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The Impact of External Financial Factors on the Eco-Innovation Practices of Small and Medium-Sized Businesses

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ABSTRACT

This paper explains how different external financing factors influence SMEs' eco-innovation adoption using the Flash Eurobarometer 441 dataset. This survey was carried out in 28 Member States of the European Union in 2016. The effect of various external financial variables on adopting green operations of 5873 SMEs were examined using binary logistic regression. The findings indicate that traditional external financing approaches, including standard bank loans and green loans, positively affect renewable energy but have no significant impact on other circular eco-innovation applications. Established forms of external public financing, including EU funds and government grants, positively impact the application of water re-design, renewable energy, and energy re-planning activities, but no influence on waste minimization and product re-design practices. The effects of newer forms of external funding are markedly different; the results reveal that crowdfunding has a significant favorable effect on implementing all green actions. Green banks can significantly impact the adoption of water re-planning and waste minimization practices. Peer-to-peer lending is positively correlated to the adoption of actions to minimize waste. Furthermore, business angels and the capital market positively influence product re-design related to green innovations. Risk or venture capital does not affect any form of circular eco-innovations. As a result, some important managerial implications for decision-makers are given.

Key Words: : SME, eco-innovation, entrepreneurial finance, sustainability, logistic regression.

JEL Classification Codes: M10, O30.

1. INTRODUCTION

It is necessary to have a thorough knowledge of what motivates small and medium-sized businesses (SMEs) to adopt innovative green methods to decrease their environmental effects (Hoogendoorn, Guerra, & van der Zwan, 2015). Eco-innovation is defined as radical or gradual changes in processes, goods, or organizations with reduced ecological impact (Demirel, & Kesidou, 2019). Eco-Innovation practices can drive businesses to enhance their competitiveness (Horbach, 2018).

However, SMEs face unique difficulties in adapting their systems to respond to a low-carbon environment while remaining competitive. For many firms, obstacles impede the implementation of emerging technologies and practices in resource management (Bodas-Freitas, & Corrocher, 2019). Several studies have identified obstacles to SMEs' adoption of such practices, including information asymmetry, uncertainty, and financial support. EU governments have developed various policy tools to promote the implementation of energy efficacy procedures (Fleiter, Schleich, & Ravivanpong, 2012).

Sustainable development plans need an in-depth awareness of the barriers to their implementation across companies and industries, as well as a knowledge of organizations' financial resources (Allcott, & Greenstone, 2012). External financing is classified as overt or indirect reliant on whether it delivers direct monetary assistance for the attainment and employment of certain technologies and methods or admittance to guidance and advice to assist in adopting resource efficacy measures (Bodas Freitas, & Tunzelmann, 2008). Restricted access to external financing discourages investment in eco-innovations and has a detrimental effect on the development of sustainable SMEs (Kunapatarawong, & Martínez-Ros, 2016). Numerous studies have highlighted the lack of financing as a significant impediment to adopting new technology, techniques, and innovative efforts (Czarnitzki & Delanote, 2013; Palm, 2018), particularly among SMEs. External financing enables businesses to invest in new technology, processes, and products without jeopardizing existing operating objectives (Bodas-Freitas, & Corrocher, 2019). Yet not much is known about the effect of the different financing mechanisms (e.g., loans, investments, and subsidies) used by SMEs to adopt innovative circular processes.

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Few studies have examined SMEs' resource efficiency techniques and the impact these practices have on business performance. Nor has research clearly defined the financial motivations that motivate SMEs to undertake such activities and how they differ from contemporary and established entrepreneurial financing methods. We want to address this gap in the study. Additionally, a more in-depth assessment of how various types of financing affect the improvements that businesses get from creative activities and products are necessary (Rennings, 2000).

We do so by analyzing the European financial ecosystem around the implementation of sustainable actions and by contributing to the increasing volume of research that illustrates the systemic improvements needed to render the financial ecosystem more sustainable (Migendt, Polzin, Schock, Täube, & Flotow, 2017). This research explores how various forms of external assistance are associated to the scope of implementation of resource efficiency procedures. We apply data from the Flash Eurobarometer 441 "European SMEs and the Circular Economy" study of 5873 European SMEs carried out by the European Union, which surveyed firms on their use of various green initiatives and the forms of external financial sources used to support them.

We concentrate on two main differences in the literature. We respond to the business and government decision-makers' demands to reduce the environmental effects of SMEs (Calogirou, et al., 2010). We analyze the influence of financial support on implementing efficient activities on the adoption of environmentally friendly methods. This research strengthens the scientific literature on implementing innovative green practices by revealing the relationship between external financial support and green practices. To that end, we address the financial obstacles to the adoption of environmentally friendly practices. From a research viewpoint, we go beyond the prevalent emphasis on big firms and targeting SMEs and focus on the lack of distinction between different external finance approaches to various forms of innovative green activities (Halme, & Laurila, 2009; Uhlaner, Berent-Braun, Jeurissen, & Wit, 2012).

The remainder of the paper is the following: Section 2 provides an outline of the research's background and relevant literature, followed by Section 3, which explains the dataset and methodology used in this work. Section 4 delves into the results of the empirical model and its implications. Finally, section 5 exhibits the study's results and discusses the managerial and policy ramifications of the findings.

2. External financial support for adoption of eco-innovations

At the European level, SMEs' contribution to innovation, job development, prosperity, and social stability is identified and seen as necessary to improve productivity. However, it is stated that the environmental effects of SMEs are less explored than those of larger businesses (Ghenta & Matei, 2018). However, SMEs have been recognized as critical to achieving a European circular economy, mainly in terms of SMEs' commitment to endeavors such as innovation, repair, and recycling (Ghenta, & Matei, 2018).

Many SMEs are unaware of the magnitude and consequences of the low-carbon shift and often lack the expertise, capabilities, and financial sources necessary to execute initiatives to increase their sustainability (Bodas-Freitas, & Corrocher, 2019). Other obstacles are linked to the absence of knowledge on the advantages of green activities and the lack of expertise to recognize the potential to incorporate and introduce them (Trianni, Cagno, & Worrell, 2013). Several impediments, such as a scarcity of cash, limited access to external funding resources, and expensive expenses, are entirely financial (Bodas-Freitas & Corrocher, 2019; Fleiter et al., 2012; Ghisetti, Mancinelli, Mazzanti, & Zoli, 2017). It is noted in the literature that the obstacles faced by SMEs in the adoption of circular innovation actions are normally connected to the significant financial expenditures required to implement sustainable solutions and a lack of access to financial resources to support green activities and innovation (Rizos, Behrens, Kafyeke, Hirschnitz-Garbers, & Ioannou, 2015).

Research on this topic often examines financial barriers to adoption. Businesses may need direct financial assistance in the type of angel investors, venture capital, crowdsourcing, and bank loans to conquer financial and expertise obstacles to acceptance (Bodas-Freitas & Corrocher, 2019; Klewitz, Zeyen, & Hansen, 2012; OECD, 2012). The use of such funding, such as direct financial funding for the procurement and application of special technology and activities, typically abides by the financing organizations' regular procedures and rules (Bodas-Freitas & Corrocher, 2019; Bodas Freitas & Tunzelmann, 2008; Klewitz et al., 2012). Access to external financing has been indicated to be difficult considering technological and industrial uncertainties, as well as regulatory changes (Rennings, 2000).

Though, both the finance sector (potential investors and banks) and policymakers have attracted substantial funds to be committed to long-term ecological programs

(EEA, 2014). External finance to advance toward a greener economy enables businesses to acquire expensive equipment and reduce internal spending and capital expenses connected with such acquisitions. This is important for SMEs, which are often constrained by cost limitations and a lack of internal funding (Doh, & Kim, 2014). Numerous SMEs seem to view significant energy and resource efficiency expenditures as a severe problem and allocate insufficient money to energy management (Bodas-Freitas, & Corrocher, 2019; Fleiter, Hirzel, & Worrell, 2012). However, the nature of financing schemes does not often consider companies' technical and business features that may limit the efficacy toward their green engagement (OECD, 2012; Olmos, Ruester, & Liong, 2012). External capital may assist businesses in overcoming financial barriers associated with the purchase and implementation of resource-efficient technologies and operations.

Research suggests that the shortage of financial capital is a substantial barrier to SMEs' involvement in the eco-innovation (Caldera, Desha, & Dawes, 2019; Ghisetti et al., 2017; Álvarez Jaramillo, Zartha Sossa, & Orozco Mendoza, 2018). When facing a scarcity of internal financial capital, SMEs are compelled to accept foreign funding, which is sometimes constrained in supply, limiting the extent of SMEs' entrepreneurship (Revest, & Sapio, 2012). Ecological, innovative SMEs are expected to face significantly more financial constraints than non-green SMEs for a variety of reasons, containing a lesser availability of external financial resources for ecological friendly developments due to risk, information disproportionateness, the lengthy time-critical to launch green inventions, and evolving regulatory settings (Criscuolo & Menon, 2015; Demirel & Danisman, 2019; Mrkajic, Murtinu, & Scalera, 2019).

In implementing green practices, external financing can enhance the need to minimize total production costs and adopt certain procedures to roles, goods, and activities where benefits are more apparent. Furthermore, external financing may increase the emphasis green firms place on return on investment and thus may improve their efforts to leverage the potential of changes in operations, parts, by-products, and waste that could otherwise have been ignored. Therefore, we believe the prospects for access to external finance are especially relevant for SMEs to improve their capacity to establish plans to adopt renewable technology and practices that can conserve money and reduce manufacturing costs. We presume that additional support for adoption would be related to initiatives and innovations projected to offer benefits for SMEs. However, the scientific community rarely evaluates a comprehensive study of the financial ecosystem underlying sustainable SMEs.

This article examines how European SMEs may access different forms of external financing for circular eco-innovation investments and how this access ultimately affects their adoption of sustainable practices.

Table 1: Descriptive statistics for the SMEs analyzed

R&D intensity (%)	Freq.	%
< 5	4532	77.2
5 to 9.9	587	10.0
10 to 14.9	343	5.8
15 to 19.9	116	2.0
≥ 20	295	5.0
Total	5873	100.0

Number of employees	**Freq.**	**%**
1 to 9	3498	59.6
10 to 49	1469	25.0
50 to 250	906	15.4
Total	5873	100.0

Firm's age	**Freq.**	**%**
Before 01.01.2010	4943	84.2
After 01.01.2010	930	15.8
Total	5873	100.0

Turnover (euros)	**Freq.**	**%**
< 25 000	500	8.5
> 25 000 to 50 000	418	7.1
> 50 000 to 100 000	513	8.7
> 100 000 to 250 000	778	13.2
> 250 000 to 500 000	754	12.8
> 500 000 to 2 000 000	1266	21.6
> 2 000 000 to 10 000 000	952	16.2
> 10 000 000	692	11.8
Total	5873	100.0

Sector	**Freq.**	**%**
Manufacturing	917	15.6
Retail	2021	34.4
Services	2087	35.5
Industry	848	14.4
Total	5873	100.0

3. Methodology

We analyzed the role of various aspects for the operational implementation of resource management procedures based on the Flash Eurobarometer 441 "European SMEs and the Circular Economy." The present study includes data from 28 European Union member states. The logistic regression model evaluates drivers that determine the positive resource efficiency behaviors of SMEs. Table 1 provides a review of the main attributes of the SMEs analyzed.

Dependent variable

1) Eco-innovation activities: We analyze the external financial drivers behind the eco-innovation adoptions in the first model. A firms' eco-innovation practices are assessed using a variable that identifies SMEs' environmental operations, including the following methods: Re-design of the method water is used to lessen usage and expand re-usage (Water Re-Plan), usage of renewable energy (Renewable Energy), Re-design energy usage to minimalize consumption (Energy Re-Plan), lessen waste by reprocessing or recycling waste or selling it to another business (Waste Management) and Re-design goods and services to minimalize the usage of resources or usage reprocessed materials (Product Re-Design). These approaches are dissimilar; some are intended to save resources (energy and material savings) to alter the production process actively; others should not modify how the firms work but instead recycle/reuse waste (Bodas-Freitas, & Corrocher, 2019). The dependent variable was coded as 0 for non-adoption or 1 for the adoption of "Water Re-Plan," "Renewable Energy," "Energy Re-Plan," "Waste Management," and "Product Re-Design" as a form of eco-innovation.

Independent variable

1) External financial support: Financial resources are essential for every firm. One of the main distinctions between large and medium-sized enterprises is access to financial resources (Berger, & Udell, 1998). SMEs frequently do not have adequate financial sources to fund their operations and assets, depending primarily on internal resources such as private funds and reserved income. In contrast, for large companies a greater variety of resources, such as equity financing, are available (Hoogendoorn et al., 2015). The literature emphasizes that many SMEs find it impossible to participate in sustainable procedures because of financial expenses (Pacheco, Dean, & Payne, 2010; Roberts, Lawson, & Nicholls, 2006). Indeed, SMEs are prone to say that financial factors are barriers to environmental implementation than to point to an absence of understanding (Pimenova, & van der Vorst, 2004).

Obtaining external financial funding is positively correlated to green activities. The following section summarizes the external financial factors that can affect SMEs' resource efficiency activities. The model reflects the type of external financing accessible for SMEs to use to adopt circular economy innovations. Traditional and modern forms of external financing sources are applied in the model. Traditional external finance encompasses standard bank loans or green loans related to sustainable activities of the firm, EU funds, and government grants. Modern forms of external finance include crowdfunding, specific green banks stimulating the circular economy and eco-friendly investment, peer-to-peer lending, venture capital/risk capital, angel investors, and capital markets.

Control variable

Several control variables were coded as independent variables of the logistic regression model.

1) Firm size: Some reports suggest that company size influences the ecological policies of a business (Bianchi, & Noci, 1998). Variations in size are also an essential factor for the group of SMEs (Uhlaner et al., 2012). Small businesses' spending on sustainability practices can be challenging to explain to investors given the lack of economies of scale and marginal market shares (Hoogendoorn et al., 2015). Small businesses are less accessible to the media and the public due to their scale. Since small companies have a specific level of confidentiality among these secondary clients, such as eco-friendly campaigners, they are less inclined to indulge in ecological activities than big firms (Aragón-Correa, Hurtado-Torres, Sharma, & García-Morales, 2008; Hoogendoorn et al., 2015). Multiple empirical studies have suggested a favorable association between business size and ecological activities (Perrini, Russo, & Tencati, 2007; Uhlaner et al., 2012).

Though, little differentiation has been made among forms of ecological practice. Differentiation between forms by SME size may reveal distinctions in the implementation of different categories of eco-innovation practices. The number of employees and revenue measures firms' size. The number of employees is coded from 1–3 (1 = 1 to 9 employees, 2 = 10 to 49 employees, and 3 = 50 to 250 employees). The turnover factor was coded from 1–8 for various turnover levels (1 = Up to 25 000 euros, 2 = 25 000 to 50 000 euros, 3 = More than 50

000 to 100 000 euros, 4 = More than 100 000 to 250 000 euros, 5 = More than 250 000 to 500 000 euros, 6 = More than 500 000 to 2 million euros, 7 = More than 2 to 10 million euros, and 8 = More than 10 million euros).

2) Type of market served: The type of market served is connected to the form of circular economy innovation. Firms' decision-makers center their environmental policies on the specific key stakeholder communities that are most important to their firm. Firms targeting consumers are more likely to seek product advancement to generate a competitive edge (Orsato, 2006). With an increasing interest for the environment, consumers appreciate the environment-friendly produced products or services. This is especially important when a product or service is offered to end consumers (Gershoff & Irwin, 2012; Hoogendoorn et al., 2015). The type of market served is coded based on the type of offering and customer (from "Product to Consumer," "Product to Company," "Service to Consumer," "Service to Company").

3) Firm age: Company age impacts the degree to which SMEs participate in environmentally friendly activities. Small firms are accountable for novelty, resource shortages, and ongoing questions regarding young companies' survival could have a detrimental effect on their ethical actions (Hoogendoorn et al., 2015; Neubaum, Mitchell, & Schminke, 2004). However, young firms are more likely to be interested in ecological activities (Hockerts, & Wüstenhagen, 2010). Firm age is coded from 1 to 3 for categories regarding the date it was founded (1= Before 01.01.2010, 2 = Between 01.01.2010 and 01.01.2015, 3 = After 01.01.2015).

4) Firm's industry sector: Sector-specific conditions face various ecological risks and benefits and affect businesses' green policies, including SMEs (Hoogendoorn et al., 2015; Orsato, 2006; Perrini et al., 2007). For instance, in resource-demanding industries such as industrial sectors, high levels of environmental effects give rise to cost savings possibilities and provide the ability to gain a comparative edge by distinguishing from others (Gershoff & Irwin, 2012; Uhlaner et al., 2012). Businesses in resource-intensive sectors may experience higher production costs and levels of environmental harm. Companies in such sectors are also more likely to be actively regulated, which renders them more likely to implement sustainability policies (Hoogendoorn et al., 2015) than businesses in less resource-demanding sectors. While these claims make intuitive perception, scientific proof is sparse. Therefore, a model is applied to distinguish the external financial effect on adopting various innovative circular actions based on the firms' sector.

5) Investment in research and development (R&D): Although eco-innovation is intended to influence the environment positively, its impact on companies' resource efficiency is not straightforward. The traditional economic approach has been focusing on engaging in environmentally friendly actions to minimize, for example, emissions, which implies increased costs for a business with few associated gains, reducing the overall productivity of a company (Palmer, Oates, & Portney, 1995). Twenty years ago, a modern green outlook arose that focusing on green practices would cover operating costs and improve company efficiency over the long term (Jové-Llopis, & Segarra-Blasco, 2018). The various levels of R&D investment are classified on a scale of 1–5 (1 = less than 5%, 2 = 5% to 9.9%, 3 = 10% to 14.9%, 4 = 15% to 19.9%, 5 = 20% or more).

Table 3 displays the effects of binary logistic regression for variables estimating the effect of external financial approaches on eco-innovation adoption patterns. The binary logistic regression model is created by applying a dichotomous-dependent variable. The resulting estimates illustrate the effect of potential external financial funding on the adoption of circular eco-innovation activities (Table 1). Our results show different implications of traditional and modern external sources of financing on various approaches to eco-innovation.

4. Results

The overall model fit was measured using the Nagelkerke R^2 test statistic and the omnibus test for model coefficients. The estimates apply a chi-square (χ^2) distribution; the findings suggested that all non-significant p statistics are a good fit for our model. The Wald test was used for a significance test of every external financing variable. Finally, we assessed the ratio of correct case categories and confirmed all values above the threshold of 60% as satisfactory and values over 70% as useful, following the suggestion of (Hair, Black, Babin, & Anderson, 2019).

Assessments of the binary logistic regression model show the effect of external financing on applying circular eco-innovations (Table 2). The overall model is statistically significant (χ^2 (56) = 378.352, $p < 0.001$ for water re-plan, $\chi 2$ (56) = 520.464, $p < 0.001$ for renewable energy, χ^2 (56) = 471.604, $p < 0.001$ for energy re-plan, χ^2 (56) = 1075.160, $p < 0.001$ for minimize waste, and χ^2 (56) = 434.620, $p < 0.001$ for product re-design). Thus, the model effectively differentiates between respondents applying or not applying the different forms of eco-innovation activities. The Nagelkerke R2 varies between 0.104 and 0.223

Table 2: The effect of external finance funds on circular eco-innovation practices

	RE-PLAN WATER		USE RENEW-ABLE ENERGY		RE-PLAN ENERGY		MINIMIZE WASTE		RE-DESIGN PRODUCT	
VARIABLES	β (SE)	Odds Ratio	β (SE)	Odds Ratio	β (SE)	Odds Ratio	β (SE)	Odds Ratio	β (SE)	Odds Ratio
External finance: Traditional sources										
Standard bank loan	-0.048 (0.12)	0.953	0.29** (0.12)	1.337	0.058 (0.09)	1.060	-0.135 (0.09)	0.873	-0.109 (0.1)	0.897
Green loan	0.127 (0.48)	1.135	1.552**** (0.41)	4.723	-0.054 (0.41)	0.947	-0.28 (0.41)	0.756	-0.617 (0.51)	0.539
EU funds	0.576** (0.27)	1.778	1.205**** (0.25)	3.335	0.735**** (0.21)	2.085	0.323 (0.21)	1.381	0.194 (0.24)	1.214
Government grant	0.518* (0.28)	1.679	0.919**** (0.28)	2.508	0.505** (0.24)	1.657	0.109 (0.25)	1.115	0.118 (0.26)	1.125
External finance Modern sources										
Crowdfunding	-0.151 (0.14)	0.860	0.211 (0.13)	1.235	0.11 (0.11)	1.117	0.038 (0.11)	1.038	0.001 (0.11)	1.001
Green bank or other private institution	0.205* (0.1)	1.227	0.035 (0.11)	1.036	0.025 (0.08)	1.025	0.183** (0.09)	1.201	-0.028 (0.09)	0.972
Peer-to-peer lending	-0.033 (0.14)	0.968	0.11 (0.14)	1.116	0.078 (0.11)	1.082	0.184* (0.11)	1.202	-0.096 (0.11)	0.908
Business angels	0.198 (0.16)	1.219	-0.244 (0.17)	0.784	-0.099 (0.13)	0.906	0.064 (0.13)	1.066	0.249* (0.13)	1.283
Risk capital/venture capital	0.03 (0.13)	1.031	0.152 (0.13)	1.164	0.142 (0.1)	1.153	-0.096 (0.1)	0.909	0.061 (0.11)	1.063
Capital market	0.155 (0.11)	1.167	-0.091 (0.11)	0.913	0.078 (0.09)	1.081	0.123 (0.09)	1.131	0.157* (0.09)	1.170
CONTROL VARIABLES										
Firm size										
Number of employees (ref. 1 to 9)										
10 to 49	0.165 (0.1)	1.179	0.015 (0.11)	1.015	-0.03 (0.08)	0.970	0.194** (0.08)	1.214	-0.027 (0.08)	0.973
50 to 250	0.246* (0.14)	1.279	0.331** (0.14)	1.392	-0.039 (0.11)	0.962	0.195* (0.11)	1.216	0.161 (0.11)	1.174
Turnover (€) (ref. Less than 25 000)										
> 25 000 to 50 000	-0.015 (0.19)	0.985	-0.435* (0.24)	0.647	-0.126 (0.15)	0.882	0.347** (0.15)	1.415	-0.056 (0.16)	0.945
> 50 000 to 100 000	-0.065 (0.18)	0.937	-0.225 (0.21)	0.799	-0.272* (0.15)	0.762	0.123 (0.14)	1.131	-0.096 (0.16)	0.909
> 100 000 to 250 000	-0.344* (0.18)	0.709	-0.131 (0.19)	0.877	-0.174 (0.13)	0.841	0.199 (0.13)	1.220	-0.094 (0.14)	0.910
> 250 000 to 500 000	-0.112 (0.18)	0.894	-0.144 (0.19)	0.866	-0.076 (0.14)	0.927	0.391*** (0.14)	1.478	0.081 (0.15)	1.084
> 500 000 to 2 000 000	-0.148 (0.17)	0.862	-0.113 (0.18)	0.893	-0.043 (0.13)	0.958	0.243* (0.13)	1.275	0.06 (0.14)	1.062
> 2 000 000 to 10 000 000	-0.33* (0.19)	0.719	-0.1 (0.2)	0.905	0.081 (0.14)	1.084	0.349** (0.14)	1.417	-0.079 (0.16)	0.924
> 10 000 000	0.082 (0.2)	1.085	0.058 (0.22)	1.060	0.349** (0.16)	1.418	0.333** (0.16)	1.395	0.014 (0.17)	1.014
Firm age (ref. Before 01.01.2010)										
Between 01.01.2010 and 01.01.2015	-0.067 (0.11)	0.936	-0.227* (0.12)	0.797	-0.145* (0.09)	0.865	-0.022 (0.09)	0.979	0.081 (0.09)	1.084
After 01.01.2015	-0.478 (0.37)	0.620	-1.368*** (0.53)	0.255	-0.524* (0.28)	0.592	-0.309 (0.26)	0.735	-0.062 (0.28)	0.940
R&D investment (%) (ref. Less than 5)										
5 to 9.9	0.164 (0.12)	1.178	0.228* (0.12)	1.256	0.14 (0.1)	1.150	-0.133 (0.1)	0.876	0.471**** (0.1)	1.601

10 to 14.9	0.259* (0.15)	1.296	0.459*** (0.15)	1.583	0.155 (0.12)	1.167	0.015 (0.12)	1.015	0.453**** (0.12)	1.574
15 to 19.9	0.413* (0.25)	1.512	-0.025 (0.28)	0.975	0.18 (0.21)	1.197	0.03 (0.21)	1.031	0.532** (0.21)	1.703
20% or more	0.352** (0.17)	1.422	0.413** (0.17)	1.512	0.232* (0.13)	1.261	-0.138 (0.13)	0.871	0.35** (0.14)	1.420
Type of market served										
Products_Consumer	0.065 (0.08)	1.067	-0.033 (0.09)	0.967	0.164** (0.07)	1.179	0.026 (0.07)	1.027	-0.01 (0.07)	0.990
Products_Company	0.063 (0.08)	1.065	0.031 (0.09)	1.031	-0.098 (0.06)	0.906	0.177*** (0.06)	1.194	0.128* (0.07)	1.137
Service_Consumer	0.407**** (0.08)	1.503	0.325**** (0.09)	1.384	0.189*** (0.07)	1.209	0.008 (0.07)	1.008	0.152** (0.07)	1.164
Service_Company	-0.228*** (0.08)	0.796	-0.057 (0.09)	0.944	-0.204*** (0.07)	0.816	-0.044 (0.07)	0.957	-0.048 (0.07)	0.954
Constant	-2.743**** (0.31)	0.064	-2.56**** (0.3)	0.077	-1.226**** (0.21)	0.294	-0.79**** (0.19)	0.454	-1.871**** (0.23)	0.154

*p < 0.1; **p < 0.05; *** p < 0.01; **** p < 0.001

Country dummies are integrated but not presented

across all circular eco-innovations; therefore, our models describe between approximately 10.4% and 22.3% of the variances.

Table 2 reveals the results of the first evaluation of the effect of external funding on the adoption of five various circular eco-innovations. The results show how access to external financing for circular eco-innovation influences the development of circular economy innovations by SMEs and suggest that established and modern external funds have different effects on their adoption.

As for traditional external financing approaches, standard bank loans and green loans positively affect renewable energy but have no significant impact on other innovations. Our findings suggest that EU funds and government grants—established forms of external public financing—positively influence the progress of water re-design, renewable energy, and energy re-planning activities but do not influence waste minimization and product re-design practices.

The results regarding newer modern forms of external funding disclose that crowdfunding has a substantial favorable impact on adopting all green endeavors. Green banks can significantly impact the adoption of water re-planning and waste minimization practices. Peer-to-peer loaning is significantly positively linked to the implementation of waste minimization action. Furthermore, findings indicate that capital markets and business angels positively influence the adoption of product re-design. Risk capital or venture capital does not affect any form of eco-innovations.

The implications of firm size vary across circular economy innovations. Generally, the findings suggest that medium-sized enterprises with a high turnover rate are keen to adopt circular green innovation practices. Waste minimization actions are conducted regardless of firm size; there is no significant relationship between firm size and product re-design activities.

In contrast to established companies, the age of new firms has a more negative impact on establishing renewable energy systems or energy re-plan. R&D investment is significantly related to product re-design activities. Furthermore, R&D-related investments of more than 10% support the adoption of water re-planning actions, and R&D investment of more than 20% also significantly supports the implementation of renewable energy and energy-replanning actions. The findings indicate that firms offering products to consumers are particularly eager to implement energy re-plan actions, while firms offering products to other firms tend to adopt waste reduction and product re-design activities. Furthermore, firms offering services to consumers tend to implement water re-planning, renewable energy, energy re-planning, and product re-design activities, whereas offering services to other companies is negatively associated with water and energy re-planning activities.

5. Conclusion

The results of these models indicate that not all sources of financing increase the adoption of eco-innovations. We find that SMEs employ five different forms of eco-innovation practices under varying circumstances. This is attributed to a variety of factors: funding source, firm size, firm age, R&D investment, and type of market. In general, SMEs' willingness to apply eco-innovations does not appear to rely on their size. However, our findings indicate that micro-sized enterprises are especially likely to make changes to minimize waste.

Our findings show different results between traditional and modern external financing sources to implement various forms of eco-innovations. In general, our results indicate that all traditional external financial approaches are efficient in supporting moves toward the use of renewable energy. The EU and other government funds are adequate when implementing water re-planning, renewable energy, and energy re-planning actions. However, interestingly, traditional forms of external financing do not support waste minimization and product re-design activities.

As a modern form of external financing, we note that green banks play a role in water re-planning and waste minimization. Peer-to-peer lending is particularly likely to result in SMEs' engagement in waste minimization. Furthermore, we noted that financing from business angels and capital markets is associated with product re-design. Risk/venture capital does not seem to play a significant role in SMEs' implementation of eco-innovations. This may be because risk or venture capital institutions lack the patience to invest in resource-intensive and costly green technologies (Demirel, & Danisman, 2019). Projects creating new green technology, including hardware, advanced technologies, and chemicals, are impossible to grow in a limited time, and therefore struggle to gain investment funds (Gaddy, Sivaram, Jones, & Wayman, 2017).

As environmental concerns grow more acute, innovative green activities have begun to draw the interest of decision-makers and the research literature. The results of our study have a variety of consequences for decision leaders in business and for researchers. The current literature indicates that external support might minimize the effects of a lack of internal expertise at SMEs, and external funding may pay off for their absence of financial capital. There has not yet been a discussion in the literature of the cumulative effects of private financing on the adoption rate of green practices.

Provided that financing is aimed at particular types of hurdles to adoption, it is fair to assume that decision-makers can maximize their influence when it is known which form of financial support is most effective, and as a consequence, improve businesses' gains from adoption. As a result, the availability of external funding will maximize firms' willingness to participate in a more holistic approach to implementing resource efficiency practices, concentrating on resource savings, reducing manufacturing costs, and enjoying higher returns. However, companies that already use external funding for these purposes have competencies to understand the importance of green practices, recognize the unique challenges encountered in their implementation, and to identify and approach possible traces of external funding. Therefore, businesses that are willing to access external financial aid to implement resource efficacy efforts are less likely than companies that have not used external funding to face high barriers to implementation, and consequently, will be more likely to benefit.

From a research perspective, this article adds to the literature by presenting details on the external financial factors behind the implementation of innovative green activities. In terms of financial effects, the inefficiency of external public support for greener product re-design indicates a need for reform in the present legal framework. This paper contributes to the scientific literature in a variety of areas. The analysis strengthens our understanding of what external financial sources cause SMEs to be involved in green-efficient activities and why the determinants differ with the type of activity. In doing so, we respond to previous calls to rely on multiple environmental approaches while analyzing organizational conduct (Halme & Laurila, 2009; Uhlaner et al., 2012). Second, we involve several countries in our study. We also concentrate on the type of market, as different markets may require different financial approaches to solve global environmental issues.

We must note that our analyses are subject to a range of significant limitations. First, there are fundamental drawbacks inherent to cross-section analyses. The extent of unobserved variability cannot be completely regulated. This is relevant since certain factors at the organization level (including greening strategies) might involve decision-making. Uncertainty, such as financial restrictions and awareness of environmental management, may affect a company's decision to apply innovative sustainable practices. To resolve this problem, we suggest that future studies acquire time-series and cross-section details from the same company. Second, applying different forms of eco-innovation activities as binary variables contributes to the lack of useful evidence on the intensity of innovative green practices that prospective studies aim to maintain. Future studies can also use long-term data on innovative circular activities of SMEs to explore the importance of the relationships described in this report.

This paper's most distinctive aspect is our study of disparities of the efficacy of external financing for different eco-innovations. By utilizing binary logistic models, we have identified disparities in external financing's effectiveness on five different forms of eco-innovations by distinguishing between traditional and modern financing approaches.

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