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# **SELLING THE CIRCULARITY: INVESTIGATING THE IMPACT OF CIRCULARITY PROMOTION ON THE PERFORMANCE OF ITALIAN MANUFACTURING COMPANIES**

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# **Selling the circularity: Investigating the impact of circularity promotion on the performance of Italian manufacturing companies**

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## **Abstract**

Promoting the circularity of business practices and of product offerings represents a pivotal process in increasing the value of circular products and encouraging the market to recognize such a value. This study investigates the communication abilities of companies manifesting an interest in adopting circular economy practices, with the aim to assess the extent to which promoting circularity increases economic performance. Employing a unique web-scraped dataset of Italian circular companies' websites, we captured and analyzed the online promotional efforts of a unique sample of manufacturing companies. Underpinned by the signaling theory, our estimation results illustrate that the ability of small and medium-sized enterprises (SMEs) to signal the circularity of their business practices on the website generally increases performance and such impact is larger among low performing companies. Our study advances knowledge on: 1) the impact of promoting circularity on economic performance, 2) the efficacy of signaling in the context of circular practices' adoption.

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

**JEL Code:** M10, M31

## **Highlights:**

- Small and medium-sized companies' signaling of circularity leads to enhanced performance.
- Low performing companies need to invest in signaling their circular practices.
- Web communications of circular practices does not benefit high performing companies.

## 1. Introduction

Sustainability plays an increasingly important role in business practice and it is seen as a fundamental strategy to the achievement of 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 given the need to meet highly demanding, environmentally-conscious consumers (Barton, 2018). In Europe specifically, the adoption of sustainable practices is seen as a key step in enabling companies to make a transition toward the creation of a circular Europe by 2030, whereby the production and consumption of products and services are sustainable, thus benefit the environment and society at large (Zucchella and Previtali, 2019). As part of such a transition process, the European Commission has introduced a European action plan for Circular Economy (hereafter CE) setting goals to increase the sustainability of products and services delivered to the common market (EC, 2015). Accordingly, the circularity concept has fast gained traction among policymakers. Germany is a pioneering country in this area given the focused efforts devoted toward the integration of Circular Economy into legislation since 1996, with the introduction of the "Closed Substance Cycle and Waste Management Act" (Su et al., 2013). Japan and China have followed by introducing the "Basic Law for Establishing a Recycling-Based Society" (METI, 2004), and China's 2009 "Circular Economy Promotion Law of the People's Republic of China" (Lieder and Rashid, 2016), respectively.

In line with Circular Economy (CE) thinking, businesses adopt practices which are characterized by a more effective use of resources that encourages the entire economic system to re-use, as opposed to consume, products (also known as 'waste as a resource', Lacy and Rutqvist, 2016). CE practices entail the multiplication of inputs, extended lifecycle of products, reduced waste as well as carbon emissions, all aspects contributing to enhanced value creation for companies (Krikke and Blanc, 2004; Yeo et al., 2017). In the same vein, CE-oriented companies are now introducing novel business models which are focused around selling 'solutions' as opposed to products (Tukker, 2015; Schulte, 2013). 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. For instance, Aquafil, based in Arco (Province of Trento, Italy), one of the key players in the production of Polyamide 6 (nylon), both nationally and internationally has been leading research on the development of new, more sustainable, circular production models. In 2011, Aquafil created ECONYL® Regeneration System, an efficient regeneration system which transforms used materials into nylon, such as fishing nets, parts of carpets and rugs (Lacy and Rutqvist, 2016). ECONYL®, a recycle nylon yarn is currently used by various large sport companies, including Adidas for their swimwear lines.

Crucially, companies increasingly direct resources toward publicizing their CE practices in the attempt to obtain reputational gains (Di Maria et al. 2019). An example of such practice concerns Orange Fiber, an Italian company specialized in the production of sustainable fabrics from citrus juice by-products. In order to increase visibility and reputation, the company embarked in a partnership with the luxury fashion house, Salvatore Ferragamo, for the creation of a capsule collection using citrus fabrics, embellished with prints made by Mario Trimarchi, winner of the 2016 Compasso d'Oro (a highly prestigious Italian design award). Thanks to technological advances, the Internet and companies' websites provide an accessible medium for easily relaying information to the market. CE-focused promotional efforts are, therefore, expected to contribute toward the achievement of business benefits linked to CE. The success of CE is in fact not only confined to enhanced production efficiency, but it also necessitates a positive reaction on the part of the market (Hazen et al., 2017). Understanding the impact of CE-focused web communications on the market is therefore important, from a theoretical and managerial standpoint.

There is thus far paucity of scholarly research that empirically investigates the efficacy of CE-focused web communications to companies. Whilst being topical and a fertile field of research, scholarly evidence on the effect of circular practices on circular companies is still at infancy. The existing body of knowledge in the domain presents two key features. First, research mainly focuses on the strategic considerations around the adoption and implementation of CE (Crainer, 2013; Lieder

and Rashid, 2016; Stål and Corvellec, 2018; Urbinati et al. , 2017; Vermeulen, 2015). In this respect, CE practices represent an opportunity to change the business model of organizations toward sustainability, notwithstanding the criticalities emerging from potential operational risks. However, the above studies overlook how CE is communicated to the market, and more importantly, how the market responds to companies' signaling of CE practices and efforts. As pointed out by Urbinati et al. (2017), business models centered around CE can only be effective if the market recognizes these as relevant. It follows that the market's reactions to CE practices communicated by companies are pivotal for understanding the efficacy of CE investments. Second, a sizeable number of studies on CE is conceptual, or qualitative and based on single/multiple case study analysis (e.g. Chamberlin and Boks, 2018; Hopkinson et al., 2018; Zucchella and Previtali, 2019). It follows that extant evidence applies to the cases examined in prior studies. Findings that can be generalized to a larger set of SMEs communicating CE is lacking, thus also warranted.

Against the above backdrop, we examine the effect of CE-focused web communications embedded in SMEs' websites on the reactions of the market. In doing so, we seek to answer two main research questions: 1) Do SMEs' CE-focused web communication abilities impact positively on economic performance? 2) Is there a linear effect of CE-focused web communication ability on firm performance? Drawing on signaling theory (Spence, 1973; 1974; 2002), we contend that, in the absence of complete information concerning the circularity of SMEs, decision makers use cues (or signals) in order to infer the desirability of a company. We conceptualize CE-focused web communications as signals employed by SMEs in order to convey their attractiveness to the market. Effective signaling shall translate into positive responses from the market, as manifested with enhanced economic performance. The predicted effect is consistent with prior research suggesting that signaling sustainability-focused messages can lead to enhanced consumer involvement with the company and willingness to contribute to product innovations (Kotler et al., 2010; Ramaswamy, 2009).

Employing big data analysis through a web-scraping method (George et al., 2014; Sivarajah et

al., 2017), we identify the extent to which SMEs communicate CE and empirically test whether high usage of CE-focused web communications leads to enhanced economic performance. Further, we investigate how the effect of CE-focused web communications might vary according to the type of company employing CE-related signals.

From a theoretical standpoint, we extend the CE literature by advancing knowledge on whether and how to effectively communicate CE practices to the market, which is ultimately an active player in adopting circular offerings. In an extension to prior literature, our study is the first to establish the link between CE-focused signaling and company performance. Further, we present a novel application of signaling theory in explaining the efficacy of CE-focused web communications of manufacturing small and medium-sized enterprises (SMEs). We also showcase the application of a novel approach to analyzing the efficacy of CE-focused web communications that employs web-scraped data. Our findings offer important managerial guidelines on whether and how to successfully communicate CE online. At a more level, our study sheds light on a viable strategy for reaping the benefits of CE concerning the promotion of SMEs' circular practices.

The paper proceeds as follows: section 2 presents the theoretical background; section 3 illustrates data, variables and methodology; section 4 summarizes the results; and section 5 offers some conclusive remarks.

## **2. Theoretical background**

### *2.1 Circular Economy in the manufacturing sector*

Circular Economy (CE) has been defined as “an industrial economy that is restorative or regenerative by intention and design” (MacArthur, 2013, p.14). In essence, CE requires a closed loop process in which waste is minimized performing repair, reuse, remanufacturing and recycling. (Geng and Doberstein, 2008).

The concept of CE goes back to the work of Pearce and Turner (1989), and it has gained momentum over the last three decades or so (MacArthur, 2013). The thinking around CE has also been influenced by Boulding (1966), who has reflected on the earth's limited assimilation capacity

and about the necessity to reach an equilibrium between economy and environment. From an industrial economics perspective, Stahel and Reday (1976) have discussed some of the key features of CE, including for instance, waste prevention, regional job creation, resource efficiency, and dematerialization of the industrial economy. Stahel (1982) also highlights the need to establish new business models that meet CE requirements, thus for instance, business models that encourage the *re-utilization* of resources instead of the *ownership* of goods

The contemporary thinking around CE and its application to economic systems and industrial 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 related to the concept of closed loop, which is at core of CE practices.

CE has opened up new, promising scenarios for manufacturing SMEs in particular. By following a CE-driven innovation trajectory, SMEs in the manufacturing sector nowadays have the opportunity to renew their business models and to overcome issues concerning new product development (Linder and Williander, 2017; Stål and Corvellec, 2018). While largely seen as an opportunity for manufacturing SMEs, the adoption of CE also raises uncertainty on the supply and demand side. Issues concerning the return on CE investments, and the reaction of the market to circular offerings remain thus far unaddressed.

## *2.2 Communicating CE-related efforts: The role of market signaling*

The thinking underpinning CE practices and business models is receiving growing attention in the academic and business community, as evidenced by a range of academic as well as practice-based publications available on the topic. The Ellen MacArthur Foundation has published a book (Webster, 2015) and a series of reports on the subject (EMF, 2014, 2013a, 2013b). The Foundation is also a major hub for businesses, policy makers, and academia to share knowledge and best practices in the area of CE. The scholarly evidence in the domain is, however, still at infancy and thus far largely

based on conceptual studies (please refer to Appendix A for a summary of key studies). A number of literature reviews on the topic have been published (e.g. Andersen, 2007; Ghisellini et al., 2016; Lieder and Rashid, 2016; Su et al., 2013). Areas of particular interest include; closed loop value and supply chains (Govindan et al., 2015; Guide Jr and Van Wassenhove, 2009; Stindt and Sahamie, 2014; Wells and Seitz, 2005), circular business models (Bocken et al., 2016) and circular product design (Bakker et al., 2014). Further, scholars have paid particular attention toward the factors that encourage or inhibit CE adoption and implementation (e.g. Lewandowski, 2016; Mathews and Tan, 2011; Ranta et al., 2018), drawing upon theoretical stances grounded across different research domains, from sustainability to industrial ecology and cleaner production. Empirical studies remain scarce and are mainly based on one (e.g., Hopkinson et al., 2018) or multiple cases of CE implementation (Chamberlin and Boks, 2018). Extant empirical evidence is thus relevant to the cases under investigation and lacks generalizability to entire sectors or groups of companies such as large or small and medium companies.

One core theme emerges from the extant literature. Scholars seem to concur on the fact that consumers, and more generally, the market to whom circular products and services are tailored, are of paramount importance in ensuring the success of CE (e.g., Ghisellini et al., 2015; Hazen et al., 2017; Antikainen et al., 2015). Existing studies emphasize the need for companies to promote and encourage purchase patterns that support sustainability to make CE a viable business model (Ghisellini et al., 2015; Antikainen et al., 2015). However, only two studies have thus far considered the role played by promotional messages in CE success. Employing exploratory research, Chamberlin and Boks (2018) examine how online communications of four retailers address ten key factors associated by consumers with the purchase of circular products and services. While insightful, Chamberlin and Boks' study (2018) is exploratory and does not measure the efficacy of the gathered messages on the retailers employing them. In a more recent survey-based study, Muranko et al. (2019) show that persuasive communications promoting remanufactured refrigerators positively influence buyers' attitudes toward circular products and intentions to purchase. The above studies overlook the



frequency of promotional messages around CE and how frequency impacts company performance. Both aspects merit further investigation given the growing pressure on companies to communicate CE practices in order to encourage the adoption of circular products and services, and to understand the return on investments in promoting CE.

We address the above knowledge gaps and advance research in the domain by investigating the effect of promoting CE practices on SMEs' economic performance. Drawing upon signaling theory (Spence, 1973, 2002), we theorize that CE-focused web communications represent signals employed by SMEs in order to convey the quality of circular products and services, and more generally, of adopted circular practices. Signals represent "activities or attributes of individuals in a market which, by design or accident, alter the beliefs of, or convey information to, other individuals in the market" (Spence, 1974, p.1). Signals are employed when "parties to a transaction have different amounts of information regarding the transaction", encountering what is known as "information asymmetry" (Kirmani and Rao, 2000, p.66).

Information asymmetry occurs in numerous contexts, including for instance in employer's hiring decisions where job applicants use signals in order to facilitate hiring decisions (Spence, 1973, 1974). In marketing contexts, where company-customer exchanges take place, information asymmetry is often encountered at the time of buying a product, wherein the inherent quality of the promoted offering is unobservable and difficult for the consumer to assess against competitors' offerings (Rao et al., 1999). We contend that conditions of information asymmetry are particularly prominent in the context of company-consumer exchanges that involve circular products and services, as also discussed by Lahti et al. (2018) in a recent review. Given the novelty of circular products and services, and the consequent low level of consumer knowledge of the practices behind circular offerings, signaling is highly relevant in such contexts. Signaling enables companies embracing CE practices to inform the market about their circular efforts, and about the quality of their circular offerings. When signaling is frequent and efficacious, we expect companies to experience positive perceptions of quality, as manifested with enhanced economic performance (i.e. consumers would buy from

signaling companies that convey good quality, while also actively avoid companies signaling bad quality).

### **3. Methodology**

#### *3.1 Data*

The empirical analysis is based on 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 (Walter R 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 - from product to service (Geissdoerfer et al., 2017; Lieder and Rashid, 2016). Our sample is composed mainly by small firms located in Lombardy (17%) and Veneto (15%), followed by Emilia Romagna (10%), Piedmont (19%), Tuscany (9%). All SMEs are involved in a variety of circular practice including, for instance, reuse of raw material, waste disposal, recycling.

The sampling procedure is explained in the following. First, we identified Italian SMEs adopting circular economy 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*", "*MAINN Legambiente*"). The combination of multiple sources allows to increase the reliability of the overall data collected, since a formal register of firms applying circular economy practices in Italy does not exist so far. Second, we retained only the 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.

#### *3.2 Variables*

##### *Dependent variable*

To measure firm performance, we calculated ROA (return on assets), as the ratio of EBITDA to total assets, in 2019 (cfr. Smart et al., 2008; Barber and Lyon, 1996). This variable measures the companies operating performance as percentage of profit the company generated on its total assets.

*Independent variable*

In order 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, suited for crawling websites and gather information about company web promotion, created by Gehman and Grimes (2017). We created a unique web-scraped dataset of circular SMEs’ websites that allowed 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, we conducted a content analysis, with the software NVivo11, of a well renown book on CE: “*Waste to wealth: The circular economy advantage*” (Lacy and Rutqvist, 2016). The analysis allowed us listing a number of keywords related to the adoption of CE practices (see Table 1). Second, we counted the frequency of 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.

Table 1: Keywords from the content analysis through the software NVivo11

1	Circular* (circular, circularity, circularly, circulars, circulate, circulation)	14	Estensione della vita
2	Recycl* (recyclability, recyclable, recycles, recycle, recycled, recycler, recyclers, recycles, recycling)	15	Rigener* (rigenerazione, rigenerati, rigenerato, rigenerare)
3	Reus* (reus, reusability, reusable, reuse, reused, reusing)	16	Remanufacture* (remanufacture, remanufactured, remanufacturer, remanufacturers, remanufactures, remanufacturing)
4	Rius* (riuso, riusare, riusabile)	17	Refurbish
5	Ricicl* (riciclati, riclare, riciclato)	18	Ricondiziona* (ricondizionamento, ricondizionati, ricondizionare)

6	Recuper* (recuperata, recupero, recuperato, recuperare)	19	Cradle
7	Wast* (waste, waste', wasted, wasteful, wastefully, wastes)	20	Culla
8	Scart* (scarto, scarti, scartare)	21	Repair* (repair, repaired, repairing, repairs)
9	Rifiut* (rifiuto, rifiuti)	22	Ripara* (riparato, riparazione, riparare)
10	Circol* (circolare, circolarità)	23	Loop* (loop, loops)
11	Shar* (share, shared, shares, sharing)	24	Ciclo
12	Condivisione	25	Upcycle* (upcycle, upcycled, upcycling, upcycling')
13	Life* (lifespan, lifetime, lifetimes, lifecycle, lifecycles)	26	Macarthur

There were a number of SMEs that have a website in English and Italian in such instance the keywords were counting only one and we excluded any duplicated (i.e. keywords appearing both in Italian AND English).

#### *Control variables*

In our model, we controlled for several company characteristics.

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

*CAPEX*. A measure of “tangible assets” 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 the International Accounting Standard (IAS) 38, intangible assets include patented technology, computer software, licensing, franchise agreements and trademarks, etc. This variable represents a business model proxy; if the indicator is greater than 0 it 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 on the business model of the companies.

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

*SIZE*. A measure calculated as the log transformation of the firm's total assets ( $Log(Assets)$ ), referred to the year 2019. We used this variable because it is more suitable for the small companies (Chircop et al., 2017; Fabrizio et al., 2014).

*AGE*. The number of years that the company has been operating in the market, since it was founded the company was founded. It was included to take into consideration the organization lifecycle and as a proxy for the level of know-how reached both on the market and with regard to internal processes (Zott and Amit, 2008).

Table 2 reports the descriptive statistics of the variables presented above.

Table 2: Descriptive statistics

<b>Variable</b>	<b>Obs</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min</b>	<b>Max</b>
ROA	165	.0541787	.2401808	-2.316833	.3805257
total_match	165	598.2788	1483.825	0	13245
Dummy_EBITDA	165	.5090909	.5014392	0	1
Capex	168	114.5359	198.2122	-158	909
Intangible_assets	165	.0698538	.1163254	0	.5526868
Leverage	165	.0698538	.3408635	.0097255	2.791416
Size	165	3.364974	1.736763	.7158867	6.851185
Age	168	20.9881	16.25581	1	94

As evidenced by Table 2, the sample comprised of small companies, established on average 20 years ago. The circular economy website communication, which is calculated through the variable *total\_match*, show that websites include, on average, about 600 words related to circular economy practices (see Table 1). Finally, we can infer that the business model of the SMEs in the sample is generally strongly based on investments in intangible assets, informing on the important role of services as key resource (*intangible\_assets* is, on average, greater than zero).

### 3.3 The regression model

To estimate the effect of the CE-focused web communication activities on the operating performance of the selected SMEs, we employed nonparametric quantile regression models (Chamberlain, 1994) using STATA software. The quantile regression offers a relevant alternative to traditional ordinary least squares (OLS) regression, given that the quintiles provide a more comprehensive description of the response distribution than the mean (Chamberlain, 1994; Hao et al., 2007; Taddy and Kottas, 2010). In several cases (e.g., econometrics, educational studies, and environmental applications) OLS regression would overlook important features that could be revealed by a quantile regression analysis (Buchinsky, 1994). The main disadvantage in the adoption of a OLS model is that it only “estimates the parameters of interest at the mean evaluation by a conditional distribution of the dependent variable” (Billger and Goel, 2009, p. 301). 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 enables us to examine the effect of signaling on performance at different intervals of the dependent variable (ROA) conditional distribution, providing finegrained understanding on the effect of CE-focused web communications on companies’ performance”.

## **Results**

Table 3 presents the correlation matrix for the dependent, independent, and control variables used in this study. A number of significant associations among 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\*), respectively. The independent variable does not show any significant correlation. Multicollinearity was not an issue for concern.

Table 3: Correlation matrix

Variable	ROA	total_match	Dummy EBITDA	Capex	Intangible_assets	Leverage	Size	Age
ROA	1.0000							
total_match	0.0739	1.0000						
Dummy EBITDA	0.2629***	0.1155	1.0000					
Capex	0.1258	-0.1053	0.1353*	1.0000				
Intangible_assets	-0.0709	-0.0315	0.0467	-0.1831**	1.0000			
Leverage	-0.6245***	-0.0757	-0.2158***	-0.2438***	0.2989***	1.0000		
Size	-0.1507*	0.0756	-0.0288	-0.2551***	0.2409***	0.2666***	1.0000	
Age	0.1186	0.0832	-0.0474	0.2101***	-0.3090***	-0.2309***	-0.1026	1.0000

Note: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Table 4: Model estimation

VARIABLES	Quantile regression			OLS
	Q25 ROA	Q50 ROA	Q75 ROA	ROA
total_match	-8.24e-06 (9.37e-06)	-1.93e-05** (8.47e-06)	-6.40e-06 (6.44e-06)	-2.05e-05 (1.81e-05)
sq_totalmatch	1.84e-09** (8.89e-10)	2.35e-09*** (8.03e-10)	1.01e-09 (6.11e-10)	2.32e-09 (1.49e-09)
DUMMY_EBITDA	0.0604*** (0.0120)	0.0528*** (0.0108)	0.0723*** (0.00825)	0.0651** (0.0262)
CAPEX	-3.48e-05 (3.10e-05)	5.82e-06 (2.80e-05)	-3.85e-05* (2.13e-05)	-5.17e-05 (6.07e-05)
Intangible_assets	-0.0599 (0.0545)	0.0256 (0.0493)	0.0154 (0.0375)	0.227 (0.239)
LEVERAGE	-0.180*** (0.0190)	-0.112*** (0.0172)	-0.128*** (0.0131)	-0.458** (0.192)
SIZE	-0.00758** (0.00356)	-0.00137 (0.00321)	0.00178 (0.00244)	-0.000994 (0.00891)
AGE	0.000449 (0.000384)	-0.000471 (0.000347)	-0.000663** (0.000264)	9.31e-05 (0.000738)
Constant	0.131*** (0.0217)	0.147*** (0.0196)	0.185*** (0.0149)	0.305** (0.135)
Observations	162	162	162	162
Pseudo R2	0.1511	0.1058	0.1784	
R-squared				0.439

Note: Standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Table 4 includes both OLS and quantile regression models' estimation. OLS estimates provide a baseline informing on 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 against the former one. As we can observe from 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 the validity of adopting the quantile regression. In the model we also introduce the square of the independent variable (sq\_totalmatch) to investigate if there is a non-linear relationship with the dependent variable. The OLS regression reveals that website communication



intensity does not affect the economic performance, while the quantile regression results do not uniformly confirm that. In particular, it emerges that the 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 non-linear 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 non-linear variable (*sq\_totalmatch*) is always positive but significant only for low and medium performing SMEs. The impact of the intensity of CE-focused web communication on firm's performance shows a U-shape distribution, reaching the minimum at 9.733e-15.

The strategic position of the SMEs against the competitors, measured through the variable *DUMMY\_EBITDA*, shows a coefficient that is always positive and significant. In other words, as demonstrated by existing literature, companies that are able to gain a competitive advantage, by investing, for instance, in new products, product customization, product quality (Afuah, 2009; Dobni, 2010; Graham, 2008) have a positive impact on their performance (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 impacts negatively on firms' performance. Controlling for 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. Conclusions**

Marketing strategies and promotional activities play a relevant role in influencing the return from investments in circular practices. It follows that SMEs need to increase their ability to signal their practices to the customers. In order to explore this rather underdeveloped research topic, we inquired on the web communication abilities of the SMEs, which adopted circular economy practices, with

the aim of identifying the impact of CE-focused web communication on performance. Employing CULTR, a web-based application, suited for crawling websites and gather information about company web promotion, created by Gehman and Grimes (2017) we analyzed the promotional activities of a unique web-scraped dataset of Italian SMEs in the manufacturing sector communicating circularity on their website. The results show that the ability of manufacturing SMEs to communicate their circularity on websites positively impacts economic performance. In particular, our evidence illustrates how low performing SMEs need to invest heavily in communicating their circular practices through their websites, in order to obtain economic returns on their CE investments. For low and medium performing SMEs, the enforcement of CE-focused web communication 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 SMEs with high performance indicators, the CE-focused web communication does not seem to add economic value. This is probably due to the fact that such SMEs have an established reputation in the marketplace and consolidated brand awareness.

Theory informs that signaling represents a highly relevant process in the context of company-consumer exchanges that involve circular products and service. Given the novelty of circular offerings, and the low level of consumer knowledge of circular business practices, signaling is beneficial to SMEs in order to inoculate information asymmetry. Our findings show that frequent signaling on the part of low performing and less well-known SMEs leads to improvements in economic performance. The above evidence demonstrates that customers are indeed concerned about sustainability and care about the circularity of business activities. The signaling of CE is especially important for consumers who lack knowledge about the company and its brand, and thus rely upon market signals in order to make inferences of quality and consequent purchase decisions. In fact, consumers who are not familiar with a brand, are more likely to try circular products from a company that actively signals its circular practices. It follows that investments in promotional activities are

pivotal in ensuring a smooth transition toward a circular economy system. Marketing managers are therefore advised to intensify their online communication efforts to promote circularity.

### *Theoretical implications*

Our research makes three important theoretical contributions.

First, we extend the CE literature by addressing an important question related to whether and how “selling” the idea of circularity helps SMEs that adopt circular practices. Extant research suggests that the adoption of circular practices can benefit companies, especially those in the manufacturing sector, by promoting renewed business models and the development of circular new products (Linder and Williander, 2017; Stål and Corvellec, 2018). Crucially, research in the same domain acknowledges that the success of CE is not only confined to improved operations, but it also necessitates a positive reaction from the market. Scholars agree that the market to whom circular products and services are tailored is pivotal in ensuring the success of 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 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. Considering the importance for managers to understand how to foster the adoption of circular offerings and CE success, we examine the market’s reactions to web communications concerning SMEs’ adoption of circular practices.

Second, we present a novel application of signaling theory in explaining the efficacy of CE-focused communications of manufacturing SMEs. Signaling theory has been widely applied in a number of contexts, including for instance, hiring decisions (Spence, 1974), branding (Rao et al., 1999), advertising (Kirmani, 1990) and pricing (Doods, Monroe and Grewal, 1991). Given the novelty of CE, the market can face conditions of information asymmetry when evaluating circular offerings and SMEs’ circular practices (Lahti et al., 2018). In such a context, signaling is found to be highly relevant in explaining the market’s reaction to communications concerning SMEs’ circular practices. Advancing prior research, we show that signaling is a conspicuous mechanism at play when

evaluating the market's reactions to web communications of SMEs' CE practices.

Third, we advance research on CE by presenting the application of a novel approach to analyzing SMEs' CE-focused web communications, which is based on a web-scraping of online textual data. The approach, initially propounded by Gehman and Grimes (2017), has been applied here for the first time to investigate CE-focused web communications. In a contribution to CE research, and online communications in general, we demonstrate the applicability of the chosen approach to analyzing online textual data from a large amount of websites.

#### *Limitations and Areas for Further Research*

Our study includes a number of limitations that present fruitful opportunities for further research. First, the choice of Italy as cultural context for the 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 in order to establish generalizability. Second, the measure of communication frequency considers web communications only. While web communications are of paramount importance, future studies should consider testing the effect of communications used across multiple channels in order to establish if our findings hold. Notwithstanding the listed limitations, we believe that this is, to our knowledge, the first type of research that addresses the issue of communication of environmental concerned initiatives as potential driver for better economic performance of firms. Our evidence elucidates the crucial role of communication, especially for low- and medium- performing firms, in increasing market share and operating performance. The transition towards a more sustainable economy is for sure supported by a greater customer engagement, which passes through a more intense relationship.

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## Appendix A

Table A.1: Summary of key studies on CE

Study	Research focus	Research design	Key constructs examined	Key findings	Examined CE communications (Y/N)
Ghisellini et al. (2016)	Review of CE literature	Literature review (C)	None	<ul style="list-style-type: none"> <li>• CE in China and worldwide seem to follow very different patterns</li> <li>• CE implementation still at early stages</li> <li>• Results obtained in waste management</li> </ul>	No
Lewandowski (2016)	Review of CE literature to identify and classify circular business models	Literature review (C)	None	<ul style="list-style-type: none"> <li>• Introduced the circular business model canvas consisting of 11 building blocks</li> <li>• triple fit challenge is a success factor in circular business models implementation</li> </ul>	No
Hazen et al. (2017)	Examine consumers' intention to switch from new laptops to remanufactured ones	Survey (E)	<ul style="list-style-type: none"> <li>• price</li> <li>• government incentives</li> <li>• environmental benefits</li> <li>• consumer attitudes</li> <li>• switching intent</li> </ul>	<ul style="list-style-type: none"> <li>• The examined factors all explain switching intentions</li> <li>• Consumers' positive attitude toward remanufactured products moderate the effect of macro and micro-level factors</li> </ul>	No
Azevedo et al. (2017)	Create an index of sustainability and circularity of manufacturing companies	Index development (E)	<ul style="list-style-type: none"> <li>• Social, environmental, economic sustainability</li> <li>• circularity</li> </ul>	<ul style="list-style-type: none"> <li>• The indicators of circularity are identified and measured</li> </ul>	No
Kirchherr et al. (2017)	Provide clarity on current understanding of CE	Literature review (C)	None	<ul style="list-style-type: none"> <li>• CE often depicted as reduce, reuse and recycle activities but necessitates a systemic shift</li> <li>• Economic goal of CE less on social equity</li> <li>• Business models and consumers are enablers of CE, though not mentioned</li> </ul>	No
Linder and Williander (2017)	Examine causes for reluctance to adopt CE	Action research (E)	None	<ul style="list-style-type: none"> <li>• circular business models imply proactive uncertainty reduction for the entrepreneur</li> <li>• many product-service system variants increase capital commitments</li> </ul>	No

Nußholz (2017)	Map the field of circular business models research	Literature review (C)	None	<ul style="list-style-type: none"> <li>• Lack of clarity on which resource efficiency strategies classify a business model as circular</li> <li>• Identified contingencies that can impede resource efficiency gains</li> </ul>	No
Chamberlin and Boks (2018)	Explore the factors affecting consumer acceptance of circular offerings	Multiple case analysis (E)	Communication design strategies	<ul style="list-style-type: none"> <li>• cost and warranties are linked to behavior change in the form of encouragement, reward</li> <li>• intangible, intrinsic factors like brand image, quality are served by eudaimonic dimensions like meaning, empathy</li> </ul>	Yes, interpretation of field notes and website comms
Hopkinson et al. (2018)	Detail best practice lessons from a CE business model	Case study (E)	None	<ul style="list-style-type: none"> <li>• Sustained circular practices can deliver significant new revenues, resource productivity, and business continuity benefits</li> <li>• Circularity requires to develop competencies and capabilities to address complexities</li> </ul>	No
Kalmykova et al. (2018)	Offer an overview of CE theoretical approaches, strategies and implementation	Literature review (C)	None	<ul style="list-style-type: none"> <li>• Recovery/Recycling and Consumption/Use are prominently featured, but Manufacturing and Distribution, are rarely involved in CE</li> <li>• CE implementation considers selected products, materials and sectors, but system changes to economy are rarely suggested</li> </ul>	No
Kirchherr et al. (2018)	Understand the barriers to CE	Survey and expert interviews (E)	None	<ul style="list-style-type: none"> <li>• Cultural, regulatory, market and technological barriers to CE</li> </ul>	No
Muranko et al. (2019)	Examine how persuasive communication influences consumers to purchase remanufactured retail refrigerators	Survey (E)	<ul style="list-style-type: none"> <li>• Communication strategies</li> <li>• Product awareness and perceptions</li> <li>• Attitudes</li> <li>• Purchase intent</li> </ul>	<ul style="list-style-type: none"> <li>• Persuasive communications lead to small increases in product perceptions and positive attitudes towards remanufactured products</li> </ul>	Yes, perceptions and intentions measured with no link to business performance tested
Zucchella and Previtali (2019)	Understand a business model based on circular principles	Case study (E)		<ul style="list-style-type: none"> <li>• Realizing a model that closes the loop of resources contributes to the sustainability agenda</li> <li>• Key building blocks of successful CE: (1) innovations in products, processes, (2) several actors are engaged, (3) an orchestrator sets the vision</li> </ul>	No

**Note:** C=Conceptual, E=Empirical