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Selling circularity: Understanding the relationship between circularity promotion and the performance of manufacturing SMEs in Italy

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Abstract

Promoting the circularity of business practices and product offerings is a pivotal process in increasing the value of circular products, coming with a still underestimated effect on market response and, thus, firm performance. This study investigates the communication intensity of companies adopting circular economy (CE) practices, here with the aim of assessing the extent to which promoting circularity increases their economic performance (measured as return on assets—ROA), disentangling this effect for the different quantiles of the ROA distribution. Employing a unique web-scraped dataset of companies' websites, we captured and analyzed the online promotional efforts of a sample of Italian manufacturing companies engaged in CE practices. Our results show that small- and medium-sized enterprises (SMEs) that fall into the lower-medium–performing range might benefit from intensively signaling their circularity on their website. Theoretical and managerial implications are put forward.

Keywords: circular economy, big data, web scraping, signaling, communication, sustainability, manufacturing, SMEs

JEL Code: M10, M31

Highlights:

- Low–medium-performing small- and medium-sized enterprises that intensively signal circularity practices have the opportunity to increase their economic performance.
- Low-performing companies need to invest heavily in signaling their circular practices to gain competitive advantage.
- Web communications of circular practices is a promising tool for SMEs.

1. Introduction

Sustainability plays an increasingly important role in business practice, and it is seen as a fundamental strategy to achieving long-term business success (Blasi et al., 2018; Schaltegger, 2011). As shown by a 2017 global survey by McKinsey, sustainability is high on companies' agenda because of the need to meet highly demanding, environmentally-conscious consumers (Barton, 2018). Sustainability objectives can be reached through a plethora of initiatives, including the adoption of circular economy (hereafter CE) practices, which are the focus of the current paper. Even if the concept of a CE has gained momentum over the last three decades (EMF, 2015), it goes back to the work of Pearce and Turner (1989), and has been influenced by Boulding (1966), who has reflected on the earth's limited assimilation capacity and the need to reach an equilibrium between the economy and environment. In a CE, the value of products and materials is maintained for as long as possible. Waste and resource depletion are minimized, and products are re-used when reaching end of life. This can bring major economic benefits to companies, including increased innovation, financial growth and job creation (Geng and Doberstein, 2008). A CE has also been defined as an industrial economy that is restorative or regenerative by intention and design (EMF, 2015). The CE is therefore considered part of an ongoing process toward achieving greater resource efficiency and effectiveness.

The existing body of knowledge focuses on the strategic considerations around the adoption and implementation of a CE (Crainer, 2013; Lieder and Rashid, 2016; Stål and Corvellec, 2018; Urbinati et al. , 2017; Vermeulen, 2015). In this respect, the adoption of circular practices represents an opportunity to change the business model of organizations, moving them toward sustainability and helping them to implement green innovation, with the objective of reducing the use of raw materials and negating the overall environmental impact of the production process (Bassetti et al., 2020). Porter and Van der Linde (1995) stress the idea that green innovation leads to a more efficient use of raw materials: improved efficiencies concerning the use of water, land, and energy can contribute to lowering resource depletion. Indeed, the choice of CE practices stimulates

companies to boost the adoption of green technology (i.e., devices that provide environmentally beneficial effects, such as end-of-line interventions, e.g., fume exhaust catalyzers) and, more generally, to transform the entire value chain (Andersen, 2008; Kemp, 2010), thereby improving the overall efficiency of the production and delivery process (De Jesus and Mendonça, 2018). Business model innovation towards CE and sustainability is becoming fundamental to sustaining companies' competitive advantage (Pieroni et al., 2019).

Prior scholarly research has addressed the relationship between production efficiency, CE practices and economic performance (Bassetti et al., 2020; Chen, 2008; Demirel and Kesidou, 2011; Gaustad et al., 2018; George et al., 2015; Ghisellini et al, 2018). Extant evidence suggests that the environmental performance of firms works as a multiplier of economic performance, consequently the future competitiveness of firms is increasingly related to their capacity to proactively address environmental issues. Bassetti et al. (2020) evaluated the effect of environmental performance on some economic performance indicators, finding that green firms show better resource management and thus perform to levels which are comparable to non-green firms, yet by utilizing far fewer resources.

While being a topical and fertile field of research, scholarly evidence on the effect of circular practices on the economic performance of circular companies is still in its infancy. Although privileging a focus on the strategic considerations around the implementation of CE practices, prior research overlooks issues concerning whether and how the efforts directed at communicating organizational circular efforts are associated with improved economic performance. Communications around the CE practices of companies function as signals to the market and are likely to engender a positive response from the market. As pointed out by Urbinati et al. (2017), business models centered around CE can only be effective if the market recognizes these are relevant. It follows that the market's reactions to CE practices, as communicated by companies, are pivotal for understanding the efficacy of CE investments. The importance of communicating companies' efforts in the area of sustainability has been well established in the marketing literature,

85 which suggests that creating stakeholder awareness of a company's CSR activities is a key
86 prerequisite for reaping CSR's strategic benefits (e.g., Du et al., 2007; 2010).
87 Seeking to address the above research gap in the CE literature, we contribute by exploring the effect
88 of web communications around a CE on economic performance (ROA—return on assets), here
89 specifically focusing on Italian manufacturing SMEs. We also disentangle this effect for the
90 different quantiles of the ROA distribution. We advance empirical evidence that can be generalized
91 to a larger set of SMEs as opposed to prior literature, which has mostly been based on case study
92 analyses (e.g., Chamberlin and Boks, 2018; Hopkinson et al., 2018; Zucchella and Previtali, 2019).
93 Moreover, we are the first to consider firms' heterogeneity, suggesting that selling the idea of
94 circularity has not the same impact at different ROA levels. In doing so, we answer two main
95 research questions: 1) Is there a relationship between SMEs' CE-focused web communication
96 intensity and their economic performance? 2) Is this relationship different at different levels of CE-
97 focused web communications and economic performance?
98 Employing big data analysis through a web-scraping method (George et al., 2014; Sivarajah et al.,
99 2017), we identify the extent to which small and medium-sized enterprises (SMEs) communicate
100 their CE and empirically test through a quantile regression analysis whether the intensity of CE-
101 focused web communications relates to enhanced economic performance. In particular, we
102 investigate how the effect of CE-focused web communications might vary according to the level of
103 performance of the company and the magnitude of the web communications.
104 Our results show a positive relationship between high levels of CE-focused web communications
105 and economic performance only for lower- and medium-performing companies, thus showing that
106 companies adopting CE practices and those not leading the market need to invest consistently in CE
107 marketing communication to gain from it. As for higher-performing companies, we do not observe
108 any effect from communication on performance.
109 Our contributions are threefold. First, from a theoretical standpoint, our paper extends the CE
110 literature by advancing knowledge on the effectiveness of communications around CE practices on

111 the economic performance of manufacturing SMEs. Second, by employing web-scraped data, we
112 showcase the application of a novel approach toward analyzing the efficacy of CE-focused web
113 communications. Third, the results offer advice for managers regarding the role of CE
114 communications in companies' efforts toward achieving competitive advantage.
115 The paper proceeds as follows: section 2 presents the theoretical background; section 3 illustrates
116 the data, variables, and methodology; section 4 summarizes the results; and section 5 offers a
117 discussion and some concluding remarks.

118 **2. Theoretical background**

119 *2.1 CE business models in manufacturing*

120 In Europe, the adoption of sustainable practices is seen as a key step in enabling companies to
121 transition toward the creation of a circular Europe by the year 2030, whereby the production and
122 consumption of products and services will be sustainable, thus benefiting the environment and
123 society at large (Zucchella and Previtali, 2019). As part of this transition process, the European
124 Commission has introduced a European action plan for a CE, setting goals to increase the
125 sustainability of products and services delivered to the common market (EC, 2015). Accordingly,
126 the circularity concept has quickly gained traction among policymakers. Germany is a pioneering
127 country in this area given its efforts since 1966 devoted toward the integration of a CE into
128 legislation, which have led to the introduction of the "Closed Substance Cycle and Waste
129 Management Act" (Su et al., 2013). Japan and China have followed: Japan has introduced the
130 "Basic Law for Establishing a Recycling-Based Society" (METI, 2004), and in 2009, China
131 introduced the "Circular Economy Promotion Law of the People's Republic of China" (Lieder and
132 Rashid, 2016). Nonetheless, the spectrum of action of CE policies in China and Europe are
133 different, as explained by McDowall et al., (2017), who cautioned in drawing direct equivalence
134 between CE efforts across different regions of the world.
135 The contemporary thinking around a CE and its application to economic systems and industrial
136 processes includes a variety of new concepts (e.g., cradle-to-cradle, McDonough and Braungart,

2002), laws of ecology (Commoner, 1971), looped and performance economy (Stahel, 2010), regenerative design (Lyle, 1994), industrial ecology (Graedel et al., 1995), biomimicry (Benyus, 2002), and the blue economy (Pauli, 2010), all of which are related to the concept of a closed loop, which is at the core of CE practices. Closed-loop supply chains are characterized by zero-waste processes, which are based on the reuse or recycling of products or by across-industry integration. These processes may occur in-house or bring in external partners, giving rise to a truly efficient and sustainable business ecosystem.

In line with CE thinking, European businesses adopt practices that encourage the entire economic system to reuse, as opposed to consume, products (also known as "waste as a resource," Lacy and Rutqvist, 2016). CE practices entail the multiplication of inputs, extended life cycle of products, and reduced waste and carbon emissions; all aspects contributing to enhanced value creation for companies (Krikke and Blanc, 2004; Yeo et al., 2017). The adoption of CE practices is particularly prevalent in the manufacturing sector. In this sector, several companies have revisited their manufacturing operations in an attempt to enhance circularity.

From an industrial economics perspective, Stahel and Reday (1976) have discussed some key features of CE, including, for instance, waste prevention, regional job creation, resource efficiency, and the dematerialization of the industrial economy. Stahel (1982), Tukker (2015), and Schulte (2013) have also highlighted the need to establish new business models that meet CE requirements (see also Linder and Williander, 2017; Stål and Corvellec, 2018). As a consequence, business model innovation for a CE and sustainability are becoming fundamental to sustaining companies' competitive advantage (Pieroni et al., 2019).

In particular, Lacy and Rutqvist (2016) identified five CE business models: 1) circular supply chain; 2) recovery and recycling; 3) product life extension; 4) sharing platform; and 5) product as a service. We now briefly summarize the main features of each model, but for a complete overview, we refer to Lacy and Rutqvist (2016). The circular supply chain business model offers access to fully renewable, recyclable, or biodegradable inputs as substitutes for linear ones. Under the

recovery and recycling model, everything previously considered waste is reused for other purposes, effectively eliminating not only waste, but also the concept of waste altogether. The product life extension business model lengthens products' useful life cycle by generating revenue through longevity instead of volume. The sharing platform is closely linked to the sharing economy and allows for connecting product owners with individuals or organizations that would like to use them, boosting coaccess or co-ownership. Finally, the product as a service business model can take several forms: pay for use (customers buy the output rather than a product and pay based on use metrics); leasing (customers buy contractual rights to use a product over a longer period); rental (customers buy the rights to use a product for a short period); and performance agreement (customers buy a predefined service and quality level and companies commit to guaranteeing a specific result).

Although largely seen as an opportunity for manufacturing SMEs, the adoption of a CE also raises uncertainty on the supply and demand side. On the supply side, the implementation of CE practices may lead to a radical transformation of the manufacturing sector with an increasing shift to service offerings, where there are unclear effects on human resources in terms of composition (white collar vs. blue collar) and required tasks (digital vs. manual). On the demand side, the reaction of the market to circular offerings remains unaddressed regarding uncertain returns on CE investments.

2.2 CE communication

The success of CE practices is not only confined to enhanced production efficiency, as evidenced in prior research, but it also necessitates a positive reaction on the part of the market (Hazen et al., 2017). Therefore, companies that recognize the potential to boost their reputation and drive positive market responses that can enhance business performance are increasingly directing resources toward publicizing their CE practices via, for instance, corporate websites (Di Maria et al. 2019). CE-focused marketing efforts could contribute toward the achievement of business benefits. Therefore, understanding the impact of CE-focused web communications on the market is pivotal

190 from a theoretical and managerial standpoint.

191 Thus far, the CE literature has privileged investigations concerning the factors that encourage or
192 inhibit CE adoption and implementation (e.g., Lewandowski, 2016; Mathews and Tan, 2011; Ranta
193 et al., 2018). Empirical studies remain scarce and are mainly based on one (e.g., Hopkinson et al.,
194 2018) or multiple cases of CE implementation (Chamberlin and Boks, 2018). The evidence extends
195 only to the cases investigated and lacks generalizability to sectors or groups of companies such as
196 large or small and medium companies (please see Supplementary material 1 for a summary of
197 studies). Notably, scholars have failed to investigate the issue of communicating CE practices and
198 how communications drive business success while recognizing its importance (e.g., Ghisellini et al.,
199 2016; Antikainen et al., 2015).

200 To the best of our knowledge, only two studies have so far addressed the role played by
201 promotional messages in CE success. Through exploratory research, Chamberlin and Boks (2018)
202 examined how the online communications of four retailers address 10 key factors associated with
203 consumers who purchase circular products and services. In a more recent survey-based study,
204 Muranko et al. (2019) showed that persuasive communications promoting remanufactured
205 refrigerators positively influence buyers' attitudes toward circular products and intentions to
206 purchase. Although insightful, the above studies are exploratory and do not measure the efficacy of
207 communications on the companies employing them. Such an aspect is crucial given the growing
208 pressure on companies to encourage the adoption of circular products and services while reaping
209 the benefits of investments in a CE.

210 We advance the research in this domain by investigating the effect of promoting CE practices
211 online on SMEs' economic performance. Drawing on the signaling theory (Spence, 1973; 1974;
212 2002), we conceptualize CE-focused web communications as signals employed by SMEs to convey
213 their attractiveness to the market. Here, signals represent "activities or attributes of individuals in a
214 market which, by design or accident, alter the beliefs of, or convey information to, other individuals
215 in the market" (Spence, 1974, p. 1). In marketing contexts, where the attractiveness of a company or

a company's offering is somewhat unknown, signaling is crucial in influencing consumers' purchasing decisions (Rao et al., 1999). Signaling is especially relevant in the context of company–consumer exchanges that involve circular products and services (Lahti et al., 2018). Given the novelty of circular products and services, the business returns of CE are contingent upon stakeholders' awareness of companies' circular practices (Du et al., 2007). Signaling enables companies to embrace CE practices, informing the market about their circular efforts and about the quality of their circular offerings. Effective signaling can translate into positive responses from the market, as manifested by enhanced economic performance (i.e., consumers would buy from circular companies more often).

The predicted effect finds theoretical grounding in the signaling theory, as elucidated above, and prior marketing research on sustainability and CSR communications (e.g., Crisafulli et al., 2020; Du et al., 2010; Ellen et al, 2006). Evidence in the marketing domain suggests that communications around sustainability, either addressed to the B2B (business to business) or the B2C (business to consumers) market, enhances the corporate image, motivate purchases, and ultimately drives profitability and market value (Barone et al., 2000; Du et al., 2010; Jahdi and Acikdilli, 2009; Luo and Bhattacharya, 2006). The more business partners or final consumers learn about CSR and companies' motivations for undertaking sustainable efforts, the greater their willingness to support the business and accept the likely impact of CSR on the business' bottom line will be (Ellen et al., 2006; Geissdoerfer et al., 2018). Further, research documents positive associations between a company's CSR initiative and consumers' advocacy behaviors toward the company (Du et al., 2010), as well as consumers' willingness to contribute to product innovations (Kotler et al., 2010; Ramaswamy, 2009). In summary, CE business models and supply chains are jointly seen as a propellent for a transition toward sustainability. Yet, CE business models and supply chains also require effective communication and marketing to deliver strategic benefits (Geissdoerfer et al., 2017). Such intuitions therefore warrant attention and empirical testing.

2 Methodology

3.1 Sample and data collection

The current study's empirical analysis is composed of a sample of 168 manufacturing SMEs based in Italy and adopting circular practices. The choice of manufacturing SMEs is driven by the fact that they are directly linked to the use of resources and are especially challenged when transforming for sustainability (Stahel, 1997). Through the adoption of strategies and business models oriented to the CE, manufacturing SMEs redesign internal processes and chain relations, promote innovative products related to new materials, and redesign how consumers can benefit from them (Geissdoerfer et al., 2017; Lieder and Rashid, 2016). Our sample is composed mainly of small firms located in Lombardy (17%) and Veneto (15%), followed by Emilia Romagna (10%), Piedmont (19%), and Tuscany (9%). The companies adopt different CE business models, including, among the others, recovery and recycling, circular supply chain, and product life extension.[1].

The sampling procedure was carried out as follows: First, we identified Italian SMEs adopting CE practices, screening a variety of sources that collect initiatives realized by different types of organizations in the realm of circularity ("*Treno Verde*," "*Io Penso Circolare*," "*Verso un'economia circolare*," "*Materiali innovative per una nuova edilizia sostenibile*," "*Enel-Symbola*," "*ReMadeinItaly*," and "*MAINN Legambiente*"). The combination of multiple sources helps increase the reliability of the overall data collected because a formal register of firms applying CE practices in Italy does not exist. Second, we retained only manufacturing SMEs. Third, we kept only those that were listed in the AIDA Bureau Van Dijk database and had a website. By doing so, we were able to collect performance indicators of the selected SMEs and analyze their website communications. See Supplementary material 2 for some empirical illustrations of the CE practices of manufacturing companies in the sample.

3.2 Variables

[1] This information was retrieved by a survey conducted by two of the authors in march 2018. Qualitative interviews with 54 managers/entrepreneurs of Italian SMEs informed that the most adopted business model was recovery and recycling (74%), followed by circular supply chain (19%), and product life extension (7%).

Dependent variable

To measure firm performance, we calculated ROA as the ratio of EBITDA to total assets in 2019 (Smart et al., 2008; Barber and Lyon, 1996). This variable measures the companies operating performance as a percentage of profit the company generated on its total assets. Data come from the AIDA Bureau Van Dijk database, which is the most comprehensive source available for financial data of SMEs in Italy.

Independent variable

To collect information on the CE-focused web communication ability of circular SMEs, in late September 2019, we performed a web-scraping analysis through CULTR (http://www.cultrtoolkit.com/), a web-based application that is suited for crawling websites and gather information about company web promotion (Gehman and Grimes, 2017). CULTR text scrapers start on the Internet home page of each company in the sample and then follow all internal links. These scrapers capture and report each instance of the text on a given page, along with metadata such as the size and location of these instances. Therefore, using this method, we created a unique web-scraped dataset of circular SMEs' websites, allowing us to identify and analyze the text-based promotional efforts employed by the selected organizations on their web pages. The communication ability variable (tot_match) was created through a two-stage procedure. First, with the software NVivo11, we conducted a content analysis of a well-known book on CE: *Waste to Wealth: The Circular Economy Advantage* (Lacy and Rutqvist, 2016). The analysis allowed us to list a number of keywords related to the adoption of CE practices (see Table 1). Second, we counted the frequency of the appearance of the keywords within the first three "levels" of a company's website (i.e., any web page appearing within two clicks of the home page) (Gehman and Grimes, 2017) using CULTR.

- Insert Table 1 about here -

There were a number of SMEs that have a website in English and Italian; in such instances, the keywords were counted only one, and we excluded any duplicated words (i.e., keywords appearing both in Italian and English).

Control variables

In our model, we controlled for several company characteristics. All financial data come from the AIDA Bureau Van Dijk database.

DUMMY_EBTDA. This variable assumes a value of 1 if the EBITDA - Earnings Before Interests Taxes Depreciation and Amortization - (in 2019) is greater or equal to the average of the peer group, which the AIDA defines as the industry in which the firm operates and the size; and the value is 0 otherwise. This variable can be considered a proxy of the strategic position of the companies against the competition (Gerli et al., 2012).

CAPEX. A measure of "tangible assets" is used to control the growth and investment opportunities (Mak and Kusnadi, 2005). It is calculated as $Tangible\ assets_t - Tangible\ assets_{t-1} + Depreciations_t$ (where t=2019).

Intangible_assets. The ratio between intangible assets and total assets in 2019. According to International Accounting Standard (IAS) 38, intangible assets include patented technology, computer software, licensing, franchise agreements and trademarks, and so forth. This variable represents a business model proxy; if the indicator is greater than 0, this means that the company has a business model based on services or high-technology products (investment in patents); if it is lower than 0, the company has a traditional manufacturing business model (Cucculelli and Bettinelli, 2015).

CAPEX and *Intangible_assets* together inform the business model of the companies.

LEVERAGE. The companies' leverage was computed as the total debt divided by total assets in 2019 (Fabrizi, Mallin, and Michelon, 2014). Leverage illustrates the debt that the company uses for financing their business (Berk et al., 2013), and it is a proxy of the capital structure (Minnema and Andersson, 2018).

316 *SIZE.* This is a measure calculated as the log transformation of the firm's total assets
317 $(Log(Assets))$, here referring to the year 2019. We used this variable because it is more suitable
318 for small companies (Chircop et al., 2017; Fabrizi et al., 2014).
319 *AGE.* The number of years that the company has been operating in the market since it was founded.
320 This was included to take into consideration the organization life cycle and as a proxy for the level
321 of know-how reached both in the market and regarding internal processes (Zott and Amit, 2008).
322 Table 2 reports the descriptive statistics of the variables presented above.
323 - Insert Table 2 about here -
324 As shown in Table 2, the sample comprised small companies, established on average 20 years ago.
325 The CE website communication, which is calculated through the variable total_match, shows that
326 websites include, on average, about 600 words related to CE practices (see Table 1). Finally, we can
327 infer that the business model of the SMEs in the sample is generally strongly based on investments
328 in intangible assets, showing the important role of services as key resources (intagible_assets is, on
329 average, greater than zero).
330 *3.3 The regression model*
331 To estimate the effect of the CE-focused web communication activities on the operating
332 performance of the selected SMEs, we employed nonparametric quantile regression models
333 (Chamberlain, 1994) using STATA software. The quantile regression offers a relevant alternative to
334 the traditional ordinary least squares (OLS) regression, given that the quintiles provide a more
335 comprehensive description of the response distribution than the mean (Chamberlain, 1994; Hao et
336 al., 2007; Taddy and Kottas, 2010). In several cases (e.g., econometrics, educational studies, and
337 environmental applications), an OLS regression would overlook important features that could be
338 revealed by a quantile regression analysis (Buchinsky, 1994). The main disadvantage in the
339 adoption of an OLS model is that it only "estimates the parameters of interest at the mean
340 evaluation by a conditional distribution of the dependent variable" (Billger and Goel, 2009, p. 301).
341 On the contrary, "quantile regression has the benefit of describing the entire conditional distribution

of the dependent variable" (Coad and Rao, 2008, p. 642). The adoption of this method enabled us to examine the effect of signaling on performance at different intervals of the dependent variable (ROA) conditional distribution, providing a fine-grained understanding of the effect of CE-focused web communications on companies' performance.

3. Results

Table 3 presents the correlation matrix for the dependent, independent, and control variables used in the current study. A number of significant associations among the dependent and control variables can be identified; for example, ROA has a positive and significant correlation with the three control variables (Dummy EBITDA: 0.2629***; Leverage: -0.6245***; Size: -0.1507*). The independent variable does not show any significant correlation. Multicollinearity was not an issue.

- Insert Table 3 about here -

- Insert Table 4 about here -

Table 4 includes both the OLS and quantile regression models' estimations. The OLS estimates provide a baseline informing the mean effects. By comparing the coefficients of the OLS model with those of the quantile regression, it is possible to verify the opportunity to use the latter (quantile regression) against the former (OLS model). As shown in Table 4, the coefficients of the quantile regression models vary with the distribution of the performance variable (ROA), and these are significantly different from the mean, thus confirming the need and validity of adopting a quantile regression. In the model, we also introduce the square of the independent variable (sq_totalmatch) to investigate if there is a nonlinear relationship with the dependent variable. The OLS regression reveals that website communication intensity does not affect economic performance, while the quantile regression results do not uniformly confirm this. In particular, CE website communication has a positive effect for low- and medium-performing SMEs (q25 and q50) but no effect on high-performing SMEs. Notably, there is a nonlinear effect of CE-focused web communication intensity for low- and medium-performing SMEs. The sign of the coefficient of the

linear variable (total_match) is always negative, but it is significant only for the medium-performing firms (q50). Nevertheless, the coefficient of the nonlinear variable (sq_totalmatch) is always positive but significant only for low- and medium-performing SMEs. The impact of the intensity of CE-focused web communications on a firm's performance shows a U-shape distribution, reaching the minimum at 9.733e-15.

The strategic position of these SMEs against their competitors, as measured through the variable DUMMY_EBITDA, shows a coefficient that is always positive and significant. In other words, as demonstrated by the literature, companies that can gain a competitive advantage by investing, for instance, in new products, product customization, and product quality (Afuah, 2009; Dobni, 2010; Graham, 2008), are positively impacted performance wise (Hooley et al., 2001; Horta and Camanho, 2014). The effect of CAPEX and AGE is significant only in the uppermost quantile (q75), where an increase of the capital expenditure or of the years since the establishment of the company negatively impacts firms' performance. Controlling for a firm's capital structure, LEVERAGE, we see that the effect on the performance of companies is always negative for both the quantile and the OLS regressions. The above finding confirms a negative relationship between companies' operational profitability and the use of debt for financing the business. Finally, SIZE reduces the operating performance, but the effect is significant only for the lower quantiles (q25).

4. Concluding remarks

Our research presents original empirical evidence and offers avenues for future research. Employing CULTR (Gehman and Grimes, 2017), we analyzed the promotional activities of a unique web-scraped dataset of Italian SMEs in the manufacturing sector that communicate circularity on their websites. The analysis allowed responding our research questions, confirming the existence of a relationship between SMEs' CE-focused web communication intensity and their economic performance, but also clarifying that this relationship is different at different levels of CE-focused web communications and economic performance. The results show that the ability of

manufacturing SMEs to communicate their circularity on websites has a positive relationship with their economic performance under certain circumstances. In particular, our evidence illustrates how low-performing SMEs need to invest heavily in communicating their circular practices through their websites to obtain economic returns on their CE investments. For low- and medium-performing SMEs, the use of CE-focused web communications can make a difference in terms of economic performance. A different scenario emerges for high-performing SMEs, which, by contrast, do not experience any additional benefit from their CE-focused web communications. For top performing SMEs, CE-focused web communications do not seem to work as effective signals in adding economic value. This is probably because such SMEs have an established reputation in the marketplace and consolidated brand awareness that overcome the "selling the circularity effect."

Theoretical implications

Our research extends the CE literature by addressing an important question related to whether "selling" the idea of circularity helps SMEs that adopt circular practices achieve better economic performance. Studies have suggested that the adoption of circular practices can benefit companies, especially those in the manufacturing sector, by promoting renewed business models and the development of new circular products (Linder and Williander, 2017; Stål and Corvellec, 2018). Crucially, the success of a CE cannot be confined to improved operations, but rather, it has benefits in generating value for adopting companies, necessitating a positive reaction from the market. Scholars have generally agreed that the market to whom circular products and services are tailored is pivotal in ensuring the success of a CE (e.g., Ghisellini et al., 2015; Hazen et al., 2017; Antikainen et al., 2015). Thus far, only two studies have examined promotional messages focused on a CE (Chamberlin and Boks, 2018; Muranko et al., 2019). The same studies, however, overlook the frequency of CE-focused promotional messages and their impact on company performance. Our work presents novel evidence on the efficacy of CE-focused communications on the performance of manufacturing SMEs. Such evidence is explained through the lens of signaling theory. We show

that, consistent with signaling theory, web communications around companies' circular practices function as signals of the quality of companies' offerings thereby boosting positive responses from the market. The signaling theory has been widely applied in a number of contexts, including hiring decisions (Spence, 1974), branding (Rao et al., 1999), advertising (Kirmani, 1990), and pricing (Dodds et al., 1991). Given the novelty of a CE, signaling can be considered highly relevant in boosting the market's reaction to SMEs' CE communications, hence opening up venues for profiting from sustainability practices.

Moreover, from a methodological standpoint, we advance the research on a CE by applying a novel approach to analyzing SMEs' CE-focused web communications, namely the web scraping of online textual data. In a contribution to the CE research and online communications in general, we demonstrate the applicability of the chosen approach in analyzing online textual data from many websites.

Managerial implications

Given the importance for managers to understand how to encourage the adoption of circular offerings in a way that fosters business success, we examine the market's reactions to web communications concerning SMEs' adoption of circular practices. Our findings offer important managerial guidelines on whether and, if so, how SMEs can successfully promote their CE practices online. Our study sheds light on a viable strategy for reaping the benefits of a CE concerning the promotion of SMEs' circular practices.

Promotional activities aimed at communicating circularity play a pivotal role in signaling the attractiveness of a company's offerings, and consequently, at increasing the return from investments in circular practices. We therefore recommend SMEs to direct efforts toward signaling their circular practices to their target market, whether that includes end consumers or business clients. To explore this rather underresearched research topic, we inquired into the web communication abilities of SMEs that have adopted CE practices, here with the aim of identifying the impact of CE-focused

web communication on performance.

Our findings suggest that intense signaling on the part of medium–low-performing SMEs, which most likely show a low brand awareness, leads to improvements in market positioning and thus economic performance. This demonstrates that the market is indeed concerned about sustainability and cares about the circularity of business activities. The signaling of a CE is especially important when the market lacks knowledge about the company's business practices and rely on market signals to infer the attractiveness of a company's offering prior to making purchase decisions. Consumers appear more likely to try circular offerings from a company that actively signals its circular practices (Muranko et al., 2019). Likewise, businesses operating alongside CE directives might be in search of suppliers/clients sharing similar sustainability concerns and select those that successfully signal sustainability endeavors. It follows that investments in promotional activities are fundamental toward ensuring a smooth transition to a CE system. Therefore, marketing managers are advised to intensify their online communication efforts to promote circularity both within the B2B and the B2C markets.

Limitations and avenues for further research

Our study includes some limitations that present fruitful opportunities for further research. To start, the choice of Italy as a cultural context for the current study is driven by the large investments made by Italian SMEs in adopting circular practices. Future research could consider testing our model with SMEs that operate in a different cultural context to establish generalizability. Next, the measure of communication intensity considers web communications only. Although web communications are of paramount importance, future studies should consider testing the effect of communications across multiple channels. Finally, our study focuses on the impact of communications around circular practices on business performance, yet it does not consider the extent to which companies deliver upon their communications. A small proportion of companies might not be genuine in their efforts and that might be detected by consumers. An inspection of consumers' perceptions could therefore be revealing, though beyond the scope of our paper. Future

research might consider the correspondence between what the company does and what the company claims, and the extent to which CE-focused communications are rather perceived as manipulative and indicative of greenwashing practices.

Notwithstanding the listed limitations, this is, to the best of our knowledge, the first research that addresses whether and how the communication of circular initiatives results in enhanced economic performance of firms. Our evidence elucidates the crucial role played by web communications, especially for low- and medium-performing firms, in enhancing operating performance. Here, the transition toward a more sustainable economy is supported by greater market response, which translates into higher economic performance.

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References

Afuah, A. (2009). *Strategic innovation: new game strategies for competitive advantage*. Routledge.

Andersen, M. M. (2008). Empirical analyses of environmental innovations. *Workshop Held at Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe*, 17–18.

Antikainen, M., Lammi, M., Paloheimo, H., Rüppel, T., & Valkokari, K. (2015). Towards circular economy business models: Consumer acceptance of novel services. *Proceedings of the ISPIM Innovation Summit, Brisbane, Australia*, 6–9.

Barber, B. M., & Lyon, J. D. (1996). Detecting abnormal operating performance: The empirical power and specification of test statistics. *Journal of Financial Economics*, *41*(3), 359–399.

Barone, M. J., Miyazaki, A. D., & Taylor, K. A. (2000). The influence of cause-related marketing on consumer choice: does one good turn deserve another? *Journal of the Academy of Marketing Science*, *28*(2), 248–262.

Barton, D. (2018). McKinsey's head of why corporate sustainability efforts are falling short.

Bassetti, T., Blasi, S., & Sedita, S. R. (2021). The management of sustainable development: A longitudinal analysis of the effects of environmental performance on economic performance. *Business Strategy and the Environment*, *30*(1), 21–37. https://doi.org/10.1002/bse.2607

Benyus, J. M. (2002). Biomimicry: Innovation Inspired by Nature, New York, É. *U.: HarperCollins*.

Berk, J., DeMarzo, P., Harford, J., Ford, G., Mollica, V., & Finch, N. (2013). *Fundamentals of corporate finance*. Pearson Higher Education AU.

Billger, S. M., & Goel, R. K. (2009). Do existing corruption levels matter in controlling corruption?: Cross-country quantile regression estimates. *Journal of Development Economics*, *90*(2), 299–305.

Blasi, S., Caporin, M., & Fontini, F. (2018). A Multidimensional Analysis of the Relationship Between Corporate Social Responsibility and Firms' Economic Performance. *Ecological Economics*, *147*, 218–229. https://doi.org/10.1016/j.ecolecon.2018.01.014

513 Boulding, K. E. (1966). The economics of knowledge and the knowledge of economics. *The*
514 *American Economic Review*, *56*(1/2), 1–13.
515 Buchinsky, M. (1994). Changes in the US wage structure 1963-1987: Application of quantile
516 regression. *Econometrica: Journal of the Econometric Society*, 405–458.
517 Chamberlain, G. (1994). Quantile regression, censoring, and the structure of wages. *Advances in*
518 *Econometrics: Sixth World Congress*, *2*, 171–209.
519 Chamberlin, L., & Boks, C. (2018). Marketing approaches for a circular economy: Using design
520 frameworks to interpret online communications. *Sustainability*, *10*(6), 2070.
521 Chen, Y.-S. (2008). The driver of green innovation and green image–green core competence.
522 *Journal of Business Ethics*, *81*(3), 531–543.
523 Chircop, J., Fabrizi, M., Ipino, E., & Parbonetti, A. (2017). Does Branch Religiosity Influence Bank
524 Risk-Taking? *Journal of Business Finance & Accounting*, *44*(1–2), 271–294.
525 Coad, A., & Rao, R. (2008). Innovation and firm growth in high-tech sectors: A quantile regression
526 approach. *Research Policy*, *37*(4), 633–648.
527 Commoner, B. (1971). The Closing Circle: Nature. *Man and Technology*, 11–44.
528 Crainer, S. (2013). Squaring the circle. *Business Strategy Review*, *24*(4), 13–19.
529 Crisafulli, B., Dimitriu, R., & Singh, J. (2020). Joining hands for the greater good: Examining
530 social innovation launch strategies in B2B settings. *Industrial Marketing Management, 89*,
531 487–498. https://doi.org/10.1016/j.indmarman.2019.11.012
532 Cucculelli, M., & Bettinelli, C. (2015). Business models, intangibles and firm performance:
533 evidence on corporate entrepreneurship from Italian manufacturing SMEs. *Small Business*
534 *Economics*, *45*(2), 329–350.
535 De Jesus, A., & Mendonça, S. (2018). Lost in transition? Drivers and barriers in the eco-innovation
536 road to the circular economy. *Ecological Economics*, *145*, 75–89.
537 Demirel, P., & Kesidou, E. (2011). Stimulating different types of eco-innovation in the UK:
538 Government policies and firm motivations. *Ecological Economics*, *70*(8), 1546–1557.

539 Dobni, C. B. (2010). The relationship between an innovation orientation and competitive strategy.
540 *International Journal of Innovation Management*, *14*(02), 331–357.
541 Dodds, W. B., Monroe, K. B., & Grewal, D. (1991). Effects of price, brand, and store information
542 on buyers' product evaluations. *Journal of Marketing Research*, *28*(3), 307–319.
543 Du, S., Bhattacharya, C. B., & Sen, S. (2007). Reaping relational rewards from corporate social
544 responsibility: The role of competitive positioning. *International Journal of Research in*
545 *Marketing*, *24*(3), 224–241.
546 Du, S., Bhattacharya, C. B., & Sen, S. (2010). Maximizing business returns to corporate social
547 responsibility (CSR): The role of CSR communication. *International Journal of Management*
548 *Reviews*, *12*(1), 8–19.
549 EC, E. C. (2015). Closing the loop—An EU action plan for the Circular Economy. *Communication*
550 *from the Commission to the European Parliament, the Council, the European Economic and*
551 *Social Committee and the Committee of the Regions, Brussels, Belgium*.
552 Ellen, P. S., Webb, D. J., & Mohr, L. A. (2006). Building corporate associations: Consumer
553 attributions for corporate socially responsible programs. *Journal of the Academy of Marketing*
554 *Science*, *34*(2), 147–157.
555 Fabrizi, M., Mallin, C., & Michelon, G. (2014). The role of CEO's personal incentives in driving
556 corporate social responsibility. *Journal of Business Ethics*, *124*(2), 311–326.
557 Gehman, J., & Grimes, M. (2017). Hidden badge of honor: how contextual distinctiveness affects
558 category promotion among certified B corporations. *Academy of Management Journal*, *60*(6),
559 2294–2320.
560 Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy –
561 A new sustainability paradigm? *Journal of Cleaner Production*, *143*, 757–768.
562 https://doi.org/10.1016/j.jclepro.2016.12.048
563 Geng, Y., & Doberstein, B. (2008). Developing the circular economy in China: Challenges and
564 opportunities for achieving'leapfrog development'. *The International Journal of Sustainable*

565 *Development & World Ecology*, *15*(3), 231–239.
566 George, G., Haas, M. R., & Pentland, A. (2014). Big data and management. *Academy of*
567 *Management Journal*, *57*(2), 321–326.
568 Gerli, F., Tognazzo, A., & Giubitta, P. (2012). What makes Italian sme entrepreneurs successful?
569 The leverage effect of relational competencies. *Piccola Impresa/Small Business*, *3*, 71–97.
570 Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: the expected
571 transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner*
572 *Production*, *114*, 11–32.
573 Graedel, T. E., Allenby, B. R., & Comrιε, P. R. (1995). Matrix approaches to abridged life cycle
574 assessment. *Environmental Science & Technology*, *29*(3), 134A-139A.
575 Graham, H. (2008). *Marketing strategy and competitive positioning*. Pearson Education India.
576 Hao, L., Naiman, D. Q., & Naiman, D. Q. (2007). *Quantile regression*. Sage.
577 Hazen, B. T., Mollenkopf, D. A., & Wang, Y. (2017). Remanufacturing for the circular economy:
578 An examination of consumer switching behavior. *Business Strategy and the Environment*,
579 *26*(4), 451–464.
580 Hooley, G., Greenley, G., Fahy, J., & Cadogan, J. (2001). Market-focused resources, competitive
581 positioning and firm performance. *Journal of Marketing Management*, *17*(5–6), 503–520.
582 Hopkinson, P., Zils, M., Hawkins, P., & Roper, S. (2018). Managing a complex global circular
583 economy business model: opportunities and challenges. *California Management Review*,
584 *60*(3), 71–94.
585 Horta, I. M., & Camanho, A. S. (2014). Competitive positioning and performance assessment in the
586 construction industry. *Expert Systems with Applications*, *41*(4), 974–983.
587 Jahdi, K. S., & Acikdilli, G. (2009). Marketing communications and corporate social responsibility
588 (CSR): marriage of convenience or shotgun wedding? *Journal of Business Ethics*, *88*(1), 103–
589 113.
590 Kemp, R. (2010). Eco-Innovation: definition, measurement and open research issues. *Economia*

Politica, *27*(3), 397–420.

Kirmani, A. (1990). The effect of perceived advertising costs on brand perceptions. *Journal of Consumer Research*, *17*(2), 160–171.

Kotler, P., Kartajaya, H., & Setiawan, I. (2010). *Marketing 3.0: From products to customers to the human spirit*. John Wiley & Sons.

Krikke, H., & Blanc, I. (2004). Product Modularity and the Design of Closed-Loop. *California Management Review*, *46*(2), 23–40.

Lacy, P., & Rutqvist, J. (2016). *Waste to wealth: The circular economy advantage*. Springer.

Lewandowski, M. (2016). Designing the business models for circular economy—Towards the conceptual framework. *Sustainability*, *8*(1), 43.

Lieder, M., & Rashid, A. (2016). Towards circular economy implementation: a comprehensive review in context of manufacturing industry. *Journal of Cleaner Production*, *115*, 36–51.

Linder, M., & Williander, M. (2017). Circular business model innovation: inherent uncertainties. *Business Strategy and the Environment*, *26*(2), 182–196.

Luo, X., & Bhattacharya, C. B. (2006). Corporate social responsibility, customer satisfaction, and market value. *Journal of Marketing*, *70*(4), 1–18.

Lyle, J. T. (1994). *Regenerative design for sustainable development*. John Wiley & Sons.

MacArthur, E. (2015). *Towards a Circular Economy: Business Rationale for an Accelerated Transition*. Retrieved from https://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Ellen-MacArthur-Foundation_26-Nov-2015.pdf

Mak, Y. T., & Kusnadi, Y. (2005). Size really matters: Further evidence on the negative relationship between board size and firm value. *Pacific-Basin Finance Journal*, *13*(3), 301–318.

Mathews, J. A., & Tan, H. (2011). Progress toward a circular economy in China: The drivers (and inhibitors) of eco-industrial initiative. *Journal of Industrial Ecology*, *15*(3), 435–457.

McDonough, W., & Braungart, M. (2002). Design for the triple top line: new tools for sustainable commerce. *Corporate Environmental Strategy*, *9*(3), 251–258.

McDowall, W., Geng, Y., Huang, B., Barteková, E., Bleischwitz, R., Türkeli, S., … Doménech, T. (2017). Circular economy policies in China and Europe. *Journal of Industrial Ecology*, *21*(3), 651–661.

Minnema, J., & Andersson, A. (2018). *The relationship between leverage and profitability: A quantitative study of consulting firms in Sweden*. Retrieved from http://www.diva-portal.org/smash/get/diva2:1234028/FULLTEXT01.pdf

Muranko, Z., Andrews, D., Chaer, I., & Newton, E. J. (2019). Circular economy and behaviour change: Using persuasive communication to encourage pro-circular behaviours towards the purchase of remanufactured refrigeration equipment. *Journal of Cleaner Production*, *222*, 499–510.

Pauli, G. A. (2010). *The blue economy: 10 years, 100 innovations, 100 million jobs*. Paradigm publications.

Pearce, D. W., & Turner, R. K. (1989). *Economics of natural resources and the environment*. JHU Press.

Pieroni, M. P. P., McAloone, T. C., & Pigosso, D. C. A. (2019). Business model innovation for circular economy and sustainability: A review of approaches. *Journal of Cleaner Production*, *215*, 198–216.

Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, *9*(4), 97–118.

Ramaswamy, V. (2009). Co-creation of value—towards an expanded paradigm of value creation. *Marketing Review St. Gallen*, *26*(6), 11–17.

Ranta, V., Aarikka-Stenroos, L., Ritala, P., & Mäkinen, S. J. (2018). Exploring institutional drivers and barriers of the circular economy: A cross-regional comparison of China, the US, and Europe. *Resources, Conservation and Recycling*, *135*, 70–82.

643 Rao, A. R., Qu, L., & Ruekert, R. W. (1999). Signaling unobservable product quality through a
644 brand ally. *Journal of Marketing Research*, *36*(2), 258–268.
645 Schaltegger, S. (2011). Sustainability as a driver for corporate economic success: Consequences for
646 the development of sustainability management control. *Society and Economy*, *33*(1), 15–28.
647 Schulte, U. G. (2013). New business models for a radical change in resource efficiency.
648 *Environmental Innovation and Societal Transitions*, *9*, 43–47.
649 Sivarajah, U., Kamal, M. M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of Big Data
650 challenges and analytical methods. *Journal of Business Research*, *70*, 263–286.
651 Smart, S. B., Thirumalai, R. S., & Zutter, C. J. (2008). What's in a vote? The short-and long-run
652 impact of dual-class equity on IPO firm values. *Journal of Accounting and Economics*, *45*(1),
653 94–115.
654 Spence, A. M. (1973). Job market signaling. In *Uncertainty in economics* (pp. 281–306). Elsevier.
655 Spence, A. M. (1974). *Market signaling: Informational transfer in hiring and related screening*
656 *processes* (Vol. 143). Harvard Univ Pr.
657 Spence, A. M. (2002). Signaling in retrospect and the informational structure of markets. *American*
658 *Economic Review*, *92*(3), 434–459.
659 Stahel, W R. (1982). The product life factor. *An Inquiry into the Nature of Sustainable Societies:*
660 *The Role of the Private Sector (Series: 1982 Mitchell Prize Papers), NARC*.
661 Stahel, W R. (2010). *The performance economy*. Springer.
662 Stahel, W R, & Reday, G. (1976). *The potential for substituting manpower for energy, report to the*
663 *Commission of the European Communities*.
664 Stahel, Walter R. (1997). The service economy:'wealth without resource consumption'?
665 *Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical*
666 *and Engineering Sciences*, *355*(1728), 1309–1319.
667 Stål, H. I., & Corvellec, H. (2018). A decoupling perspective on circular business model
668 implementation: Illustrations from Swedish apparel. *Journal of Cleaner Production*, *171*, 630–

643.

Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: moving from rhetoric to implementation. *Journal of Cleaner Production*, *42*, 215–227.

Taddy, M. A., & Kottas, A. (2010). A Bayesian nonparametric approach to inference for quantile regression. *Journal of Business & Economic Statistics*, *28*(3), 357–369.

Tukker, A. (2015). Product services for a resource-efficient and circular economy - A review. *Journal of Cleaner Production*, *97*, 76–91. https://doi.org/10.1016/j.jclepro.2013.11.049

Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production*, *168*(1), 487–498. https://doi.org/10.1016/j.jclepro.2017.09.047

Vermeulen, W. J. V. (2015). Self-governance for sustainable global supply chains: can it deliver the impacts needed? *Business Strategy and the Environment*, *24*(2), 73–85.

Yeo, N. C. Y., Pepin, H., & Yang, S. S. (2017). Revolutionizing technology adoption for the remanufacturing industry. *Procedia CIRP*, *61*, 17–21.

Zott, C., & Amit, R. (2008). The fit between product market strategy and business model: implications for firm performance. *Strategic Management Journal*, *29*(1), 1–26.

Zucchella, A., & Previtali, P. (2019). Circular business models for sustainable development: A "waste is food" restorative ecosystem. *Business Strategy and the Environment*, *28*(2), 274–285.