performers (Group 3 of the cluster analysis) accounted for 53.57% of the sample, but 83.19% of the GDP of the 28 Member States in 2017. Countries with a majority of low CE performers (Group 1 of the cluster analysis) accounted for 42.86% of the sample but only 16.74% of the GDP of the 28 Member States in 2017 (Eurostat). Thus, there seem to be at least two CE in Europe, developing at two different paces. Our results match the performance of EU Member States on some environmental and circularity indicators. Using Eurostat data for 2017, only 17% of the low CE performers had a resource productivity and domestic material consumption index above the mean rate of the 28 EU Members. In contrast, 53% of the high CE performers performed better on this index than the European mean. Similarly, 25% of low CE performers had a better rate of circular material reuse than the European mean, whereas 47% of high CE performers had a rate above this mean.

There is at least one previous call recommending environmental policies to stimulate eco-innovation, and more specifically in Member States that have joined the EU from 2004 (Beltrán-Esteve & Picazo-Tadeo, 2017). Consequently, research is being conducted to identify the different drivers and country conditions that explain the different levels of eco-innovativeness in Europe (Halkos et al., 2021; Horbach, 2016), and efforts in this direction should continue. Eastern European countries are still characterised by energy intensive technologies and lower financial performance, which make them more dependent upon subsidies and knowledge transfer from Western European countries to eco-innovate. Lower environmental awareness in these countries also makes voluntary codes or agreements to promote pro-environmental practices less common (Horbach, 2016). Case studies in certain countries confirm the potential of eco-innovating, even if they perform below the European average on circularity, such as in Slovakia and Poland (Hroncová Vicianová et al., 2017; Przychodzen & Przychodzen, 2015). These case studies also evidence country-specific barriers, such as the dependence on foreign capital in the case of Slovakia.

Despite the disparities between countries, results are encouraging as there is no evidence that EU Member States cannot fully benefit from eco-innovating or from the implementation of circular practices. In line with this idea, a recent example, although not from the EU, indicates that Ukraine has not yet reached the level of technological development that could allow the country to benefit from the implementation of circular practices (Deineko et al., 2019).

5 | CONCLUDING REMARKS

Our paper makes several contributions. First, we confirm the positive role of process-related circularity and eco-innovativeness, as well as the allocation of green jobs, in reducing firms' production costs. Our findings support the 'win-win scenario' suggested in the Porter Hypothesis (Ambec et al., 2013; Ambec & Lanoie, 2008; Garcés-Ayerbe & Cañón-de-Francia, 2017). Proactivity in circularity and greater economic performance can be aligned, even for SMEs. Our second contribution is the distinction between the level of circularity within firms, that is, the circular process-related practices implemented, and firms' eco-innovativeness in processes, that is, the investments directed at developing the efficiency of these circular practices through process-related EI. This distinction yields clearer insights on the mechanisms of how firms' sustainable efforts impact firm economic performance. And third, we contribute to the still very limited literature on green jobs (Moreno-Mondéjar et al., 2021) by showing that SMEs with green jobs seem to have a cost-efficiency advantage compared to their counterparts, although increasing this capability does not increase their economic performance.

Our results add knowledge to the growing literature on the state and consequences of CE for firms in Europe. For entrepreneurs and managers of SMEs, these results should be interpreted as encouraging. They support the idea that a transition towards CE and its benefits are not reserved exclusively to large firms. By investing in circularity and process-related eco-innovations, SMEs can build a valuable competitive advantage, besides contributing to the European transition towards a sustainable development. Yet, it is important to keep in mind that a certain threshold must be reached before the effects of eco-innovativeness and proactivity in circularity become visible.

Our results also draw the attention of policymakers on the need to differentiate instruments to promote circular practices, eco-innovations and green jobs depending on the actual performance of EU Member states, and on the circumstances and state of their development and technological capabilities. Market forces play an important role in motivating firms to eco-innovate. However, policymakers may intervene to support firms, and especially SMEs, in developing capabilities that are common barriers to eco-innovativeness when insufficiently developed, such as financial resources. Policymakers also play an important role in the promotion and training campaigns that reduce the costs of green jobs. Finally, policymakers should improve the level of environmental awareness of the populations, which affects both the speed of business transition towards more circularity and the achievement of a sustainable development. The intervention of policymakers is all the more desired that encouraging the practices analysed in this study contribute directly to the sustainable development goals 12 (Responsible consumption and production), and to a lesser degree to the goals 8 (Decent work and economic growth) and 9 (Industry, innovation, and infrastructure).

The costlier steps towards CE involve tighter relations with stakeholders, for example in the case of selling waste to another industry. Reaching this stage implies that CE is not developing only within the firm, at the micro level, but also at the meso level, in an eco-industrial park or within the local region. At this stage, a high degree of maturity in the circularity of the actors involved in such a value chain is required. The complexity and network nodes of intense circular practices call for tighter cooperation and partnership at the macro level, echoing the UN's 17th sustainable development goal (Partnerships for the goals). More cooperation and partnership contribute to CE and sustainability, and to reducing disparities among regions or countries.

Despite the precautions taken to conduct this research, we can highlight several limitations. First, we used secondary data from the Flash Eurobarometer. Thus, our measures were constrained by the available data. However, this survey has become increasingly sophisticated over the years, and our measures found support in the literature. In addition, the robustness and significance of our results suggest that this issue may not threaten our findings. Second, our results cover circular practices at the European level and should not be separated from their context when invoked. Indeed, CE has followed different paths in different regions around the world (Ghisellini et al., 2016) and the results obtained here may not be replicated in another region of the world.

Overall, our results stress the need to investigate the different types of circular practices and EI separately. They also call for more research to answer the question: '*How does it pay to be proactive in Circular Economy?*'

There is indeed an urgent need for research on the CE paradigm as it can enable firms and societies to adapt and respond to other global challenges. In the path towards sustainability, societies are learning to adapt and manage resilience (Lebel et al., 2006). With increasing pressure from climate change, resilience has become crucial to accompany societies and empower them to face global challenges. For firms and especially SMEs, eco-innovativeness may act as an instrument to reinforce their resilience, by providing them with the flexibility, adaptive capabilities and competitive advantage needed for them to stay and grow in their market. But resilience is not restricted to environmental issues. It could also empower SMEs to face unprecedented or unexpected crises such as the COVID-19 pandemic. Flexibility, adaptation and resilience should become basic competences of firms so that they can face dramatic global threats with more confidence.

Our results support the idea that CE evolves at two paces in Europe. One third of the sample is composed of firms rated as low CE performers, as opposed to another third that makes up the group of high CE performers. Each group appears to be related to a different set of EU member states, reinforcing the idea of a division between countries in their progress towards CE. Future research should investigate, from different theoretical perspectives, the country-level factors that shape these different CE.

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