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Green Growth & Sustainability Transition through information. Are the greener better informed? Evidence from European SMEs

Abstract

The European Green Deal along with directives promoting Circular Economy support sustainability transition and foster green growth through developing appropriate funding. However, information on how to access such funding affects firms' decision to expand their business strategy. This paper investigates the effect of information about financing tools on the adoption of Circular Economy business activities by exploring whether the better-informed firms are 'greener' and what influences such decision through a switching endogenous regressor model to account for endogeneity and selectivity bias. Data on European SMEs is combined with country-specific characteristics and econometric results indicate that better informed firms are by 65 percentage points more likely to adopt an activity promoting Circular Economy, highlighting that awareness about funding tools is crucial for sustainability transition. Evidence advocates for mainstreaming information regarding funding sources to pave the way towards green growth. A rebound effect regarding the use of renewables is observed whilst evidence points towards the rejection of Porter Hypothesis. Policy makers should target in fostering a greener business environment for the firms that engage in Circular Economy practices through increased information on funding options. Findings are also pertinent to the ongoing discussion and policy agenda around acceleration of the transition to a greener European Economy.

Keywords: Green Growth, Circular Economy, European Green Deal, Awareness & Information, Competitiveness, Switching with binary endogenous regressors

JEL classification: B41, C13, C51, C54, D22, D83, M21, Q56

Conflict of Interests

The authors declare that there is no conflict of interest.

Highlights

- We explore whether better informed firms are greener and what drives that decision.
- Firms with information on funding tools are by 65% more likely to be greener.
- Mainstreaming information about funding paves the way towards green growth.
- Better informed firms are not deterred by the complexity of funding procedures.
- Funders should reward trailblazing firms by simplifying funding acquisition.

1. Introduction & motivation

Green growth and sustainability transition through altering the production paradigm to become greener are in the forefront of the policy agenda, particularly in Europe. Small and Medium Enterprises (SMEs) represent most European enterprises, employ 66% of the total workforce (Južnik Rotar et al., 2019) and have been promoted as a key component in the European Union's (EU) attempt for a paradigm shift in production, both due to their prevalence in production and for their persistence to employ non-sustainable production means (Ormazabal et al., 2018). To achieve such a shift, changes in policy and funding mobilization are required.

This policy shift is dictated in several directed policies. The Resource Efficiency Flagship Initiative of the Europe 2020 growth Strategy aiming at establishing sustainability through the Resource Efficiency Roadmap (European Commission, COM/2011/0571), the Renewable Energy Directive (2009/28/EC; 2018/2001/EU; COM/2021/557) setting "*binding target for the use of renewable energy in improving sustainability*" along with the European Green Deal (European Commission, COM/2019/640), the new growth strategy of Europe sets ambitious targets regarding the environmental impact of the human behavior while at the same time aims at reshaping the established production paradigms that proved to have high environmental cost compromising the quality of life.

To mobilize further greener and more sustainable solutions to push the economy forward to embrace and implement the concept of Circular Economy (CE), the 2020 Circular Economy Action Plan (European Commission, COM/2020/98) was introduced. CE aims at prolonging the life cycle of products and preserving scarce resources, by retaining the economic value of the inputs and raw materials in the system (Prieto-Sandoval et al., 2018). Application of CE principles is expected to occur at all levels within the value chain (Ghisellini et al., 2016). Such being the case, adoption of CE activities has been advocated as a departure from a traditional, linear economy established during the first industrial revolution, as it is crucial to preserve resources and promote close material loops and halt resource depletion (Prieto-Sandoval et al., 2019).

Recent literature has examined SME's decision to adopt CE activities to identify potential drivers within and across countries. Studies have turned the spotlight on the relationship between firm growth and adoption of CE practices (e.g., Demirel and Danisman, 2019), the barriers to adopt CE practices (e.g., Garcia-Quevedo et al., 2019) and the cross-sector firm factors affecting CE adoption (e.g., Basi and Dias, 2019; Gusmerotti et al., 2019) so far. Funding for such 'green activities' (such as CE practices) has also been found to influence CE adoption, as it facilitates sustainability transition though technology betterment and production paradigm alternation (Ghisseti and Montresor, 2020).

Nevertheless, conceptual approaches of the impact of information about financial tools for 'green activities' in firms that have already been implementing CE practices, are missing. Therefore, this paper examines *whether there is a differential effect of information about financing tools on CE business activities.* In other words, this paper investigates *whether the better-informed firms are 'greener' and what influences such a decision.*

Better information is expected to make firms less reluctant to expand their business strategy towards this end (Dulia et al., 2021). Information about financial instruments exerts an influence on the decision to engage in activities promoting green growth (Ghisseti and Montresor, 2020). Therefore, there is a potential endogenous relationship between information about funding CE activities and decision to expand the business strategy to include CE activities, affected by the micro- and as well as the macro- environment of the firm. The former is assumed to include firm-specific characteristics such as firm size and barriers to adaptation. The latter is assumed to include country-specific factors such as competitiveness, eco-innovation, and regulations.

A country's policy framework influences the level of CE adoption but how policy is implemented in real-life depends on country-specific factors such as its attitude towards green growth and sustainability (Basi and Dias, 2019). Literature highlights how competitiveness increases when a paradigm shift such as economy-wide CE adoption, which in turn reduces environmental footprint (Gusmerotti et al., 2019). As competitiveness can include many elements of the production and institutional environment of the country, the use of a multi-faceted index to control for the same pillars across countries, is required. To this end, literature has acknowledged the role of the Global Competitiveness Index produced by the World Economic Forum, in exploring a country's potential and technology level (Gkypali et al., 2019; Tsekouras et al., 2017).

Moreover, literature suggests that there is significant heterogeneity in the implementation of sustainable development goals (Chatzistamoulou and Koundouri, 2020), implying different attitudes towards green growth and CE practices. Thus, the macro-level characteristics such as resource productivity, circularity rate, eco innovation performance, regulation quality and renewable energy use, outlining the country's performance and attitude towards sustainability and green growth, need to be considered. However, studies incorporating such macro-level information have not surfaced yet.

Country-level characteristics are expected to influence CE adoption, along with the country's institutional framework. A favorable policy environment can support changes in sourcing and designing of products and production processes (Esposito et al., 2018), as well as creating an appropriate business and policy environment in terms of regulations (García-Quevedo et al., 2020). In turn, this is expected to affect decisions regarding the business strategy of the firm, as improved institutional mechanisms and stable production environment enhance the flow of information in the system.

The contribution of this paper is found on the ground that it brings to the forefront the influence of information about funding green strategies on the adoption of CE activities. Specifically, the adopted conceptual approach accounts for endogeneity of information about funding tools in adopting CE practices, through employing the potential of a switching endogenous regressor model allowing for measuring the differential effect of CE practices adoption contingent on awareness about funding sources. This study contributes to the growing literature by disentangling adoption of CE strategies from barriers, allowing an in-depth look at the drivers of the adoption of CE activities and the influence of both the micro as well as the macro environment to reach a sustainable trajectory.

Findings indicate that better informed firms regarding the existence of funding tools to promote CE activities are by 65 percentage points more likely to expand their business strategy to include them. Therefore, there is a differential effect of information on the decision to develop green agenda. Funding is a major driver of this decision, especially the self-founding while firm heterogeneity impedes CE activities adoption. Hence, funding itself is a necessary but not sufficient condition to boost CE activities and thus sustainability, as information is used to bridge the gap between the former and CE activities. Both the country profile and attitude towards CE are also found to influence the production environment firms operate into. Specifically, a rebound effect is documented along with the rejection of the Porter Hypothesis while it is showcased that competitiveness acts as a driver of CE activities adoption.

The paper is structured as follows. Section 2 presents a brief background of the policy framework and related literature, Section 3 describes the dataset along with the empirical strategy and research hypotheses, in Section 4 the discussion of the estimation results, managerial and policy implications is presented while Section 5 concludes the paper.

2. Existing knowledge: policy and literature

2.1 Circular Economy; related policy framework

The concept of Circular Economy (CE) globally begun to gain ground since 2002 (Basi and Dias, 2019). Ever since, initiatives supporting and encouraging eco-innovation have been a target of the European Union (EU), as firms that apply eco-innovation activities (i.e., eco-businesses) account for 2.5% of EU's Gross Domestic Product (European Commission, 2013). To promote CE within its remit, the European Commission launched two specialized legislative proposals to boost CE as it foresees that wide adoption of CE across its member states could bring substantial environmental benefits, energy savings and job creation (Ellen MacArthur Foundation, 2015).

Specifically, in 2015 the EU "*adopted its first circular economy action plan*" to boost green growth transition to sustainability, to enhance competitiveness and create more jobs (European Commission, COM/2015/614) with recent contributions confirming the latter (Moreno-Mondéjar et al., 2021) while the second action plan was launched in 2018 addressing challenges posed by plastics use (European Commission, COM/2018/028). These two echoed in the 2019 Commission's climate action plan about CE aiming at fostering climate neutrality and CE through resource conservation (European Commission, COM/2019/190).

The CE concept also permeates other EU policies such as the recent European Green Deal (European Commission, COM/2019/640) as well as the Circular Economy Action Plan (European Commission, COM/2020/98). In terms of supporting CE activities, the EU has earmarked 10 billion euros under its InvestEU programme (European Commission, COM/2018/439) which is a "*dedicated natural capital and circular economy initiative*" up to 2030. InvestEU aims at attracting public-private blended finance to deliver its goals, a testament to the nature of CE that requires all sectors of an economy to collaborate for benefits to be delivered.

Despite the European Commission's efforts and policies, CE implementation is still at its infancy across Europe, with countries displaying varying levels of progress (Kirchherr et al., 2018). Nevertheless, recent studies show that 73.2% of out of 10 thousand EU SMEs firms were either already, or in the process of, implementing and adopting some aspect of CE (e.g., Basi and Dias, 2019). According to the Green Employment Initiative (European Commission, COM/2014/446) and the Green Action Plan (European Commission, COM/2014/0440). European SMEs adopting CE practices are also more likely to have "green jobs" currently (Moreno-Mondéjar et al., 2021) while generating 7 and 10 million new, "green" jobs, in the retail and service sectors, respectively. Such job creation can reduce unemployment in all EU member states by half a million, by 2030 (Mitchell and James, 2015) and for several young European people employment in "green jobs" allows them to enter the workforce for the first time (Sulich and Rutkowska, 2020). Therefore, a transition to green growth, through application of CE, is beginning to be sketched out.

2.2 Circular Economy; connecting the dots towards sustainability and green growth

The literature focusing on SMEs adoption of CE principles is growing and has identified several activities European SMEs undertake that are considered as approximations of good CE practices. The focus has been both countrywide (e.g., Arranz et al., 2019; Gusmerotti et al., 2019) and EU-wide (e.g., Garrido-Prada et al., 2021; Robaina et al., 2020; Demirel and Danisman 2019; Garcia-Quevedo et al., 2019).

Several approaches have been employed in the literature to account for CE adoption. Those could be grouped into two categories, where the first uses a combination of activities at the country, region or firm-level to approximate CE adoption and the second uses indicators as 'proxies' of CE adoption (Saidani et al., 2019). The former is developed through the following five activities considered to reflect adoption of CE principles: minimising energy consumption, using renewable energy in production, minimise waste through reusing, re-selling and recycling waste, minimise the use of materials through better design and production of services and products and minimise water use and maximise water reuse (Garrido-Prada et al., 2021; Garcia-Quevedo et al., 2020; Bassi and Dias, 2019; Demirel and Danisman, 2019). The latter category relies on the use of indicators such as the Resource Productivity index (e.g., Robaina et al., 2020) and indicators resulting from the Material Flow Accounting approach (Gao et al., 2020; Helander et al., 2019; Wagner, 2015) such as the Direct Material Input (DMI) and the Total Material Requirement (TMR) indicators (Sastre et al., 2015; Geng et al., 2012).

Focusing on the literature of adoption of CE practices by SMEs, a steadily growing literature has attempted to identify potential drivers within and across countries. Garcia-Quevedo et al. (2020) highlight that SMEs involvement with CE activities is directly related and impacted by regulatory obstacles such as administration procedures and costs, as well as human resources' scarcity. The authors also find that the type of CE activities SMEs already engage with, differentiates what firms perceive as barriers (such as regulation, administration procedures or the availability of financing) to engage with wider CE activities. Similarly, Cuerva et al., (2014) demonstrate how adoption of good practices such as quality control management and product differentiation increases SMEs' adoption of eco-innovation

while they found a negative and significant relationship between funding constraints and adoption of green innovation. Other constraints such as lack of knowledge and external advice impeding adoption of resource efficiency measures from SMEs have also been reported (Bodas-Freitas and Corrocher, 2019). Arranz et al. (2019) find that existing firm innovation capacity is a driver for adopting eco-innovation practices. Obstacles of increasing such innovation capacity are of a two-fold nature. First, high investment and financing costs and second, lack of knowledge, information, and human resources.

Reviews of the literature on adoption of CE practices by SMEs such as de Jesus and Mendonça (2018) and Rizos et al., (2015) highlight as barriers the lack of financial support from both own resources/reserves and the government, as well as administrational and human resource costs. With respect to wider-economy activities, Ilic and Nikolic (2016) report that economic incentives may drive eco-innovation practices at the country-level while Robaina et al. (2020) claim the opposite when examining drivers of resource productivity. Focusing on SMEs, Garrido-Prada et al. (2021) and Demirel and Danisman (2019) report that SMEs growth is negatively impacted by external funding when provided by traditional funders (such as banks) or large funders (government or EU-funding) and only alternative means of funding such as venture capital and equity finance can have a positive impact on SMEs growth. Bodas-Freitas and Corrocher (2019) report that SME's adoption of resource efficiency measures is virtually impossible in the absence with funding availability. Moreover, firm characteristics such as firm size and internal investment in R&D were found by Basi and Dias (2019) and Garrido-Prada et al (2021) to have a significant and positive effect on CE adoption.

Shifting the attention to the influence of the country's potential, Robaina et al. (2020) focus on resource productivity of a country as a proxy for CE adoption to find that the general environment at the country level (such as taxation rates, population density, use of renewable energy and recycling of materials) have a significant impact on CE adoption. Moreover, Garrido-Prada et al. (2021) claim that the 'stock' of scientific and technological knowledge at the country-level or in other words the absorptive capacity (Gkypali et al., 2019; Cohen and Levinthal 1990), has a positive effect on SMEs adopting CE business strategies. Technological knowledge also influences firm performance (Vlačić et al., 2019) and promotes green technologies (Hötte, 2020). Such being the case, the literature has acknowledged the value of the global competitiveness index (GCI) (Tsekouras et al., 2016; 2017). GCI is a multi-faceted index capturing country heterogeneity as it embraces twelve pillars[1] common across all countries, produced by the World Economic Forum annually (Sala-i-Martin and Artadi, 2004; Sala-i-Martin et al. 2008).

Huppes and Ishikawa (2009) highlight the importance of the social system in a country (comprised of 'Culture', 'Institutions', Economy' and 'Polity') whenever CE adoption is considered by focusing specifically on culture and polity. The former refers to knowledge, beliefs, values, and education that promotes, eventually, the designing and implementation of CE activities, the latter refers to the combination of such views along with institutional power to affect economic decisions both in the micro- and the macro- environment in a country. The authors conclude that, the bigger such 'social capital' in a country, the higher the assumed adoption of CE practices. Confirming this, Ilic and Nikolic (2016) suggest regulation and policy incentives support elements of CE such as innovative waste collection.

The importance of information flow in fostering environmental awareness to promote sustainability becomes, therefore, apparent. Along this line, Giudici et al. (2019) highlight the influence of environmental awareness on the creation of green start-ups while Chatzistamoulou and Koundouri (2021) construct environmental awareness regimes to explore effect of awareness on environmental

[1] Pillars include Institutions, Infrastructure, Macroeconomic Environment, Health and Primary Education, Higher Education and Training, Goods market efficiency, Financial market development, technological readiness, market size, business sophistication and innovation.

efficiency at a global scale to find that the latter supports resource efficiency measures. Hence, information or even access to it, appears to be a beacon of hope in the pursuit of sustainability, circularity, and green growth.

Overall, advancements have been made on circularity integration to business strategy and information is outlined by many studies as a key factor driving more informed decisions towards achieving a sustainable and resource efficient orbit, a systematic attempt to measure the impact of information on implementing CE actions is still missing. Therefore, this paper fills this gap by investigating the differential effect of information on the decision to integrate CE activities in the business strategy by combining elements of the micro and the macro-environment. This approach also accounts for selectivity bias to cope with endogeneity concerns. The latter has significant policy implications as it highlights the role of information in promoting sustainability and green growth.

3. Data, methodology & research hypotheses

3.1 Data

The paper explores data from 10,051 European Small-Medium Enterprises (onwards SMEs) on CE drawn from the Flash Eurobarometer 441 titled "European SMEs and the Circular Economy", launched in 2016 and covering the EU-28 member states[2] including information on the micro-environment of the firm. Therefore, the unit of analysis is SMEs across the EU-28 in 2016.

The firm-level characteristics capturing firm heterogeneity correspond to (i) whether a firm has adopted some of the activities promoting CE[3], (ii) the information availability on how to access finance, (iii) the awareness of the financial incentives through government programs supporting circularity, (iv) the size of the firm (in categories of full-time equivalent employees), (v) the funding source of the firm (binary outcome variables captures whether a firm receives European funding, is private financed through green loans, or self-funded) to develop activities promoting circularity and green growth, (vi) the industry-sector each firm belongs to, (vii) turnover changes, (viii) investment strategy on research and development activities, (ix) the barriers encountered in the process of undertaking circularity related activities inhibiting green growth.

Moreover, Flash Eurobarometer 441 data is matched with additional country-specific variables related to the macro-environment capturing aspects of the attitude of the country towards green growth, collected from several specialized databases such as Eurostat, the Eco-Innovation Observatory-DG Environment, the World Economic Forum, and the Fraser Institute. Data from Eurostat Europe 2020 section as well as from the CE indicators, is collected. Specifically, the lead indicator that is the resource productivity reflecting how efficiently resources are transformed into product has been included to mirror productivity differences among countries in attaining green growth and sustainability while the circular material use captures the circularity rate of each country.

Data on the renewable energy use, as the share of the total energy, is collected through the World Bank database to capture the adaptation rate of green energy of each country. The Eco-innovation index composed by five thematic areas[4], measures a country's eco-innovation performance and thus green growth (Binswanger, 2001; Rennings, 2000). Data on the eco-innovation index was collected through the Eco-innovation Scoreboard of the DG Environment Eco-Innovation Action Plan, published

[2] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Rep., Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithouania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Rep., Slovenia, Spain, Sweden, United Kingdom. The latter has been included as during period covered by the dataset, the UK was subject to the European policy directives and was reporting data on the respective indicators.
[3] Activities promoting circularity inlude whether or not the firm has undertaken any of the following activities towards sustainability: (i) re-plan the way water is managed, (ii) use of renewable energy, (iii) re-plan energy usage to minimize consumption, (iv) minimize waste by recycling or reusing waste or selling it to another company and (v) redesign products and services to minimize the use of materials or use recycled materials.
[4] Eco-innovation Inputs, Activities and Outputs, Socio-economic Outcomes, Resource efficiency Outcomes.

by the Eco-Innovation Observatory and Eurostat. Park et al. (2017) compare eco-innovation indices, mentioning that it is an adequate measure as it has been constructed by theory-driven indicators and includes the determinants and process of eco-innovation.

Competitiveness captured by the multi-faceted Global Competitiveness Index (GCI) produced by the World Economic Forum annually (Sala-i- Martin and Artadi, 2004; Sala-i- Martin et al., 2008), including twelve pillars common across countries, has been acknowledged by the literature (Tsekouras et al., 2017; Gkypali et al., 2019) in explaining cross country differences. Data on GCI has been hand-collected through the Global Competitiveness Report. Data on regulation is produced by the Fraser Institute as integral part of measuring the functionality of each economy and thus the production environment of the firm, is included as well.

It is worth to mention that the coverage is subject to data availability, which is not possible to be complemented by other databases. However, the country-varying characteristics included capturing the attitude of the country towards CE, enhance the validity of the empirical results by controlling for the country strategic orientation and operation environment affecting the decision of SMEs to adopt CE strategies. To the best of knowledge, this is the first study that combines micro- as well as macro- level characteristics to investigate business actions to achieve green growth. Table 1 below provides the descriptive statistics of the variables use.

Table 1. Variables, sources, and descriptive statistics.

Variables	Brief description & units of measurement	Frequency	Source
Firm-level characteristics			European Commission EU Open Data Portal
Adoption of Circular Economy activities	Engagement to the adopting/development of some form of action related to circularity	73.83%	
Awareness	Awareness on financial tools supporting circularity	37.08%	
Information availability	Information availability on financing Circular Economy at the country	49.72%	
Firm size categories	1-9 Full-time eq. employees (category 1)	62.97%	
	10-49 Full-time eq. employees (category 2)	23.33%	
Turnover change	Turnover decrease over the last year	21.06%	
Low R&D investment	Less than 5% of turnover in R&D	74.77%	
Barriers	Lack of human resources	19.76%	
	Lack of expertise to implement	21.55%	
	Administrative and legal complexity	27.56%	
	Cost of attaining standards	25.10%	
Funding source	Green loan	.9%	
	EU funded	5.72%	
	Self-funded	60.91%	
Country performance and attitude towards sustainability and green growth		**Mean (Standard Deviation)**	
Renewable Energy use	Share of total final energy consumption (percentage)	20.81 (11.46)	World Bank Database
Circular Material use	It is defined as the ratio of the circular use of materials to the overall material use. It measures the material recovered and fed back into the economy (% of total material use).	8.9 (6.35)	Eurostat – Circular Economy indicators section
Resource productivity	Gross domestic product to domestic material consumption (euro/kg).	1.86 (1.16)	Eurostat – Europe 2020 section
Eco Innovation index	Eco-innovation performance across the EU-28 (number)	91.24 (26.24)	Eco-Innovation Observatory & Eurostat, DG Environment
Global Competitiveness index	Global Competitiveness Index score (number)	4.80 (.50)	World Economic Forum
Regulation	Reflects regulatory restraints affecting economic freedom (number)	7.72 (.46)	Economic Freedom-Fraser Institute

3.2 Econometric strategy & research hypotheses

This paper investigates *whether information about the financial opportunities promoting green growth and thus sustainability, influences the decision to adopt CE activities.*

To do so, the drivers affecting the decision to adopt such activities contributing to the promotion of green growth and sustainability through blocks of variables capturing the micro as well as macro environment, are investigated. However, firms are less reluctant to make decisions to expand their business strategy when they possess information about how to finance those activities to avoid risk. Information is more likely to affect a firm's decision to self-select in such activities. Therefore, the simultaneity of the decisions, or in other words the potential endogenous relationship between information and decision to engage in CE activities promoting sustainability, is addressed.

The case described herein is one bringing together a switching regime model with sample selection (Horbach & Rennings, 2013; Lokshin & Sajaia, 2004; Maddala, 1986) and that of a binary endogenous regressor. The characteristics of the methodology adopted could be argued to be (i) that it does not require potentially cumbersome adjustments to derive consistent standard errors, (ii) implements the full information maximum likelihood method to simultaneously estimate the binary selection and the binary outcome parts of the model to yield consistent standard errors of the estimates, (iii) relies on an assumption of joint normality of the error terms in the selection and outcome equations and (iv) the derivation of the average treatment effects that is the average effects of treatment on the treated and on the untreated—and the marginal treatment effects (Lokshin and Sajaia, 2011).

The outcome variable ($CE\ active$) corresponds to whether a firm has undertaken some activity promoting CE during the last 3 years as activities promoting CE are considered as forces towards achieving the same goal (Katz-Gerro and López Sintas, 2019) and the endogenous regressor of whether a firm is aware about CE activities financial support at the national level ($Awareness$). The most appropriate methodology would be the *switching with endogenous binary regressor and sample selection model* (Lokshin & Sajaia, 2011). The model can be described as follows using the selection equation and the outcome equation:

$Selection\ equation$:

$$Awareness_i = 1\ if\ \mu_0 + \theta_1 InfoAvailability_i + \boldsymbol{\zeta Barriers} + \boldsymbol{\lambda FirmHeterogeneity} + u_i$$
$$> 0\ for\ the\ aware\ SMEs$$
$$Awareness_i = 0\ if\ \mu_0 + \theta_0 InfoAvailability_i + \boldsymbol{\zeta Barriers} + \boldsymbol{\lambda FirmHeterogeneity} + u_i$$
$$< 0\ for\ the\ non-aware\ SMEs$$

$Binary\ outcome\ equation$:

$$Regime\ 1: CE\ active_{1i}$$
$$= 1\ if\ \boldsymbol{\gamma_1 Funding_{1i}} + \boldsymbol{\lambda_1 FirmHeterogeneity_{1i}} + \boldsymbol{\delta_1 MacroEnvironment_{1i}}$$
$$+ \epsilon_{1i}\ if\ Awareness_i = 1$$
$$Regime\ 0: CE\ active_{0i}$$
$$= 1\ if\ \boldsymbol{\gamma_0 Funding_{0i}} + \boldsymbol{\lambda_0 FirmHeterogeneity_{0i}} + \boldsymbol{\delta_1 MacroEnvironment_{0i}}$$
$$+ \epsilon_{0i}\ if\ Awareness_i = 0$$

Then, a set of hypotheses is formulated. The first argument is that the decision to develop a business strategy promoting Circular Economy is affected by drivers affecting the micro- as well as the macro environment of the firm. This contributes to the relevant literature as the effect of firm heterogeneity on CE strategies' adoption is tested. In the form of a testable hypothesis:

H_1: Firm-specific heterogeneity inhibits the adoption of CE promoting activities and thus, sustainability transition.

The block of drivers related to funding flows includes information about how a firm supports its CE activities including green loans (*Greenloan-funding*), European Union funding (*EU-funding*), or self-funding (*Self-funding*). This highlights that policy design needs to develop a set of financial tools to promote green growth and sustainability. In the form of a testable hypothesis, can be stated as:

H_2: Funding is a key driver in the decision to engage in CE activities promoting green growth.

The block with the macro-environment factors includes the renewable energy use capturing the level of clean energy used (*Renewable Energy Use*), the resource productivity index (*Resource Productivity*), the Circular Material Use (*Circularity rate*), the global competitiveness index (*GCI*) capturing aspects of technology heterogeneity (Tsekouras et al., 2017), the eco-innovation index (*Eco-Innovation Index*), and the regulations (*Regulation*) capturing aspects of the regulatory environment of the country (Fraser Institute, 2021). In the form of a testable hypothesis:

H_3: The country attitude towards sustainability and green growth, influences the decision of the firm to engage in CE activities promoting green growth.

The parameters to be estimated are the $\boldsymbol{\theta, \gamma, \delta, \lambda, \zeta}$ while ϵ_i *and* u_i are the disturbance terms of the binary outcome and selection equation respectively.

4. Estimation Results: does information affect CE activities adoption?

4.1 Discussion

Table 2 below presents the estimation results[5] (coefficients and standard errors) while Table 3 presents the average marginal effects for the SMEs possessing information regarding the financial incentives to adopt a CE activity funding tools offer. It is noticeable that there is indeed a differentiated effect of information about funding tools on the decision to develop activities related to CE, compared to those firms that are not aware. This is further explored through the drivers influencing the decision to adopt a CE business strategy.

As regards the micro-level and particularly the firm-level characteristics, both for the outcome and selection equation, evidence suggests that heterogeneity matters, in line with the literature (e.g., Dosi et al., 2010). More precisely, relatively small firms of the sectors considered are less likely to engage in CE activities and so is the case for firms devoting a limited amount of their turnover in research and development activities. Results are in line with empirical evidence suggesting that relatively small firms are less likely to innovate (Garrido-Prada et al., 2021; Basi and Dias 2019; Horbach and Rennings, 2013). Decreased turnover and information accessibility on the financial support exert a significant influence of the expected direction on SMEs adopting a CE business strategy, in line with previous literature (Demirel and Danisman 2019), even in the presence of information about funding tools. Therefore, heterogeneity inhibits the adoption of a green agenda (*Hypothesis 1 is not rejected*). However, such heterogeneity also provides an opportunity to SMEs to direct their activity towards alternative ways of sustainable production.

[5] To validate the empirical results, additional robustness tests have been performed by partitioning the sample based on the average performance of each country on the Sustainable Development Goals index, SDGi, (Sachs et al., 2021), in two distinct sub-groups, that of low SDGi and that of high SDGi levels. Then, for each group, we re-estimate the model. No significant changes occurred; thus, the empirical findings are adequately valid. Robustness tests on the empirical results appear in the Appendix (Figure A1, Table A1, A2).

Shifting the attention to the funding flows available to the firms at national level, a significant effect of all the sources considered on the decision to adopt CE activities is documented (*Hypothesis 2 is not rejected*). A differentiated effect is documented, as firms do not seem willing to rely on private funding schemes through green loans. This probably occurs as altering the production paradigm or including green activities requires heavy initial investment costs, accompanied by high risk which compromises survival in a changing business environment (Demirel and Danisman, 2019). Even the firms aware of financial support to promote CE seem to be reluctant to access this type of funding.

The macro-environment of the firm appears to exert a significant influence on the decision of the firm to develop a green agenda, to a considerable extent (*Hypothesis 3 is not rejected).* Specifically, a differential negative and systematic effect of the use of renewable energy use for SMEs with information is noticed. Although the effect of renewable energy sources has been documented in the literature (Mavi & Mavi, 2019; Mikulčić et al., 2019), this indicates that a rebound effect is taking place (Vélez-Henao et al., 2020; Liu et al., 2019). Resource productivity (see Table 2) exerts a positive although weak influence of the decision to engage in CE activities. This is an indication that the attitude of the country towards the promotion of green growth principles modulates the components of environmentally conscious production (Robaina et al., 2020). Nevertheless, mixed findings appear in the literature. For instance, Ilic and Nikolic (2016) claiming that top-down government economic incentives can drive eco-innovation while Robaina et al. (2020) find that the country environment has a negative effect on resource productivity. Results indicate that a low circularity rate would limit the likelihood of adopting a CE activity, even in the presence of better information about financial tools. However, Haupt and Hellweg (2019) raise doubt on the accuracy of circularity indices as the environmental aspect may has not been properly accounted for.

Results from the selection equation, including additional variables such as the barriers firms face in the process of adopting an activity related to the CE, indicate that firm heterogeneity matters, but also that the most significant barrier is the lack of prior experience (Arranz et al., 2019; Bodas-Freitas and Corrocher, 2019). Generally, environmental regulations in the EU-context such as CE can be considered as a source of risk for a SME (Daou et al., 2020). Results indicate that aware firms planning to expand their agenda to include green activities are not deterred by the complexity of procedures or the cost of attaining standards. Nevertheless, firms do appear discouraged by the lack of familiarization of green production processes and technology shift.

Focusing on the last part of Table 3, SMEs that appear to be aware about financial support, at national level, to promote CE activities are by 64.69% more likely to decide to engage in green growth promoting activities. This result echoes the effect of funding, as it appears to be a major driver of the decision to engage in CE promoting activities. However, this driver appears to be a necessary yet not a sufficient condition for a firm to extend its business strategy towards this end.

4.2 Managerial and policy implications

Shifting the attention to the managerial and policy implications front, evidence indicates that green funding should be increased to support the transition (Bodas-Freitas and Corrocher, 2019) as evidence indicates that funding supports CE strategies and the probability to eco-innovate (Costantini et al., 2015; Costantini & Crespi, 2013). In line with this, the recently launched European Green Deal (European Commission COM/2019/640) as the new growth strategy of Europe, designates green growth through CE, inter alia, as top priorities and dedicates significant amount of funding through the European Green Deal Horizon Programs to promote sustainability transition such as the Invest EU programme, the Circular Economy Action Plan as well as the Biodiversity Strategy for 2030 (European Commission, COM/2018/439, COM/2020/98, COM/2020/380). Finally, literature has shown that the firms' search for funding green activities is not particularly straightforward, impeding their adoption (Cecere et al., 2020).

Evidence indicates that external European funding exerts a negative and significant influence of the decision to adopt CE activities, in line with previous studies (Garrido-Prada et al., 2021; Demirel and Danisman, 2019). This could be twofold, however. From the one hand, it is an indication that firms funded through this scheme either encountered cumbersome difficulties in absorbing the funds or in the process of accessing the funds that they became uninterested eventually. On the other, firms might have realized that the amount of funding is not sufficient to support transition to greener production, and thus sustainability, and abandoned the idea of adopting a green strategy without extra support. Other reasons reported in the literature include lack of good firm practices, knowledge, or external advice (Bodas-Freitas and Corrocher, 2019; Cuerva et al., 2014). Hence, funding itself is a necessary but not sufficient condition to boost green growth and thus sustainability.

A positive and significant effect of self-funded firms that decide to develop activities promoting CE is documented in this paper. This is opposite to the findings of Ghisetti and Montresor (2020) who find a negative relationship between self-funded options and adoption of CE practices from European SMEs. From the current analysis, it seems that it is more likely for aware firms to self-fund green activities, compared to the non-aware ones. In this line, knowing that funding is available but not sufficient to support a shift to a greener agenda directs firms to fund internally the sustainability transition. Such findings support those by Demirel and Danisman (2019) and Garrido-Prada et al. (2021) who find that only SMEs using venture capital and equity finance to fund CE activities reported growth. From a policy perspective, considering the above, an appropriate design for provisioning of funding could support private-public partnership (PPPs) to benefit from exploitation of complementarities in developing a green agenda by collaboration and knowledge exchange. Recent evidence suggests that PPPs promote sustainability and circularity (Ferronato et al., 2019).

It is no surprise that competitiveness is a major driver of green growth affiliated with the decision to engage in green activities, in line with the literature (e.g., Arranz et al., 2019). This is also in line with recent evidence documenting that competitiveness also affects energy efficiency patterns across the globe (Chatzistamoulou et al., 2019). The effect of eco-innovation appears to be weak, albeit positive, and this could be attributed the technology heterogeneity among the EU-members in conjunction to differences in institutions and resource endowments deepening technological inequality (Bianchi et al., 2020; Caravella and Crespi, 2020). From a policy perspective, a targeted policy considering technological heterogeneity in enhancing any of its pillars could boost eco-innovation levels. Regarding regulation, it appears that the stringency of regulation at the country level impedes green growth, (He et al., 2020; Lundgren and Zhou, 2017). Thus, in this case, the Porter Hypothesis (Porter and Van der Linde, 1995) is not confirmed, as the stringency of environmental regulation requires a shift in the production technology that could not be supported even by the firms with a high level of awareness regarding the financial tools to promote CE activities.

In conjunction to the findings above, the analysis shows that the instruments that could be mobilized to ensure a smooth sustainability transition could be the dissemination of information about the financial support, training on CE transition as well as increasing funding opportunities from the EU, confirming earlier findings (Rizos, 2015). In other words, dissemination of information, funding and training at the firm level pave the way to CE activities adoption and thus sustainability transition.

Table 2. Estimation results of the switching regime model: Coefficients & Robust Standard Errors.

Regime 1: Aware SMEs of information regarding financial support			
Regime 0: Non-aware SMEs of information regarding financial support			
Dependent variable: SMEs adopting a CE activity			
Drivers	**SMEs with information**	**SMEs without information**	**Selection Equation**
Micro-environment			
Firm heterogeneity			
Information availability on Circular Economy	-	-	.632*** (.025)
Low R&D investment on Circular Economy	-.183*** (.054)	-.096** (.038)	-.121*** (.030)
Decreased turnover	-	-	-.055** (.026)
Size category 1 (very small firms)	-.352*** (.076)	-.202*** (.052)	-.171*** (.039)
Size category 2 (moderately small firms)	-.211** (.082)	-.049 (.057)	-.115*** (.044)
Barriers to Circular Economy			
Lack of human resources	-	-	.030 (.030)
Lack of expertise to implement	-	-	-.178*** (.029)
Administrative and legal complexity	-	-	.192*** (.029)
Cost of attaining standards	-	-	.139*** (.032)
Industry effects	Yes	Yes	Yes
Funding source			
Green-loan funding	-.338*** (.111)	-.694*** (.169)	-
EU funding	-.745*** (.070)	-.848*** (.074)	-
Self-funded	.533*** (.042)	.640*** (.033)	-
Macro-environment-Attitude towards sustainability			
Renewable Energy Use	-.010*** (.002)	-.009*** (.002)	
Resource Productivity	.030 (.026)	-.002 (.016)	-
Circularity Rate	-.017*** (.005)	-.012*** (.003)	
GCI	.305*** (.086)	.230*** (.063)	-
Eco Innovation index	.001 (.001)	.004*** (.001)	-
Regulation	-.116** (.061)	-.103** (.045)	-
	Model Information		
Obs	10,051		
Model p-value	.000		
Rho 1	-.994*** (.011)		
Rho 2	-.852*** (.022)		
Wald test of indep. eqns. (rho1=rho0=0)	.000		

Notes: (i) all models include constants, (ii) coefficients and robust standard errors in parentheses, (iii) stars indicate statistical significance at 1% "***", 5% "**", 10% "*", (iv) considering the structured nature of the dataset, standard errors are clustered at the region-country level to account for possible interdependencies considering heteroskedastic errors.

Table 3. Estimation results: Average Marginal Effects.

Regime 1: Aware SMEs of information regarding financial support		
Regime 0: Non-aware SMEs of information regarding financial support		
Dependent variable: SMEs adopting a CE activity		
Drivers	**SMEs with information**	**Selection Equation**
Micro-environment		
Firm heterogeneity		
Information availability on Circular Economy	-	.219*** (.008)
Low R&D investment on Circular Economy	-.060*** (.010)	-.060*** (.010)
Decreased turnover	-	-.019** (.009)
Size category 1 (very small firms)	-.095*** (.013)	-.095*** (.013)
Size category 2 (moderately small firms)	-.061*** (.015)	-.061*** (.015)
Barriers to Circular Economy		
Lack of human resources	-	.011 (.010)
Lack of expertise to implement	-	-.062*** (.010)
Administrative and legal complexity	-	.066*** (.010)
Cost of attaining standards	-	.048*** (.011)
Industry effects	Yes	Yes
Funding source		
Green-loan funding	-.034*** (.011)	-
EU funding	-.076*** (.006)	-
Self-funded	.054*** (.004)	-
Macro-environment-Attitude towards sustainability		
Renewable Energy Use	.001*** (.000^{+})	
Resource Productivity	.003 (.003)	-
Circularity Rate	.002*** (.000^{+})	
GCI	.031** (.009)	-
Eco Innovation index	.000^{+} (.000^{+})	-
Regulation	-.012* (.006)	-
Model Information		
Effect of aware SMEs of funding tools information on promoting green growth – N=3,765	.6469 (.1518)	

Notes: (i) all models include constants, (ii) average marginal effects and robust standard errors in parentheses, (iii) stars indicate statistical significance at 1% "***", 5% "**", 10% "*", (iv) the symbol "+" stands for a very small number, (v) considering the structured nature of the dataset, standard errors are clustered at the region-country level to account for possible interdependencies considering heteroskedastic errors.

5. Concluding remarks

A firm's decision to augment their business strategy to include CE activities is affected on their capabilities but also by the access the have on information about funding tools to develop green strategies. By adopting a recent dataset on Small-Medium-Enterprises in the EU-28 in 2016 and by employing a switching regime model with one endogenous regression, this paper explores whether information on funding options bends reluctance in adopting CE-related activities, by accounting for endogeneity and selectivity bias.

Results are in favor of the latter, meaning that funding does promote the adoption of green strategies, such as CE activities. Firms with information on funding tools are by 65 percent more likely to augment their business strategy to include activities promoting green growth. The transition to sustainability could be promoted through disseminating information about funding options along with funding increase itself. A simplification of the funding flow could potentially attract more high-capacity firms to direct their know-how in developing such strategies.

The main conclusion is that firms that decide to invest in CE activities will engage in such activities independent of the awareness level about financial tools. However, more information on funding tools promotes further adoption of CE activities. This is particularly relevant in the long run, as such business strategy paves the way to reach sustainability targets. Funders, either public ones such as the EU or private ones should "reward" these "trailblazing" firms both by having more funding available and simplifying the process of funding acquisition. In any case, green funding could accelerate green transition to a more sustainable production in line with the current global as well as European agenda.

Findings also document that the macro environment, such as a country's competitiveness level, regulation, and attitude towards green growth, influence the behavior of the firm indicating that policy design should internalize such effects. Findings are also pertinent to the ongoing discussion around acceleration of the transition to a greener European Economy. This study's results provide evidence that the EU's current funding mechanisms generate some results and advocate for mainstreaming information regarding funding sources.

The analysis could be extended to include more data spells should those become readily available to enable the investigation of any time effects, convergence, or divergence patterns. Data pluralism could drive the development of firm specific performance indices on green growth. For the time being, this remains an interesting addition to our research agenda. This study is not limitations independent. Given the cross-section nature of the dataset, conclusions should be drawn cautiously. However, the conceptual framework could be investigated through other datasets conveying similar information.

All in all, the main message could be summarized along the following lines. More of a matter of just "pumping" more money into the economy, a change in regulations (which can also be, in theory, more cost-effective) is required. The analysis shows that promoting competitiveness does increase CE adoption, especially in the more informed firms, therefore fostering such a climate can further support the already "green" firms and encourage others to turn "green". Such findings make this paper's contribution relevant beyond the coverage of the dataset.

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Conflict of interest

The authors declare that there is no conflict of interest.

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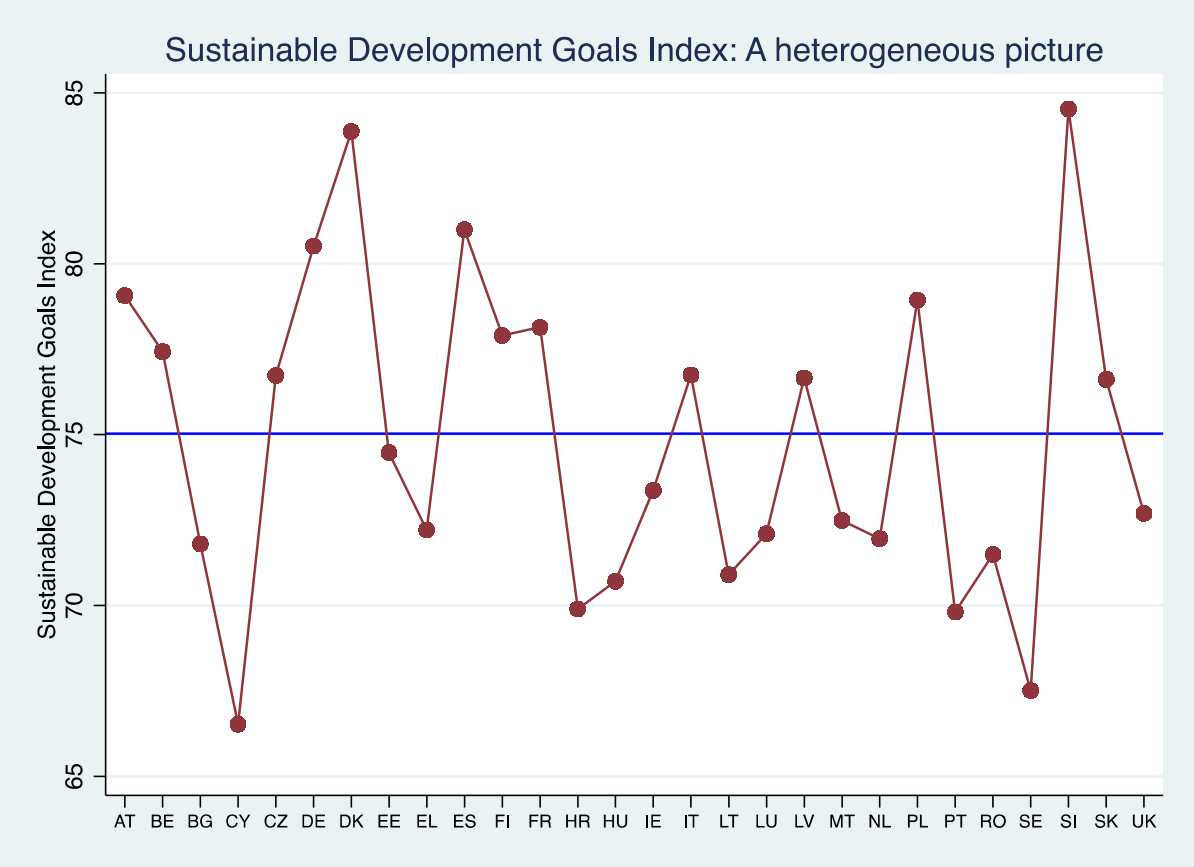
Appendix – Supplementary material

Figure A1. The Sustainable Development Goals index as a partitioning factor.



Source: Authors' construction.

Table A1. Robustness test using the Sustainable Development Goals Index. Coefficients & Robust Standard Errors.

Regime 1: Aware SMEs of information regarding financial support						
Regime 0: Non-aware SMEs of information regarding financial support						
Dependent variable: SMEs adopting a CE strategy						
	Countries of low SDGi levels			**Countries of high SDGi levels**		
Drivers	**SMEs with information**	**SMEs without information**	**Selection Equation**	**SMEs with information**	**SMEs without information**	**Selection Equation**
Micro-environment						
Firm heterogeneity						
Information availability on Circular Economy	-	-	.632*** (.025)	-	-	.702*** (.039)
Low R&D investment on Circular Economy	-.210*** (.073)	-.116** (.052)	-.105** (.042)	-.149* (.082)	-.084 (.059)	-.130*** (.044)
Decreased turnover	-	-	-.042 (.033)	-	-	-.065 (.046)
Size category 1 (very small firms)	-.374*** (.095)	-.283*** (.071)	-.148*** (.054)	-.379*** (.128)	-.164** (.080)	-.194*** (.056)
Size category 2 (moderately small firms)	-.205* (.104)	-.108 (.077)	-.111* (.060)	-.255* (.142)	-.006 (.089)	-.109* (.065)
Barriers to Circular Economy						
Lack of human resources	-	-	.107** (.041)	-	-	.064 (.046)
Lack of expertise to implement	-	-	-.179*** (.039)	-	-	-.193*** (.045)
Administrative and legal complexity	-	-	.205*** (.037)	-	-	.175*** (.045)
Cost of attaining standards	-	-	.169*** (.043)	-	-	.090** (.044)
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes
Funding source						
Green-loan funding	-.382** (.160)	-1.138*** (.322)	-	-.482** (.208)	-.426* (.235)	-
EU funding	-.705*** (.063)	-.759*** (.080)	-	-.754*** (.138)	-1.132*** (.218)	-
Self-funded	.602*** (.056)	.695*** (.046)	-	.417*** (.065)	.592*** (.052)	-
Macro-environment-Attitude towards sustainability						
Renewable Energy Use	-.018*** (.003)	-.012*** (.003)		-.006* (.003)	-.007*** (.002)	
Resource Productivity	-.069* (.037)	-.076*** (.029)	-	-.107** (.051)	.051 (.036)	-
Circularity Rate	-.026*** (.007)	-.013** (.006)		-.024** (.009)	-.030** (.006)	
GCI	.191 (.183)	.164 (.133)	-	.747*** (.225)	.700 (.168)	-
Eco Innovation index	.007*** (.002)	.008*** (.001)	-	-.009*** (.003)	-.008*** (.002)	-
Regulation	-.161 (.108)	-.213*** (.081)	-	-.290** (.118)	-.292*** (.085)	-
	Model Information					
Obs	5,358			4,693		
Model p-value	.000			.000		
Rho 1	-.990*** (.009)			-.999*** (.000+)		
Rho 2	-.881*** (.025)			-.760*** (.050)		
Wald test of indep. eqns. (rho1=rho0=0)	.000			.000		

Notes: (i) all models include constants, (ii) coefficients and robust standard errors in parentheses, (iii) stars indicate statistical significance at 1% "***", 5% "**", 10% "*", (iv) considering the structured nature of the dataset, standard errors are clustered at the region-country level to account for possible interdependencies considering heteroskedastic errors.

Table A2. Robustness test using the Sustainable Development Goals Index: Average Marginal Effects.

Regime 1: Aware SMEs of information regarding financial support				
Regime 0: Non-aware SMEs of information regarding financial support				
Dependent variable: SMEs adopting a CE strategy				
	Countries of low SDGi levels		**Countries of high SDGi levels**	
Drivers	**SMEs with information**	**Selection Equation**	**SMEs with information**	**Selection Equation**
Micro-environment				
Firm heterogeneity				
Information availability on Circular Economy	-	.201*** (.010)	-	.245*** (.012)
Low R&D investment on Circular Economy	-.059*** (.014)	-.059*** (.014)	-.058*** (.015)	-.058*** (.015)
Decreased turnover	-	-.014 (.011)	-	-.023 (.016)
Size category 1 (very small firms)	-.092*** (.018)	-.092*** (.018)	-.100*** (.020)	-.100*** (.020)
Size category 2 (moderately small firms)	-.060*** (.020)	-.060*** (.020)	-.060** (.023)	-.060** (.023)
Barriers to Circular Economy				
Lack of human resources	-	.036*** (.014)	-	.022 (.016)
Lack of expertise to implement	-	-.061*** (.013)	-	-.067*** (.016)
Administrative and legal complexity	-	.070*** (.013)	-	.061*** (.016)
Cost of attaining standards	-	.057*** (.015)	-	.031** (.015)
Industry effects	Yes	Yes	Yes	Yes
Funding source				
Green-loan funding	-.042** (.018)	-	-.041** (.018)	-
EU funding	-.078*** (.006)	-	-.065*** (.012)	-
Self-funded	.067*** (.006)	-	.036*** (.006)	-
Macro-environment-Attitude towards sustainability				
Renewable Energy Use	-.002*** (.000^{+})		-.000+* (.000^{+})	
Resource Productivity	.008* (.004)	-	.008* (.004)	-
Circularity Rate	-.003*** (.001)		-.002*** (.001)	
GCI	.021 (.020)	-	.064*** (.020)	-
Eco Innovation index	.001*** (.000^{+})	-	.001*** (.000^{+})	-
Regulation	-.018 (.012)	-	-.025** (.010)	-
Model Information				
Effect of aware SMEs of funding tools information on promoting green growth	.6583 (.1859)		.5634 (.1266)	
Obs	2,008		1,757	

Notes: (i) all models include constants, (ii) average marginal effects and robust standard errors in parentheses, (iii) stars indicate statistical significance at 1% "***", 5% "**", 10% "*", (iv) the symbol "+" stands for a very small number, (v) considering the structured nature of the dataset, standard errors are clustered at the region-country level to account for possible interdependencies considering heteroskedastic errors.